Sustainability and Energy Statement
Home Farm, Chislehurst

A Zero Carbon Development

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1.0 Executive Summary

This Sustainability and Energy Statement considers the sustainability issues relating to the proposed development of Home Farm, Chislehurst.

After a number of years, Home Farm is now in a single-family ownership. The site benefits from a number of extant planning consents and rather than implement these, an opportunity exists to develop a masterplan for the whole site, which provides for its sustainable future.

It is proposed to carry out selected demolition, to provide new extensions to existing buildings and to create a new net zero carbon exemplary dwelling, whilst providing no additional increase in the total area or volume of buildings on site. The rationalisation of the road network within the site also provides a reduction in the impermeable area of the site, which in turn reduces surface water runoff.

A new vineyard will be developed in the eastern part of the site, which will assist in providing for the long-term sustainability of the farming activity on site.

The new dwelling (Vine House) will be constructed using fabric efficiency standards currently defined as 'best practice' including the installation of triple glazed windows and doors and the installation of a HydroGenesis system.

As a first in the region the house will use electricity generated on site by a hydrogen fuel cell. The hydrogen will be created on site using electricity generated by photovoltaic panels. The hydrogen store is essentially a far superior and efficient energy store system than using batteries. The electricity generated by the fuel cell will power a ground source heat pump, which will provide all space heating and hot water to the house. Whilst a mains Grid connection will be provided it is anticipated that the house can operate **off-Grid.**

Courtesy of HydroGenesis

The new house will achieve net zero carbon.

The works proposed to the existing dwellings (Polo Mews and the Bothy) will include the installation of air source heat pumps to provide space heating and hot waters to the homes. In the fullness of time, and depending on the success of the installation to Vine House it is anticipated that the existing houses can use a similar HydroGenesis system and use electricity generated by the fuel cell.

There will be no on-site carbon dioxide or nitrous oxide emissions associated with the dwellings.

An indicative construction specification has been proposed in the Statement, which demonstrates how the homes will (significantly) exceed the requirements of the Building Regulations and therefore the objectives of the planning policy.

The reductions in emissions from Vine House can be summarised as follows:

	Total Emissions	% Reduction
	T CO_2 per year	
Be Lean		
Baseline (Building Regulations TER) – based on gas	4.719	
Be Lean - after energy efficiency (DER) – based on gas	3.539	**25.00%**
Be Green		
Emissions – after GSHP	**1.409**	**70.14%**
Emissions – after HydroGenesis installation	**0.000**	**100.00%**

In addition to the renewable heating systems, it is also proposed to install a photovoltaic array near the southern boundary to the site. The array will be comprised of **80 x 400W panels** with a total output of **32 kW**. The indicative location of the array is shown on the Site Plan attached as Appendix 5.

The key sustainability findings can be summarised as;

- An exemplary new dwelling using best practice fabric standards and an innovative, potentially ground breaking method of providing power to the property;
- 100% reduction in carbon dioxide emissions of the new dwelling (Vine House) compared to the maximum permissible by the Building Regulations;
- All heating to the dwellings will be provided by renewable technologies (GSHP to Vine House and ASHPs to Polo Mews and the Bothy);
- The water use to each unit will achieve the enhanced standard required by the Building Regulations of 110 litres per person per day;
- A new Vineyard will provide for a sustainable future of farming on the estate;
- The impermeable area of the site will be reduced as a result of the reorganisation of the roadways;
- High standards of environmental construction, including the development of a Site Waste Management Plan and other construction management principles;

2.0 Introduction

2.1 Context

Bluesky Unlimited has been commissioned by Mr. and Mrs. A Selby to prepare a Sustainability and Energy Statement in support of;

An application for planning permission for the partial demolition and replacement extensions of existing locally Listed Buildings, a new viticultural enterprise, new solar & hydrogen energy plant, a new single storey dwelling & landscape enhancement to a small-scale family farm on Green Belt land at Home Farm, Kemnal Lane, Chislehurst, BR7 6LY.

This Statement has been prepared to demonstrate how the proposed development meets and in a number of cases exceeds the requirements of national, regional and local planning policy and guidance in relation to sustainability.

The objectives of the Sustainability and Energy Statement are to;

- examine and comprehend the key sustainability themes and associated standards within the national, regional and local planning policy and guidance;
- assess the performance of the development proposals in achieving the sustainability standards;
- identify any opportunities and appropriate actions required to ensure sustainability is delivered at the detailed design stage.

Study Area

The site is located in Chislehurst, which is to the east of Bromley and approximately 25km from Central London. To the north of the site is Kemnal Park Cemetery and Memorial Gardens, to the southwest is Foxbury Manor and to the south and southeast are University College London Sports Ground and Chislehurst School for Girls respectively.

The site extends to 8.3 hectares and is accessed off Kemnal Road, which is privately owned.

2.2 Preamble

Costs for sustainable initiatives and strategies are reducing through improvements in technology, design techniques and construction methods. Utility prices continue to rise and individuals and organisations are starting to value the more intangible benefits associated with 'sustainability'. A greater awareness is becoming apparent about the need for sustainable environments and building owners and occupiers are starting to demand these.

Sustainable development is a core principle throughout the proposed development.

3.0 The Policy Context

This Sustainability Statement reflects existing policy frameworks at a number of levels including Homes and Communities Agency Design Standards and Contractual Obligations, National and Local Policy and Guidance. The following provides an overview of the documents that form the basis for the principles and targets.

3.1 National Policies

The UK Government published its sustainable development strategy in 1999 entitled "A better quality of life: A strategy for sustainable development in the UK". This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone;
- Effective protection of the environment;
- Prudent use of natural resources; and
- Maintenance of high stable levels of economic growth and employment.

The most relevant national planning policy guidance on sustainability is set out in:

- National Planning Policy Framework - 2021

Paragraph 152 states;

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Paragraph 153 states;

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

3.2 Regional and Local Policies

The Development Plan comprises the London Plan (2021) and the London Borough of Bromley Local Plan, which was adopted in January 2019.

London Plan, published March 2021 **–** the following policies are relevant to the application:

Policy SI 1 Improving air quality

A Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.

B To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:

1) Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) create unacceptable risk of high levels of exposure to poor air quality.

2) In order to meet the requirements in Part 1, as a minimum:

a) development proposals must be at least Air Quality Neutral

b) development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures

c) major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

d) development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

C Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:

1) how proposals have considered ways to maximise benefits to local air quality, and

2) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.

E *Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.*

Policy SI 2 Minimising greenhouse gas emissions

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

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

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

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

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

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

E *Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.*

F *Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.*

Policy SI 4 Managing heat risk

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

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

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure

2) minimise internal heat generation through energy efficient design

3) manage the heat within the building through exposed internal thermal mass and high ceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling systems.

Policy SI 5 Water infrastructure

A In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.

B Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.

C Development proposals should:

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

2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)

3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.

D In terms of water quality, Development Plans should:

1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans

2) support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.

E Development proposals should:

1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided

2) *take action to minimise the potential for misconnections between foul and surface water networks. F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.*

The energy strategy within the Statement has been prepared in accordance with **Energy Assessment Guidance** published by the Mayor of London.

London Borough of Bromley

The Local Plan was adopted in January 2019 and provides the local planning policy for the site.

The following policies are relevant to this application and the topic area of this Statement.

Policy 113 - Waste Management in New Development

Major development proposals will be required to implement Site Waste Management Plans to reduce waste on site and manage remaining waste sustainably.

New development will be required to include adequate space to support recycling and efficient waste collection.

Integrated waste management in new development will be supported where appropriate.

Although re-use and recycling rates construction, excavation and demolition waste in London are high, the London Plan sets a target of 95% to be recycled by 2020. London Plan policy 5.18 states that boroughs should require developers to produce site waste management plans to arrange for the efficient handling of construction, excavation and demolition waste.

Policy 116 - Sustainable Urban Drainage Systems (SUDS)

All developments should seek to incorporate Sustainable Urban Drainage Systems (SUDS) or demonstrate alternative sustainable approaches to the management of surface water as far as possible.

Applications for developments located within Flood Zones 2, 3a and 3b and in Flood Zone 1 for areas identified as hot spots in Bromley's Surface water Management Plan (SWAMP), Preliminary Flood Risk Assessment (PFRA) and in the Strategic Flood Risk Assessment must be accompanied by a site-specific Flood Risk Assessment (FRA).

Policy 123 - Sustainable Design and Construction

All applications for development should demonstrate how the principles of sustainable design and construction have been taken into account alongside the principles set out in the general design policy.

Policy 124 - Carbon Dioxide Reduction, Decentralised Energy Networks and Renewable Energy

Major developments should aim to reduce their carbon dioxide emissions in accordance with the levels set out in the London Plan. Planning applications for major development should include evidence of how the energy requirements and carbon dioxide emissions of proposed developments have been assessed and propose a clear reduction strategy in line with the energy hierarchy. Information submitted should be sufficient to demonstrate how the relevant London Plan policies have been addressed and how the strategy can be fully implemented without additional permissions.

3.3 Other Relevant Guidance

BRE Green Guide to Specification

The Building Research Establishment Green Guide to Specification lists building materials and components, and ranks their potential life cycle environmental impact.

4.0 Assessment Methodology and Targets

4.1 Methodology

The methodology involves completing a detailed policy review of current and emerging national, regional and local policy relating to sustainability to provide a specific policy context for the assessment.

A review of good practice methods and techniques relating to sustainability has been carried out.

The key aspects of sustainability are addressed under the following headings and these form the structure of this assessment.

- Climate change
- Community
- Place making
- Transport
- Ecology
- Resources
- Business
- Buildings

The set of targets the site will achieve is set out in section 4.2 below. The subsequent sections propose strategies for meeting the targets and for the development to become an exemplar scheme, which delivers a sustainable way of living by addressing social, economic and environmental drivers.

The energy strategy uses SAP calculations prepared for the new home to 'test' different specification options.

Carbon Emission Factors

The CO_2 emission factors, where applicable, used throughout this report have been taken from SAP 10 as required by the GLA Energy Assessment Guidance.

	kg CO_2/kWh
Mains gas	0.210
Grid supplied and displaced electricity	0.233
Hydrogen (generated on site)	0.000

4.2 Targets

Schedule of Sustainability Requirements

The following targets have been crafted to comply or exceed compliance with National, Regional and Local planning policy as well as with the Building Regulations.

The numbering in the table relates to the chapters in this Sustainability Statement.

Schedule of Sustainability Requirements		
Ref	Description of Target	Target/Scope
6.0	Climate Change	
	Ensure that peak run off rates is less for the developed site than it was for the pre-development site.	Whole Site
	In appropriate areas the use of porous surfaces will be implemented. The area of impermeable surfacing will be reduced All surface water will be attenuated and treated using SuDS (sustainable urban drainage systems).	Whole Site
	Green roofs will be installed where appropriate.	Selected buildings

Schedule of Sustainability Requirements		
Ref	Description of Target	Target/ Scope
7.0	Community	
	The existing homes and the new house will be built in accordance with Part M4(1) of the Building Regulations.	All dwellings, existing and proposed
	Secured by Design principles will be followed. This will involve consultation with the Architectural Liaison Officer/ Crime Prevention Officer at the detailed design stage.	Whole Site

Schedule of Sustainability Requirements		
	Description of Target	Target/ Scope
10.0	Resources	
	90% of demolition material will be recycled (by volume) and reused on site if feasible.	Whole Site
	All materials in buildings will be A+, A or B rated according to The Green Guide to Specification, unless deemed impractical or otherwise prescribed.	Whole Site
	All timber for basic elements will be obtained from appropriately certified legal sources. In addition, 80% of building element timber will be procured from sustainably certified forests.	Whole Site

Schedule of Sustainability Requirements		
Ref	**Description of Target**	**Target/ Scope**
12.0	**Buildings**	
	The new dwelling will achieve fabric efficiency standards currently representing 'best practice' including the installation of triple-glazed windows and doors.	New Dwelling (Vine House)
	The new dwelling will use photovoltaic panels to generate hydrogen, which will be used in a fuel cell to generate electricity for the house. The new house will achieve **NET ZERO CARBON** for regulated emissions.	New Dwelling (Vine House)
	The new dwelling will benefit from a ground source heat pump, which will provide all space heating and hot water to the house	New Dwelling (Vine House)
	The dwellings, which are subject to extension and refurbishment will benefit from the installation of air source heat pumps, which will provide all the space heating and hot water to the dwellings.	Polo Mews and Bothy
	It is anticipated that the HydroGenesis system can be rolled out at some future time to provide clean, zero emissions electricity to the existing buildings.	Polo Mews and Bothy
	A photovoltaic array of at least 32 kW will be installed.	Whole Site
	All white goods will achieve the highest energy efficiency rating for the appliance in question.	All dwellings
	100% of internal lighting is to be energy efficient.	All dwellings
	The completed building fabric for the new dwelling will to achieve air leakage rates of no greater than 3.0 $m^3/hr/m^2$.	3.0 $m^3/hr/m^2$ for the new house
	Sanitary fittings will be selected that minimise the consumption of mains water and all dwellings will achieve a water efficiency target of 110 l/p/d.	All dwellings to use less than 110 l/p/d

Schedule of Sustainability Requirements		
Ref	**Description of Target**	**Target/ Scope**
13.0	**Construction Process and Site Management**	
	Waste arising from site will be monitored and segregated into at least five waste streams for recycling throughout the construction period.	Construction Site
	All temporary timber (site hoardings, formwork, and scaffold boards) will be from FSC, CSA, SFI or PEFC sources, or re-used timber.	Construction Site

5.0 Proposal

It is proposed to submit;

An application for planning permission for the partial demolition and replacement extensions of existing locally Listed Buildings, a new viticultural enterprise, new solar & hydrogen energy plant, a new single storey dwelling & landscape enhancement to a small-scale family farm on Green belt land at Home Farm, Kemnal Lane, Chislehurst, BR7 6LY.

The proposal includes the demolition of various parts of buildings and the extension and rationalisation of those retained. For the purposes of the energy strategy the proposal has been based upon the following floor area schedule:

Unit	Proposed Floor Area
	m^2
Bothy – Existing building	492.0
Polo Mews – Existing building	320.0
Vine House - new	335.0

Environmental Considerations

6.0 Climate Change

6.1 Flooding

Climate change projection predicts a decrease in annual rainfall in the South East of England by up to 10% with significantly wetter winters (between 15-20% more winter rain) and an increase in frequency of severe weather. Drier summers may lead to increased flash flooding when sudden storms cause rapid run off over dry ground. Recent research suggests the number of people at risk of localised urban flooding in England could increase fourfold due to climate change.

Sustainable drainage involves the provision of surface water drainage systems that slow down the run off rate to rivers/watercourses and aquifers, thus conserving water as a natural resource.

The Environment Agency Flood Maps show the site to be entirely within Flood Zone 1. A watercourse flows through the site (within a culverted section), which discharges into a basin on the northern boundary of the site. From this point water discharges into the woodland to the north of the site.

Over the years various flood alleviation works have been undertaken to attenuate the stream.

The rationalisation of the road network within the site will reduce the impermeable area of the site resulting in a reduction in surface water runoff. Notwithstanding this it is proposed to rationalise the surface water system and to provide mitigation measures to ensure the rate of runoff is managed.

Ground investigations have found that infiltration methods are unlikely to work. The measures will therefore include the installation of a geocellular storage tank, which will drain to the basin in the north of the site or directly into the existing culverted watercourse.

Green Roofs

The plans for the roof of the mew dwelling and the extension to Polo Mews propose the installation of a ‘green’ roof as part of the roof structure. As well as providing additional surface water storage capacity, the green roof will also increase biodiversity.

Green roofs decrease the total amount of rainwater runoff and slow the rate of runoff from the roof. It has been found that they can retain up to 75% of rainwater, gradually releasing it back into the atmosphere via condensation and transpiration, while retaining pollutants in their soil. Green roofs have also been found to dramatically improve a roof's insulation value.

In addition, green roofs can:

- Reduce heating (by adding mass and thermal resistance value) and cooling (by evaporative cooling) loads on a building
- Reduce the urban heat island effect
- Reduce surface water run off
- Filter pollutants and CO_2 out of the air
- Increase wildlife habitat in built-up areas

A Flood Risk Assessment, which also provides details of the surface water disposal strategy has been prepared by Herrington Consulting and accompanies the planning application.

7.0 Community

7.1 Introduction

Whilst the site is privately owned and not generally accessible to the public there is an existing public right of way which runs north to south across the fields in the eastern part of the site. This right of way will be maintained and under the proposal will be bordered on both sides by the new vineyard.

Consequently, it is proposed to enhance the public's experience and to erect some information boards along the footpath explaining the development of the vineyard.

In addition, an informal picnic area will be developed at the southern end of the right of way together with a picnic shelter and a community meadow with fruit trees.

7.2 Accessible Housing

The works to the existing homes and the new dwelling will be built in accordance with Part M4(1) of the Building Regulations.

8.0 Place Making

8.1 Efficient Use of Land

The proposal seeks to rationalise the arrangement of the buildings particularly in the context of the various extant consents that exist across the site and provide for its continued occupation by the current owner. The development of the vineyard provides for continued farming use of the site and for a more sustainable future.

8.2 Design Process

High quality design is an integral element to sustainable development, both of internal and external spaces and some key elements, which have been considered within the detailed design of the site and dwellings includes the following:

- Resource efficiency;
- Safety;
- Adequate daylight and minimum overlooking;
- Provision of outside spaces;
- Aesthetically pleasing.

A detail analysis is provided in the Design and Access Statement by Holloway Architects, which accompanies the application.

8.3 Passive Solar Gain

The energy required for space heating and lighting can be reduced by using the orientation, form and fenestration to make the most use of passive solar gain. The design of the extensions to the existing dwellings and the new house minimises the northerly aspects and maximise the orientations towards the south.

8.4 Daylighting

The design of the new house maximises the natural daylighting to all rooms, which creates a high-quality internal environment, whilst reducing the need for artificial lighting.

8.5 Safety and Security

The scheme will, through detailed design development, aim to incorporate Secured by Design principles, which will put the safety of the community on site at the forefront and in turn will help to create a high-quality environment for residents and occupiers for the long term. Consultation with the local Architectural Liaison/ Crime Prevention Officer will be sought during working drawing design development.

9.0 Ecology and Landscaping

Ecology

A Preliminary Ecological Appraisal have been prepared.

The site does not lie within or is adjacent to any statutory designated sites and the Impact Risk Zones do not indicate any impacts from the proposed development. The habitats on site are common and widespread throughout the local area and the UK as a whole.

The native hedgerows are of the greatest ecological value in the context of the site and will be fully retained. These provide foraging and commuting opportunities for bats.

The proposed development includes significant planting and habitat creation, and this has also resulted in the development achieving biodiversity net gain. The new habitat and enhancement of the existing habitats will enhance opportunities for bats post-development. This will include the installation of bat boxes.

Further bat surveys are planned to be carried out on the existing buildings where work is proposed. However, it is thought the potential is low to support roosting bats due to limited external gaps within the tiles, soffit board and weatherboarding.

No evidence was found of any Great Crested Newt population or of badger activity.

Birds may use the scrub and trees for nesting and consequently any works will be undertaken outside of bird nesting season (March – September inclusive) or after a nesting bird check by a qualified ecologist.

The site does not support suitable habitats for water voles, or otters and is not considered to support dormice and reptiles.

Full details are provided in the Preliminary Ecological Appraisal carried out by The Ecology Partnership, which accompanies the application.

Landscape

A Landscape Masterplan and Design and Access Statement has been prepared by EDLA and accompanies the application.

This sets out how the different character areas will be developed across the site and what those character areas will comprise of.

As a result of the proposals the Biodiversity Net Gain of the site will increase by more than 15%.

10.0 Resources

10.1 Materials

The Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction will target the use of materials that are A+, A or B rated, unless otherwise agreed or deemed impractical.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

10.2 Pollution

All insulation materials to will have a zero-ozone depleting potential.

As a result of the systems proposed there will be no onsite CO_2 or NO_x emissions from the dwellings.

10.3 Construction waste

A Site Waste Management Plan will be prepared which will monitor and report on waste generated on site into defined waste groups.

The Plan will indicate the setting of targets to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

A Construction Strategy will be developed, once planning consent has been secured which will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage.
- Efficient purchasing arrangements to minimise over ordering.
- Segregation of construction waste to maximise potential for reuse/recycling.
- Suppliers who collect and reuse/recycle packaging materials

10.4 Domestic Waste and Recycling

Domestic and operational waste has been considered in the proposed development in the following way:

- External space is provided for storing recyclable materials, for collection by the Authority or private contractors, within the boundary of the site;
- The external space for recyclable material is of sufficient size to accord with Local Authority procedures;
- Internal storage for recyclables is provided within homes at a capacity in excess of 30 litres;
- Internal storage will be provided to all homes for kitchen food waste;

11.0 Buildings

11.1 Energy use and CO_2 emissions statement

11.1.1 Introduction

The site will be designed and constructed to reduce energy demand and carbon dioxide emissions. The objective is to reduce the energy demand to an economic minimum by making investment in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once cost-effective structures have been designed, renewable and low carbon technologies have been considered to provide heat and electricity.

The following hierarchy has been followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

11.1.2 Methodology

Design

The energy performance of a building is affected by the building design, its construction and its use. Whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Passive solar gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The design of the extensions to the existing dwellings and the new house minimises the northerly aspects and maximise the orientations towards the south.

11.1.3 Building Envelope (Be Lean)

U-values of the dwelling envelope must meet Building Regulations Part L standards with further improvements to U-values reducing the home's heating requirements.

Extensions to Existing Buildings

It is proposed to construct the new extensions using traditional load bearing brick and block construction with precast concrete beam and infill block floors and green flat or pitched roofs.

The following U-values will be targeted for the building elements;

Element	Proposed
	W/m^2K
Ground Floors	**0.13**
External Walls	**0.18**
Roofs (cold roofs)	**0.11**
Sloping Ceilings	**0.15**
Flat Roofs (green)	**0.15**
Windows and Glazed Doors	**1.20**
Entrance and Utility Doors	**1.00**

'g' Value for Glazing	**0.63**

New Dwelling (Vine House)

It is proposed to achieve best practice standard as follows;

Element	Proposed
	W/m^2K
Ground Floor	**0.11**
External Walls	**0.15**
Flat Roofs (green)	**0.10**
Windows and Glazed Doors	**0.80-1.00**
Entrance and Utility Doors	**1.00**

'g' Value for Glazing	**0.63**

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The air tightness standard to the new dwelling will seek to average at least a 70% improvement over Building Regulations and the house will target a permeability of less than 3.0 $m^3/hr/m^2$.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO_2 reduction targets set out in this strategy.

The bridging losses will be calculated using SAP Appendix K Table 1.

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F18 addresses the possibility of overheating and poor air quality.

A full mechanical ventilation system with heat recovery will be installed to the new dwelling. This will recover over 90% of the heat in the exhaust air and will reduce losses through ventilation.

Lighting

Throughout the scheme natural lighting will be optimised.

Approved Document L1A requires three in four light fittings (75%) to be dedicated low energy fittings. The existing and new house will exceed this and all light fittings will be of a dedicated energy efficient type.

Space Heating and Hot Water

It is proposed to install a ground source heat pump to the new house and to install air source heat pumps to the existing homes.

HydroGenesis

The new dwelling (Vine House) will use electricity generated on site by a hydrogen fuel cell. The hydrogen will be created on site using electricity generated by photovoltaic panels. The hydrogen store is essentially a far superior and efficient energy store system than using batteries.

The electricity generated by the fuel cell will power the ground source heat pump, which will provide all space heating and hot water to the new house. Whilst a mains Grid connection will be provided it is anticipated that the house can operate **off-Grid.**

11.1.4 Establishing Energy Demand and Carbon Dioxide Emissions (Be Lean)

The GLA Energy Assessment Guidance requires the energy efficiency of a building (Be Lean) to be expressed using a gas heating system as a baseline.

A set of calculations have therefore been prepared on this basis, which are not necessarily the proposed final option but are used to test the 'Be Lean' reductions only.

The Regulations Compliance Report, TER and DER Worksheets are attached as Appendix 1 but the energy demand for the new house can be summarised as follows;

Vine House	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	18,869	12,360
Water heating	2,726	2,622
Electricity for pumps, fans & lighting	790	1,686
Total	**22,385**	**16,668**

Summary

The energy demand figures calculated above have been inputted into the SAP 10 spreadsheet, which is attached as Appendix 2 and provides the total site TER and DER emissions for the new house using the SAP 10 carbon emissions factors as required by the GLA Energy Assessment Guidance.

The maximum allowable carbon dioxide emissions from the new house (TER) are assessed as **4,719 kg CO_2 per year**, with the actual carbon dioxide emissions (DER) assessed as **3,539 kg CO_2 per year.**

The reduction in emissions from energy efficiency measures for the 'Be Lean' scenario and using the SAP 10 carbon factors is **1,180 kg CO_2 per year**, which equates to;

- **25.00%**

The energy efficiency standards (Be Lean) incorporated into the new house therefore significantly exceed the requirements of the GLA Energy Assessment Guidance (10% improvement at the Be Lean stage).

11.1.5 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The energy demand and carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Kemnal Road to be 5.6 m/s at 10m above ground level and 6.3 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition, the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used to generate small amounts of renewable electricity but the low output means any investment would be purely tokenism. The use of wind turbines will also have a detrimental aesthetic impact on the appearance of the development.

Wind turbines are not proposed

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings.

CHP units are generally gas fuelled and generate electricity with heat being a by-product.

The heat is usually used to meet the hot water load, which is fairly consistent throughout the year.

Historically CO_2 savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity, However, with the de-carbonisation of the electricity grid the benefit of CHP is negated.

CHP is longer an appropriate technology.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12^o C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

There is sufficient ground area to install a shallow, horizontal collection system for the new house and therefore this technology is appropriate for the new unit.

There is insufficient ground area for the existing houses to use the technology and their heating will be provided by a different renewable solution – see below.

Solar

(i) Solar Water Heating

Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

The installation of solar hot water heating would need to be on the roof of the buildings they serve, which would have a detrimental impact on the aesthetics of the proposal.

Solar hot water heating panels are therefore not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

It is proposed to install a photovoltaic array.

The Site Plan attached as Appendix 5 shows the indicative location of the panels and from the area shown it is assumed a total of 80 panels would be installed. Assuming the installation of 400W panels the array could generate **29,235 kWh of electricity** (based on an inclination of 20 degrees and orientated towards due south). The total reduction in emissions would be **6,812 kg CO_2 per year**.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however, the initial heat energy is extracted from the external air rather than the ground.

The use of an air source heat pumps is appropriate to the existing houses.

11.1.6 Establishing Energy Demand and Carbon Dioxide Emissions (Be Green)

A further set of calculations have been prepared for the new house using the chosen heating solution.

This includes the installation of a ground source heat pump, which uses electricity generated by the HydroGenesis system (hydrogen fuel cell).

The DER Worksheets based on the installation of a Vaillant geotherm ground source heat pump are attached as Appendix 3 but the energy demand for the new house can be summarised as follows;

Vine House	Energy Demand DER
	kWh/yr
Space heating	3,351
Water heating	1,175
Electricity for pumps, fans & lighting	1,521
Total	**6,047**

Summary

The energy demand figures calculated above have been inputted into the SAP 10 spreadsheet, which is attached as Appendix 4 and provides the total DER emissions for the new house using the SAP 10 carbon emissions factors as required by the GLA Energy Assessment Guidance.

The actual carbon dioxide emissions (DER) are assessed as **1,409 kg CO_2 per year.**

The reduction in emissions from energy efficiency measures and from the installation of a ground source heat pump is **3,310 kg CO_2 per year**, which equates to a reduction of **70.14%.**

However, it is proposed to install a hydrogen fuel cell, which will use part of the photovoltaic array to create hydrogen, which will be sorted on site and used in a fuel cell to generate electricity as required by the ground source heat pump to provide space heat and hot water to the new house as well as meeting the operational requirements of the new house.

The new dwelling achieves net zero carbon.

11.1.7 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

Be Lean

A baseline calculation has been prepared for the new dwelling (Vine House) using 2013 Building Regulations and the SAP 10 carbon factors. Using the 2013 Regulations and based upon a gas heating system for the new house the total site CO_2 emissions are calculated as **4,719 kg CO_2 per year** (TER) and **3,539 kg CO_2 per year** (DER)**.** This is not the proposed solution but purely 'tests' the energy efficiency measures incorporated into the house.

The reduction equates to **1,180 kg CO_2 per year** or **25.00%** of the total TER emissions and is therefore compliant with the GLA energy planning guidance for the 'Be Lean' stage.

The Regulation Compliance Reports, TER and DER Worksheets for the new house using the gas system are attached as Appendix 1 and the SAP 10 'Be Lean' spreadsheet is attached as Appendix 2.

Be Green –Ground Source Heat Pump

A further set of calculations has been prepared for the proposed energy strategy.

This proposes the installation of a ground source heat pump into the new house. These calculations have been converted to SAP 10 emissions and the 'Be Green' spreadsheet is attached as Appendix 4. The DER Worksheets for the house using the proposed energy strategy are attached as Appendix 3.

The actual carbon dioxide emissions (DER) are assessed as **1,409 kg CO_2 per year.**

The reduction in emissions from energy efficiency and the proposed heating systems and using the SAP 10 carbon factors therefore equates to **70.14%.**

Be Green – Photovoltaic Panels and HydroGenesis installation

It is proposed to install a photovoltaic array of 32.0 kW (based on 80 x 400W panels). The attached Site Plan shows the indication location of the panels. Part of the array will generate electricity which will be used to produce hydrogen, which will run a fuel cell, which will generate electricity for use in the new house. The balance of electricity generated will be used by the other buildings on site.

<u>Summary</u>

THE NEW DWELLING WILL BE NET ZERO CARBON AND WILL USE A SYSTEM WHICH HAS NOT BEEN USED IN THE REGION BEFORE BUT COULD PROVIDE A SOLUTION FOR FUTURE HOMES.

11.2 Water use statement

In the South East of England, water demand exceeds the volume licensed for abstraction, with the shortfall being met from ground water. In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The amount of potable water used within buildings can be reduced by using fixed fittings, which reduce water use in WC's, taps and showers.

Throughout the design process for the development the following will be considered as part of the proposal:

- Reductions in the use of water within homes.
- Facilities for rainwater harvesting for landscape maintenance.

A water consumption target for the dwellings of less than 110 litres/ person/ day will be achieved.

Water efficient devices will be fully evaluated, and installed to all units. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the existing and proposed houses:

- Water efficient taps;
- Water efficient toilets;
- Low output showers;
- Flow restrictors to manage water pressures to achieve optimum levels and
- Water meters with guidance on water consumption and savings.

Water consumption calculations have been carried out for the dwellings using the Water Efficiency Calculator provided by the BRE. This calculator gives an indication of the probable water use in a dwelling, although this is largely dependent on the way on which occupants use their homes.

Below is a typical specification, which would achieve the 110 Litres per person per day target.

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	4/2.6 litres dual flush	14.72
Basin	1.7 litres/min.	5.98
Shower	9.5 litres/min	28.50
Bath	160 litres	25.60
Sink	4 litres/min	14.13
Washing Machine	Default used	16.66
Dishwasher	Default used	3.90
		109.49

12.0 Construction Process and Site Management

12.1 Where best practice guidance is available dealing with construction methods and standards these will be adopted.

12.2 The effects of construction can be divided into two sections;

- those related to the materials used on site
- those related to the construction process

Construction Site Impacts

12.3 Site management procedures will be put in place to monitor water consumption and all site timber used in construction will be sourced from certified suppliers.

13.0 Conclusion

This Statement demonstrates that the proposed development will provide a highly sustainable development in terms of its economic, social and environmental sustainability.

Throughout the design process, the applicant and design team have and will give careful consideration to the sustainability issues relating to the site, and how these can be enhanced in a marketable and feasible manner. As a result, this Statement demonstrates that the development meets relevant sustainability criteria and in a number of areas exceeds them.

The Statement also describes the responsibilities that the applicant, designers and consultant and construction team have in delivering sustainability measures that will contribute to, meet and/or exceed the objectives and targets set out above (in section 4.2.2).

The key sustainability findings can be summarised as;

The key sustainability findings can be summarised as;

- An exemplary new dwelling using best practice fabric standards and an innovative, potentially ground breaking method of providing power to the property;
- 100% reduction in carbon dioxide emissions of the new dwelling (Vine House) compared to the maximum permissible by the Building Regulations;
- All heating to the dwellings will be provided by renewable technologies (GSHP to Vine House and ASHPs to Polo Mews and the Bothy);
- A photovoltaic array of 32.0 kW will be installed;
- The water use to each unit will achieve the enhanced standard required by the Building Regulations of 110 litres per person per day;
- A new Vineyard will provide for a sustainable future of farming on the estate;
- The impermeable area of the site will be reduced as a result of the reorganisation of the roadways;
- High standards of environmental construction, including the development of a Site Waste Management Plan and other construction management principles;
- Secured by Design principles will be followed;
- All dwellings will be built in accordance with Part M4(1) of the Building Regulations.

Appendix 1 – Compliance Report, TER & DER Worksheets for Vine House using Gas Baseline

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.51
Printed on 27 July 2022 at 13:49:40

Project Information:

Assessed By: Bluesky Unlimited | **Building Type:** Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE | Total Floor Area: 295m²

Site Reference : Home Farm, Chislehurst | **Plot Reference:** Vine House

Address :

Client Details:

Name: Selby Capital

Address :

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

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.2 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.94 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	75.9 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	57.0 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.00 (max. 2.00)	1.00 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 502, product index 018625): Boiler systems with radiators or underfloor heating - mains gas Brand name: Worcester Model: Greenstar 8000 Life Model qualifier: GR8300iW 45 R NG (Regular) Efficiency 89.9 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.40 kWh/day		
	Permitted by DBSCG: 2.56 kWh/day		**OK**
Primary pipework insulated:	Yes		**OK**

6 Controls

Space heating controls	Time and temperature zone control by device in database	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**
Boiler interlock:	No	

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.56	
Maximum	1.5	**OK**
MVHR efficiency:	92%	
Minimum	70%	**OK**

9 Summertime temperature

Overheating risk (South East England):	Not significant	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South	8.91m²
Windows facing: South	12.42m²
Windows facing: South	2.84m²
Windows facing: South	9.72m²
Windows facing: East	10.8m²
Windows facing: North	2.84m²
Windows facing: East	18.9m²
Windows facing: South	8.51m²
Windows facing: South	2.84m²
Windows facing: South	6.75m²
Windows facing: West	9.18m²
Windows facing: North	17.55m²
Ventilation rate:	6.00
Blinds/curtains:	None

10 Key features

Air permeablility	3.0 m³/m²h
Windows U-value	1 W/m²K
Doors U-value	1 W/m²K
Roofs U-value	0.1 W/m²K
Floors U-value	0.11 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Vine House

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	295	(1a) x	3.2	(2a) =	944	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	295	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	944	(5)

2. Ventilation rate:

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

DRAFT

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

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

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

DER WorkSheet: New dwelling design stage

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) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

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

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

(24a)m=	0.27	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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

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

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

(25)m=	0.27	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			4.32	x	1	=	4.32			(26)
Windows Type 1			8.91	x	1/[1/(1)+ 0.04]	=	8.57			(27)
Windows Type 2			12.42	x	1/[1/(1)+ 0.04]	=	11.94			(27)
Windows Type 3			2.84	x	1/[1/(1)+ 0.04]	=	2.73			(27)
Windows Type 4			9.72	x	1/[1/(1)+ 0.04]	=	9.35			(27)
Windows Type 5			10.8	x	1/[1/(1)+ 0.04]	=	10.38			(27)
Windows Type 6			2.84	x	1/[1/(1)+ 0.04]	=	2.73			(27)
Windows Type 7			18.9	x	1/[1/(1)+ 0.04]	=	18.17			(27)
Windows Type 8			8.51	x	1/[1/(1)+ 0.04]	=	8.18			(27)
Windows Type 9			2.84	x	1/[1/(1)+ 0.04]	=	2.73			(27)
Windows Type 10			6.75	x	1/[1/(1)+ 0.04]	=	6.49			(27)
Windows Type 11			9.18	x	1/[1/(1)+ 0.04]	=	8.83			(27)
Windows Type 12			17.55	x	1/[1/(1)+ 0.04]	=	16.87			(27)
Floor			295	x	0.11	=	32.45			(28)
Walls	401.22	115.58	285.64	x	0.15	=	42.85			(29)
Roof	295	0	295	x	0.1	=	29.5			(30)
Total area of elements, m²			991.22							(31)

** 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) = 216.1 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)		((28)…(30) + (32) + (32a)…(32e) =	41918.4	(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		63	(36)

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

Total fabric heat loss	(33) + (36) =	279.1	(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=	84.6	83.6	82.61	77.65	76.65	71.69	71.69	70.7	73.67	76.65	78.64	80.63	(38)

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

(39)m=	363.7	362.7	361.71	356.75	355.75	350.79	350.79	349.8	352.77	355.75	357.74	359.73	

Average = $Sum(39)_{1…12}$ /12= 356.5 (39)

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

(40)m=	1.23	1.23	1.23	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	1.22

Average = $Sum(40)_{1…12}$ /12= 1.21 (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 3.13 (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) + 36 108.43 (43)

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

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

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

(44)m=	119.27	114.93	110.6	106.26	101.92	97.59	97.59	101.92	106.26	110.6	114.93	119.27

Total = $Sum(44)_{1…12}$ = 1301.15 (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=	176.88	154.7	159.63	139.17	133.54	115.23	106.78	122.53	124	144.51	157.74	171.3

Total = $Sum(45)_{1…12}$ = 1706.01 (45)

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

(46)m=	26.53	23.2	23.95	20.88	20.03	17.29	16.02	18.38	18.6	21.68	23.66	25.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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): 1.4 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.76 (50)

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

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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)		0.76	(55)

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

(56)m=	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(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=	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(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	(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=	223.58	196.88	206.33	184.36	180.24	160.43	153.48	169.23	169.19	191.2	202.93	217.99	(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=	223.58	196.88	206.33	184.36	180.24	160.43	153.48	169.23	169.19	191.2	202.93	217.99	

Output from water heater (annual)$_{1...12}$ 2255.85 (64)

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

(65)m=	96.17	85.18	90.44	82.43	81.76	74.47	72.86	78.1	77.38	85.41	88.6	94.31	(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=	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	40.49	35.97	29.25	22.14	16.55	13.97	15.1	19.63	26.34	33.45	39.04	41.62	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	454.2	458.92	447.04	421.75	389.84	359.84	339.8	335.08	346.96	372.25	404.16	434.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	(71)
Water heating gains (Table 5)													
(72)m=	129.26	126.76	121.56	114.48	109.89	103.43	97.93	104.97	107.48	114.79	123.06	126.77	(72)

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

(73)m=	693.84	691.52	667.72	628.26	586.16	547.12	522.71	529.57	550.66	590.37	636.14	672.43	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.84	x	10.63	x	0.63	x	0.7	=	9.23	(74)
North	0.9x	0.77	x	17.55	x	10.63	x	0.63	x	0.7	=	57.03	(74)
North	0.9x	0.77	x	2.84	x	20.32	x	0.63	x	0.7	=	17.64	(74)
North	0.9x	0.77	x	17.55	x	20.32	x	0.63	x	0.7	=	108.99	(74)
North	0.9x	0.77	x	2.84	x	34.53	x	0.63	x	0.7	=	29.97	(74)
North	0.9x	0.77	x	17.55	x	34.53	x	0.63	x	0.7	=	185.2	(74)
North	0.9x	0.77	x	2.84	x	55.46	x	0.63	x	0.7	=	48.14	(74)
North	0.9x	0.77	x	17.55	x	55.46	x	0.63	x	0.7	=	297.48	(74)
North	0.9x	0.77	x	2.84	x	74.72	x	0.63	x	0.7	=	64.85	(74)
North	0.9x	0.77	x	17.55	x	74.72	x	0.63	x	0.7	=	400.74	(74)
North	0.9x	0.77	x	2.84	x	79.99	x	0.63	x	0.7	=	69.42	(74)
North	0.9x	0.77	x	17.55	x	79.99	x	0.63	x	0.7	=	429	(74)
North	0.9x	0.77	x	2.84	x	74.68	x	0.63	x	0.7	=	64.81	(74)
North	0.9x	0.77	x	17.55	x	74.68	x	0.63	x	0.7	=	400.53	(74)
North	0.9x	0.77	x	2.84	x	59.25	x	0.63	x	0.7	=	51.42	(74)
North	0.9x	0.77	x	17.55	x	59.25	x	0.63	x	0.7	=	317.77	(74)
North	0.9x	0.77	x	2.84	x	41.52	x	0.63	x	0.7	=	36.03	(74)
North	0.9x	0.77	x	17.55	x	41.52	x	0.63	x	0.7	=	222.67	(74)
North	0.9x	0.77	x	2.84	x	24.19	x	0.63	x	0.7	=	21	(74)
North	0.9x	0.77	x	17.55	x	24.19	x	0.63	x	0.7	=	129.74	(74)
North	0.9x	0.77	x	2.84	x	13.12	x	0.63	x	0.7	=	11.39	(74)
North	0.9x	0.77	x	17.55	x	13.12	x	0.63	x	0.7	=	70.36	(74)
North	0.9x	0.77	x	2.84	x	8.86	x	0.63	x	0.7	=	7.69	(74)
North	0.9x	0.77	x	17.55	x	8.86	x	0.63	x	0.7	=	47.54	(74)
East	0.9x	0.77	x	10.8	x	19.64	x	0.63	x	0.7	=	64.83	(76)
East	0.9x	0.77	x	18.9	x	19.64	x	0.63	x	0.7	=	113.44	(76)
East	0.9x	0.77	x	10.8	x	38.42	x	0.63	x	0.7	=	126.81	(76)
East	0.9x	0.77	x	18.9	x	38.42	x	0.63	x	0.7	=	221.92	(76)
East	0.9x	0.77	x	10.8	x	63.27	x	0.63	x	0.7	=	208.84	(76)
East	0.9x	0.77	x	18.9	x	63.27	x	0.63	x	0.7	=	365.47	(76)
East	0.9x	0.77	x	10.8	x	92.28	x	0.63	x	0.7	=	304.58	(76)
East	0.9x	0.77	x	18.9	x	92.28	x	0.63	x	0.7	=	533.02	(76)
East	0.9x	0.77	x	10.8	x	113.09	x	0.63	x	0.7	=	373.28	(76)
East	0.9x	0.77	x	18.9	x	113.09	x	0.63	x	0.7	=	653.23	(76)

East	0.9x	0.77	x	10.8	x	115.77	x	0.63	x	0.7	=	382.11	(76)
East	0.9x	0.77	x	18.9	x	115.77	x	0.63	x	0.7	=	668.7	(76)
East	0.9x	0.77	x	10.8	x	110.22	x	0.63	x	0.7	=	363.79	(76)
East	0.9x	0.77	x	18.9	x	110.22	x	0.63	x	0.7	=	636.63	(76)
East	0.9x	0.77	x	10.8	x	94.68	x	0.63	x	0.7	=	312.49	(76)
East	0.9x	0.77	x	18.9	x	94.68	x	0.63	x	0.7	=	546.86	(76)
East	0.9x	0.77	x	10.8	x	73.59	x	0.63	x	0.7	=	242.89	(76)
East	0.9x	0.77	x	18.9	x	73.59	x	0.63	x	0.7	=	425.06	(76)
East	0.9x	0.77	x	10.8	x	45.59	x	0.63	x	0.7	=	150.47	(76)
East	0.9x	0.77	x	18.9	x	45.59	x	0.63	x	0.7	=	263.33	(76)
East	0.9x	0.77	x	10.8	x	24.49	x	0.63	x	0.7	=	80.83	(76)
East	0.9x	0.77	x	18.9	x	24.49	x	0.63	x	0.7	=	141.45	(76)
East	0.9x	0.77	x	10.8	x	16.15	x	0.63	x	0.7	=	53.31	(76)
East	0.9x	0.77	x	18.9	x	16.15	x	0.63	x	0.7	=	93.29	(76)
South	0.9x	0.77	x	8.91	x	46.75	x	0.63	x	0.7	=	127.31	(78)
South	0.9x	0.77	x	12.42	x	46.75	x	0.63	x	0.7	=	177.46	(78)
South	0.9x	0.77	x	2.84	x	46.75	x	0.63	x	0.7	=	40.58	(78)
South	0.9x	0.77	x	9.72	x	46.75	x	0.63	x	0.7	=	138.88	(78)
South	0.9x	0.77	x	8.51	x	46.75	x	0.63	x	0.7	=	121.59	(78)
South	0.9x	0.77	x	2.84	x	46.75	x	0.63	x	0.7	=	40.58	(78)
South	0.9x	0.77	x	6.75	x	46.75	x	0.63	x	0.7	=	96.44	(78)
South	0.9x	0.77	x	8.91	x	76.57	x	0.63	x	0.7	=	208.5	(78)
South	0.9x	0.77	x	12.42	x	76.57	x	0.63	x	0.7	=	290.63	(78)
South	0.9x	0.77	x	2.84	x	76.57	x	0.63	x	0.7	=	66.46	(78)
South	0.9x	0.77	x	9.72	x	76.57	x	0.63	x	0.7	=	227.45	(78)
South	0.9x	0.77	x	8.51	x	76.57	x	0.63	x	0.7	=	199.14	(78)
South	0.9x	0.77	x	2.84	x	76.57	x	0.63	x	0.7	=	66.46	(78)
South	0.9x	0.77	x	6.75	x	76.57	x	0.63	x	0.7	=	157.95	(78)
South	0.9x	0.77	x	8.91	x	97.53	x	0.63	x	0.7	=	265.59	(78)
South	0.9x	0.77	x	12.42	x	97.53	x	0.63	x	0.7	=	370.21	(78)
South	0.9x	0.77	x	2.84	x	97.53	x	0.63	x	0.7	=	84.65	(78)
South	0.9x	0.77	x	9.72	x	97.53	x	0.63	x	0.7	=	289.73	(78)
South	0.9x	0.77	x	8.51	x	97.53	x	0.63	x	0.7	=	253.66	(78)
South	0.9x	0.77	x	2.84	x	97.53	x	0.63	x	0.7	=	84.65	(78)
South	0.9x	0.77	x	6.75	x	97.53	x	0.63	x	0.7	=	201.2	(78)
South	0.9x	0.77	x	8.91	x	110.23	x	0.63	x	0.7	=	300.17	(78)
South	0.9x	0.77	x	12.42	x	110.23	x	0.63	x	0.7	=	418.42	(78)
South	0.9x	0.77	x	2.84	x	110.23	x	0.63	x	0.7	=	95.68	(78)
South	0.9x	0.77	x	9.72	x	110.23	x	0.63	x	0.7	=	327.46	(78)
South	0.9x	0.77	x	8.51	x	110.23	x	0.63	x	0.7	=	286.69	(78)
South	0.9x	0.77	x	2.84	x	110.23	x	0.63	x	0.7	=	95.68	(78)

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South	0.9x	0.77	x	6.75	x	110.23	x	0.63	x	0.7	=	227.4	(78)
South	0.9x	0.77	x	8.91	x	114.87	x	0.63	x	0.7	=	312.8	(78)
South	0.9x	0.77	x	12.42	x	114.87	x	0.63	x	0.7	=	436.02	(78)
South	0.9x	0.77	x	2.84	x	114.87	x	0.63	x	0.7	=	99.7	(78)
South	0.9x	0.77	x	9.72	x	114.87	x	0.63	x	0.7	=	341.23	(78)
South	0.9x	0.77	x	8.51	x	114.87	x	0.63	x	0.7	=	298.75	(78)
South	0.9x	0.77	x	2.84	x	114.87	x	0.63	x	0.7	=	99.7	(78)
South	0.9x	0.77	x	6.75	x	114.87	x	0.63	x	0.7	=	236.97	(78)
South	0.9x	0.77	x	8.91	x	110.55	x	0.63	x	0.7	=	301.02	(78)
South	0.9x	0.77	x	12.42	x	110.55	x	0.63	x	0.7	=	419.61	(78)
South	0.9x	0.77	x	2.84	x	110.55	x	0.63	x	0.7	=	95.95	(78)
South	0.9x	0.77	x	9.72	x	110.55	x	0.63	x	0.7	=	328.39	(78)
South	0.9x	0.77	x	8.51	x	110.55	x	0.63	x	0.7	=	287.51	(78)
South	0.9x	0.77	x	2.84	x	110.55	x	0.63	x	0.7	=	95.95	(78)
South	0.9x	0.77	x	6.75	x	110.55	x	0.63	x	0.7	=	228.05	(78)
South	0.9x	0.77	x	8.91	x	108.01	x	0.63	x	0.7	=	294.12	(78)
South	0.9x	0.77	x	12.42	x	108.01	x	0.63	x	0.7	=	409.98	(78)
South	0.9x	0.77	x	2.84	x	108.01	x	0.63	x	0.7	=	93.75	(78)
South	0.9x	0.77	x	9.72	x	108.01	x	0.63	x	0.7	=	320.86	(78)
South	0.9x	0.77	x	8.51	x	108.01	x	0.63	x	0.7	=	280.91	(78)
South	0.9x	0.77	x	2.84	x	108.01	x	0.63	x	0.7	=	93.75	(78)
South	0.9x	0.77	x	6.75	x	108.01	x	0.63	x	0.7	=	222.82	(78)
South	0.9x	0.77	x	8.91	x	104.89	x	0.63	x	0.7	=	285.63	(78)
South	0.9x	0.77	x	12.42	x	104.89	x	0.63	x	0.7	=	398.15	(78)
South	0.9x	0.77	x	2.84	x	104.89	x	0.63	x	0.7	=	91.04	(78)
South	0.9x	0.77	x	9.72	x	104.89	x	0.63	x	0.7	=	311.6	(78)
South	0.9x	0.77	x	8.51	x	104.89	x	0.63	x	0.7	=	272.81	(78)
South	0.9x	0.77	x	2.84	x	104.89	x	0.63	x	0.7	=	91.04	(78)
South	0.9x	0.77	x	6.75	x	104.89	x	0.63	x	0.7	=	216.39	(78)
South	0.9x	0.77	x	8.91	x	101.89	x	0.63	x	0.7	=	277.44	(78)
South	0.9x	0.77	x	12.42	x	101.89	x	0.63	x	0.7	=	386.73	(78)
South	0.9x	0.77	x	2.84	x	101.89	x	0.63	x	0.7	=	88.43	(78)
South	0.9x	0.77	x	9.72	x	101.89	x	0.63	x	0.7	=	302.66	(78)
South	0.9x	0.77	x	8.51	x	101.89	x	0.63	x	0.7	=	264.98	(78)
South	0.9x	0.77	x	2.84	x	101.89	x	0.63	x	0.7	=	88.43	(78)
South	0.9x	0.77	x	6.75	x	101.89	x	0.63	x	0.7	=	210.18	(78)
South	0.9x	0.77	x	8.91	x	82.59	x	0.63	x	0.7	=	224.88	(78)
South	0.9x	0.77	x	12.42	x	82.59	x	0.63	x	0.7	=	313.47	(78)
South	0.9x	0.77	x	2.84	x	82.59	x	0.63	x	0.7	=	71.68	(78)
South	0.9x	0.77	x	9.72	x	82.59	x	0.63	x	0.7	=	245.33	(78)
South	0.9x	0.77	x	8.51	x	82.59	x	0.63	x	0.7	=	214.79	(78)

South	0.9x	0.77	x	2.84	x	82.59	x	0.63	x	0.7	=	71.68	(78)
South	0.9x	0.77	x	6.75	x	82.59	x	0.63	x	0.7	=	170.36	(78)
South	0.9x	0.77	x	8.91	x	55.42	x	0.63	x	0.7	=	150.9	(78)
South	0.9x	0.77	x	12.42	x	55.42	x	0.63	x	0.7	=	210.35	(78)
South	0.9x	0.77	x	2.84	x	55.42	x	0.63	x	0.7	=	48.1	(78)
South	0.9x	0.77	x	9.72	x	55.42	x	0.63	x	0.7	=	164.62	(78)
South	0.9x	0.77	x	8.51	x	55.42	x	0.63	x	0.7	=	144.13	(78)
South	0.9x	0.77	x	2.84	x	55.42	x	0.63	x	0.7	=	48.1	(78)
South	0.9x	0.77	x	6.75	x	55.42	x	0.63	x	0.7	=	114.32	(78)
South	0.9x	0.77	x	8.91	x	40.4	x	0.63	x	0.7	=	110	(78)
South	0.9x	0.77	x	12.42	x	40.4	x	0.63	x	0.7	=	153.34	(78)
South	0.9x	0.77	x	2.84	x	40.4	x	0.63	x	0.7	=	35.06	(78)
South	0.9x	0.77	x	9.72	x	40.4	x	0.63	x	0.7	=	120	(78)
South	0.9x	0.77	x	8.51	x	40.4	x	0.63	x	0.7	=	105.07	(78)
South	0.9x	0.77	x	2.84	x	40.4	x	0.63	x	0.7	=	35.06	(78)
South	0.9x	0.77	x	6.75	x	40.4	x	0.63	x	0.7	=	83.34	(78)
West	0.9x	0.77	x	9.18	x	19.64	x	0.63	x	0.7	=	55.1	(80)
West	0.9x	0.77	x	9.18	x	38.42	x	0.63	x	0.7	=	107.79	(80)
West	0.9x	0.77	x	9.18	x	63.27	x	0.63	x	0.7	=	177.51	(80)
West	0.9x	0.77	x	9.18	x	92.28	x	0.63	x	0.7	=	258.89	(80)
West	0.9x	0.77	x	9.18	x	113.09	x	0.63	x	0.7	=	317.28	(80)
West	0.9x	0.77	x	9.18	x	115.77	x	0.63	x	0.7	=	324.8	(80)
West	0.9x	0.77	x	9.18	x	110.22	x	0.63	x	0.7	=	309.22	(80)
West	0.9x	0.77	x	9.18	x	94.68	x	0.63	x	0.7	=	265.62	(80)
West	0.9x	0.77	x	9.18	x	73.59	x	0.63	x	0.7	=	206.46	(80)
West	0.9x	0.77	x	9.18	x	45.59	x	0.63	x	0.7	=	127.9	(80)
West	0.9x	0.77	x	9.18	x	24.49	x	0.63	x	0.7	=	68.7	(80)
West	0.9x	0.77	x	9.18	x	16.15	x	0.63	x	0.7	=	45.31	(80)

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

(83)m=	1042.47	1799.72	2516.7	3193.61	3634.55	3630.51	3491.16	3160.8	2751.96	2004.62	1253.24	889.03	(83)

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

(84)m=	1736.3	2491.24	3184.42	3821.88	4220.71	4177.63	4013.88	3690.37	3302.62	2595	1889.38	1561.46	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.87	0.72	0.53	0.38	0.43	0.68	0.94	0.99	1	(86)

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

(87)m=	19.92	20.15	20.43	20.71	20.88	20.93	20.94	20.94	20.9	20.65	20.21	19.89	(87)

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

(88)m=	19.89	19.9	19.9	19.91	19.92	19.93	19.93	19.93	19.92	19.92	19.91	19.9	(88)

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

(89)m=	1	0.99	0.95	0.84	0.65	0.44	0.29	0.33	0.6	0.91	0.99	1	(89)

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

(90)m=	18.45	18.79	19.19	19.58	19.77	19.84	19.85	19.85	19.81	19.51	18.89	18.41	(90)

fLA = Living area ÷ (4) = 0.1 (91)

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

(92)m=	18.6	18.92	19.31	19.69	19.88	19.95	19.96	19.96	19.92	19.62	19.02	18.56	(92)

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

(93)m=	18.6	18.92	19.31	19.69	19.88	19.95	19.96	19.96	19.92	19.62	19.02	18.56	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.98	0.94	0.83	0.65	0.44	0.29	0.34	0.6	0.9	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1730.02	2448.16	2996.89	3178.06	2742.35	1855.82	1175.32	1240.66	1972.14	2344.92	1868.38	1557.94	(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=	5200.85	5085.78	4633.97	3850.91	2911.42	1876.59	1177.38	1244.66	2053.97	3208.78	4265.34	5164.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2582.3	1772.48	1217.98	484.45	125.79	0	0	0	0	642.71	1725.81	2683.29	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 11234.82 (98)

Space heating requirement in kWh/m²/year 38.08 (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		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	2582.3	1772.48	1217.98	484.45	125.79	0	0	0	0	642.71	1725.81	2683.29	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	2840.82	1949.92	1339.92	532.95	138.38	0	0	0	0	707.05	1898.58	2951.92	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 12359.54 (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)

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Water heating

Output from water heater (calculated above)

223.58	196.88	206.33	184.36	180.24	160.43	153.48	169.23	169.19	191.2	202.93	217.99

Efficiency of water heater 80.2 (216)

(217)m=	89.94	89.7	89.18	87.68	84.28	80.2	80.2	80.2	80.2	88.2	89.64	90	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	248.57	219.47	231.38	210.28	213.86	200.03	191.37	211.01	210.96	216.78	226.38	242.22

Total = $Sum(219a)_{1...12}$ = 2622.33 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			12359.54	
Water heating fuel used			2622.33	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		806.18		(230a)
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		971.18	(231)
Electricity for lighting			715.11	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			16668.15	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	2669.66	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	566.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3236.08	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	504.04	(267)
Electricity for lighting	(232)	x	0.519	=	371.14	(268)
Total CO2, kg/year			sum of (265)…(271) =		4111.27	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		13.94	(273)
EI rating (section 14)					84	(274)

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User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Vine House

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	295	(1a) x	3.2	(2a) =	944	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	295	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	944	(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							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.04	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.29	(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) =	0.25	(21)

Infiltration rate modified for monthly wind speed

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

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

0.32	0.31	0.3	0.27	0.27	0.24	0.24	0.23	0.25	0.27	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(24d)

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

(25)m=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(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			4.32	x	1	=	4.32			(26)
Windows Type 1			5.56	x1/[1/(1.4)+ 0.04]		=	7.37			(27)
Windows Type 2			7.75	x1/[1/(1.4)+ 0.04]		=	10.27			(27)
Windows Type 3			1.77	x1/[1/(1.4)+ 0.04]		=	2.35			(27)
Windows Type 4			6.07	x1/[1/(1.4)+ 0.04]		=	8.05			(27)
Windows Type 5			6.74	x1/[1/(1.4)+ 0.04]		=	8.94			(27)
Windows Type 6			1.77	x1/[1/(1.4)+ 0.04]		=	2.35			(27)
Windows Type 7			11.79	x1/[1/(1.4)+ 0.04]		=	15.63			(27)
Windows Type 8			5.31	x1/[1/(1.4)+ 0.04]		=	7.04			(27)
Windows Type 9			1.77	x1/[1/(1.4)+ 0.04]		=	2.35			(27)
Windows Type 10			4.21	x1/[1/(1.4)+ 0.04]		=	5.58			(27)
Windows Type 11			5.73	x1/[1/(1.4)+ 0.04]		=	7.6			(27)
Windows Type 12			10.95	x1/[1/(1.4)+ 0.04]		=	14.52			(27)
Floor			295	x	0.13	=	38.35			(28)
Walls	401.22	73.74	327.48	x	0.18	=	58.95			(29)
Roof	295	0	295	x	0.13	=	38.35			(30)
Total area of elements, m²			991.22							(31)

** 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) = 232 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	44428.8	(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		44.06	(36)

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

Total fabric heat loss	(33) + (36) =	276.06	(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=	171.4	170.79	170.2	167.4	166.88	164.44	164.44	163.99	165.38	166.88	167.94	169.04	(38)

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

(39)m=	447.46	446.85	446.26	443.46	442.94	440.5	440.5	440.05	441.44	442.94	444	445.1	

Average = Sum(39)$_{1…12}$ /12= 443.46 (39)

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

(40)m=	1.52	1.51	1.51	1.5	1.5	1.49	1.49	1.49	1.5	1.5	1.51	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 3.13 (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) + 36 108.43 (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=	119.27	114.93	110.6	106.26	101.92	97.59	97.59	101.92	106.26	110.6	114.93	119.27	

Total = Sum(44)$_{1…12}$ = 1301.15 (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=	176.88	154.7	159.63	139.17	133.54	115.23	106.78	122.53	124	144.51	157.74	171.3	

Total = Sum(45)$_{1…12}$ = 1706.01 (45)

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

(46)m=	26.53	23.2	23.95	20.88	20.03	17.29	16.02	18.38	18.6	21.68	23.66	25.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.89 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.02 (50)

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

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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)		1.02	(55)

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

(56)m=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(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=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(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	(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=	231.78	204.29	214.54	192.31	188.45	168.37	161.69	177.44	177.13	199.41	210.88	226.2	(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=	231.78	204.29	214.54	192.31	188.45	168.37	161.69	177.44	177.13	199.41	210.88	226.2	

Output from water heater (annual)$_{1…12}$ — 2352.49 (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=	102.74	91.11	97	88.78	88.33	80.82	79.43	84.67	83.74	91.97	94.96	100.88	(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=	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	(66)

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

(67)m=	40.49	35.97	29.25	22.14	16.55	13.97	15.1	19.63	26.34	33.45	39.04	41.62	(67)

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

(68)m=	454.2	458.92	447.04	421.75	389.84	359.84	339.8	335.08	346.96	372.25	404.16	434.16	(68)

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

(69)m=	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	(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=	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	(71)

Water heating gains (Table 5)

(72)m=	138.09	135.58	130.38	123.31	118.72	112.26	106.76	113.8	116.3	123.62	131.88	135.59	(72)

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

(73)m=	705.66	703.35	679.55	640.09	597.99	558.95	534.54	541.39	562.49	602.2	647.97	684.25	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.77	x	10.63	x	0.63	x	0.7	=	5.75	(74)
North	0.9x	0.77	x	10.95	x	10.63	x	0.63	x	0.7	=	35.58	(74)
North	0.9x	0.77	x	1.77	x	20.32	x	0.63	x	0.7	=	10.99	(74)
North	0.9x	0.77	x	10.95	x	20.32	x	0.63	x	0.7	=	68	(74)
North	0.9x	0.77	x	1.77	x	34.53	x	0.63	x	0.7	=	18.68	(74)
North	0.9x	0.77	x	10.95	x	34.53	x	0.63	x	0.7	=	115.55	(74)
North	0.9x	0.77	x	1.77	x	55.46	x	0.63	x	0.7	=	30	(74)
North	0.9x	0.77	x	10.95	x	55.46	x	0.63	x	0.7	=	185.61	(74)
North	0.9x	0.77	x	1.77	x	74.72	x	0.63	x	0.7	=	40.42	(74)
North	0.9x	0.77	x	10.95	x	74.72	x	0.63	x	0.7	=	250.03	(74)
North	0.9x	0.77	x	1.77	x	79.99	x	0.63	x	0.7	=	43.27	(74)
North	0.9x	0.77	x	10.95	x	79.99	x	0.63	x	0.7	=	267.67	(74)
North	0.9x	0.77	x	1.77	x	74.68	x	0.63	x	0.7	=	40.4	(74)
North	0.9x	0.77	x	10.95	x	74.68	x	0.63	x	0.7	=	249.9	(74)
North	0.9x	0.77	x	1.77	x	59.25	x	0.63	x	0.7	=	32.05	(74)
North	0.9x	0.77	x	10.95	x	59.25	x	0.63	x	0.7	=	198.27	(74)
North	0.9x	0.77	x	1.77	x	41.52	x	0.63	x	0.7	=	22.46	(74)
North	0.9x	0.77	x	10.95	x	41.52	x	0.63	x	0.7	=	138.93	(74)
North	0.9x	0.77	x	1.77	x	24.19	x	0.63	x	0.7	=	13.08	(74)
North	0.9x	0.77	x	10.95	x	24.19	x	0.63	x	0.7	=	80.95	(74)
North	0.9x	0.77	x	1.77	x	13.12	x	0.63	x	0.7	=	7.1	(74)
North	0.9x	0.77	x	10.95	x	13.12	x	0.63	x	0.7	=	43.9	(74)
North	0.9x	0.77	x	1.77	x	8.86	x	0.63	x	0.7	=	4.8	(74)
North	0.9x	0.77	x	10.95	x	8.86	x	0.63	x	0.7	=	29.66	(74)
East	0.9x	0.77	x	6.74	x	19.64	x	0.63	x	0.7	=	40.46	(76)
East	0.9x	0.77	x	11.79	x	19.64	x	0.63	x	0.7	=	70.77	(76)
East	0.9x	0.77	x	6.74	x	38.42	x	0.63	x	0.7	=	79.14	(76)
East	0.9x	0.77	x	11.79	x	38.42	x	0.63	x	0.7	=	138.44	(76)
East	0.9x	0.77	x	6.74	x	63.27	x	0.63	x	0.7	=	130.33	(76)
East	0.9x	0.77	x	11.79	x	63.27	x	0.63	x	0.7	=	227.98	(76)
East	0.9x	0.77	x	6.74	x	92.28	x	0.63	x	0.7	=	190.08	(76)
East	0.9x	0.77	x	11.79	x	92.28	x	0.63	x	0.7	=	332.5	(76)
East	0.9x	0.77	x	6.74	x	113.09	x	0.63	x	0.7	=	232.95	(76)
East	0.9x	0.77	x	11.79	x	113.09	x	0.63	x	0.7	=	407.49	(76)

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East	0.9x	0.77	x	6.74	x	115.77	x	0.63	x	0.7	=	238.47	(76)
East	0.9x	0.77	x	11.79	x	115.77	x	0.63	x	0.7	=	417.14	(76)
East	0.9x	0.77	x	6.74	x	110.22	x	0.63	x	0.7	=	227.03	(76)
East	0.9x	0.77	x	11.79	x	110.22	x	0.63	x	0.7	=	397.14	(76)
East	0.9x	0.77	x	6.74	x	94.68	x	0.63	x	0.7	=	195.02	(76)
East	0.9x	0.77	x	11.79	x	94.68	x	0.63	x	0.7	=	341.13	(76)
East	0.9x	0.77	x	6.74	x	73.59	x	0.63	x	0.7	=	151.58	(76)
East	0.9x	0.77	x	11.79	x	73.59	x	0.63	x	0.7	=	265.16	(76)
East	0.9x	0.77	x	6.74	x	45.59	x	0.63	x	0.7	=	93.91	(76)
East	0.9x	0.77	x	11.79	x	45.59	x	0.63	x	0.7	=	164.27	(76)
East	0.9x	0.77	x	6.74	x	24.49	x	0.63	x	0.7	=	50.44	(76)
East	0.9x	0.77	x	11.79	x	24.49	x	0.63	x	0.7	=	88.24	(76)
East	0.9x	0.77	x	6.74	x	16.15	x	0.63	x	0.7	=	33.27	(76)
East	0.9x	0.77	x	11.79	x	16.15	x	0.63	x	0.7	=	58.2	(76)
South	0.9x	0.77	x	5.56	x	46.75	x	0.63	x	0.7	=	79.44	(78)
South	0.9x	0.77	x	7.75	x	46.75	x	0.63	x	0.7	=	110.73	(78)
South	0.9x	0.77	x	1.77	x	46.75	x	0.63	x	0.7	=	25.29	(78)
South	0.9x	0.77	x	6.07	x	46.75	x	0.63	x	0.7	=	86.73	(78)
South	0.9x	0.77	x	5.31	x	46.75	x	0.63	x	0.7	=	75.87	(78)
South	0.9x	0.77	x	1.77	x	46.75	x	0.63	x	0.7	=	25.29	(78)
South	0.9x	0.77	x	4.21	x	46.75	x	0.63	x	0.7	=	60.15	(78)
South	0.9x	0.77	x	5.56	x	76.57	x	0.63	x	0.7	=	130.1	(78)
South	0.9x	0.77	x	7.75	x	76.57	x	0.63	x	0.7	=	181.35	(78)
South	0.9x	0.77	x	1.77	x	76.57	x	0.63	x	0.7	=	41.42	(78)
South	0.9x	0.77	x	6.07	x	76.57	x	0.63	x	0.7	=	142.04	(78)
South	0.9x	0.77	x	5.31	x	76.57	x	0.63	x	0.7	=	124.25	(78)
South	0.9x	0.77	x	1.77	x	76.57	x	0.63	x	0.7	=	41.42	(78)
South	0.9x	0.77	x	4.21	x	76.57	x	0.63	x	0.7	=	98.51	(78)
South	0.9x	0.77	x	5.56	x	97.53	x	0.63	x	0.7	=	165.73	(78)
South	0.9x	0.77	x	7.75	x	97.53	x	0.63	x	0.7	=	231.01	(78)
South	0.9x	0.77	x	1.77	x	97.53	x	0.63	x	0.7	=	52.76	(78)
South	0.9x	0.77	x	6.07	x	97.53	x	0.63	x	0.7	=	180.93	(78)
South	0.9x	0.77	x	5.31	x	97.53	x	0.63	x	0.7	=	158.28	(78)
South	0.9x	0.77	x	1.77	x	97.53	x	0.63	x	0.7	=	52.76	(78)
South	0.9x	0.77	x	4.21	x	97.53	x	0.63	x	0.7	=	125.49	(78)
South	0.9x	0.77	x	5.56	x	110.23	x	0.63	x	0.7	=	187.31	(78)
South	0.9x	0.77	x	7.75	x	110.23	x	0.63	x	0.7	=	261.09	(78)
South	0.9x	0.77	x	1.77	x	110.23	x	0.63	x	0.7	=	59.63	(78)
South	0.9x	0.77	x	6.07	x	110.23	x	0.63	x	0.7	=	204.49	(78)
South	0.9x	0.77	x	5.31	x	110.23	x	0.63	x	0.7	=	178.89	(78)
South	0.9x	0.77	x	1.77	x	110.23	x	0.63	x	0.7	=	59.63	(78)

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South	0.9x	0.77	x	4.21	x	110.23	x	0.63	x	0.7	=	141.83	(78)
South	0.9x	0.77	x	5.56	x	114.87	x	0.63	x	0.7	=	195.19	(78)
South	0.9x	0.77	x	7.75	x	114.87	x	0.63	x	0.7	=	272.07	(78)
South	0.9x	0.77	x	1.77	x	114.87	x	0.63	x	0.7	=	62.14	(78)
South	0.9x	0.77	x	6.07	x	114.87	x	0.63	x	0.7	=	213.09	(78)
South	0.9x	0.77	x	5.31	x	114.87	x	0.63	x	0.7	=	186.41	(78)
South	0.9x	0.77	x	1.77	x	114.87	x	0.63	x	0.7	=	62.14	(78)
South	0.9x	0.77	x	4.21	x	114.87	x	0.63	x	0.7	=	147.8	(78)
South	0.9x	0.77	x	5.56	x	110.55	x	0.63	x	0.7	=	187.84	(78)
South	0.9x	0.77	x	7.75	x	110.55	x	0.63	x	0.7	=	261.83	(78)
South	0.9x	0.77	x	1.77	x	110.55	x	0.63	x	0.7	=	59.8	(78)
South	0.9x	0.77	x	6.07	x	110.55	x	0.63	x	0.7	=	205.07	(78)
South	0.9x	0.77	x	5.31	x	110.55	x	0.63	x	0.7	=	179.4	(78)
South	0.9x	0.77	x	1.77	x	110.55	x	0.63	x	0.7	=	59.8	(78)
South	0.9x	0.77	x	4.21	x	110.55	x	0.63	x	0.7	=	142.23	(78)
South	0.9x	0.77	x	5.56	x	108.01	x	0.63	x	0.7	=	183.53	(78)
South	0.9x	0.77	x	7.75	x	108.01	x	0.63	x	0.7	=	255.83	(78)
South	0.9x	0.77	x	1.77	x	108.01	x	0.63	x	0.7	=	58.43	(78)
South	0.9x	0.77	x	6.07	x	108.01	x	0.63	x	0.7	=	200.37	(78)
South	0.9x	0.77	x	5.31	x	108.01	x	0.63	x	0.7	=	175.28	(78)
South	0.9x	0.77	x	1.77	x	108.01	x	0.63	x	0.7	=	58.43	(78)
South	0.9x	0.77	x	4.21	x	108.01	x	0.63	x	0.7	=	138.97	(78)
South	0.9x	0.77	x	5.56	x	104.89	x	0.63	x	0.7	=	178.24	(78)
South	0.9x	0.77	x	7.75	x	104.89	x	0.63	x	0.7	=	248.44	(78)
South	0.9x	0.77	x	1.77	x	104.89	x	0.63	x	0.7	=	56.74	(78)
South	0.9x	0.77	x	6.07	x	104.89	x	0.63	x	0.7	=	194.59	(78)
South	0.9x	0.77	x	5.31	x	104.89	x	0.63	x	0.7	=	170.22	(78)
South	0.9x	0.77	x	1.77	x	104.89	x	0.63	x	0.7	=	56.74	(78)
South	0.9x	0.77	x	4.21	x	104.89	x	0.63	x	0.7	=	134.96	(78)
South	0.9x	0.77	x	5.56	x	101.89	x	0.63	x	0.7	=	173.12	(78)
South	0.9x	0.77	x	7.75	x	101.89	x	0.63	x	0.7	=	241.32	(78)
South	0.9x	0.77	x	1.77	x	101.89	x	0.63	x	0.7	=	55.11	(78)
South	0.9x	0.77	x	6.07	x	101.89	x	0.63	x	0.7	=	189.01	(78)
South	0.9x	0.77	x	5.31	x	101.89	x	0.63	x	0.7	=	165.34	(78)
South	0.9x	0.77	x	1.77	x	101.89	x	0.63	x	0.7	=	55.11	(78)
South	0.9x	0.77	x	4.21	x	101.89	x	0.63	x	0.7	=	131.09	(78)
South	0.9x	0.77	x	5.56	x	82.59	x	0.63	x	0.7	=	140.33	(78)
South	0.9x	0.77	x	7.75	x	82.59	x	0.63	x	0.7	=	195.6	(78)
South	0.9x	0.77	x	1.77	x	82.59	x	0.63	x	0.7	=	44.67	(78)
South	0.9x	0.77	x	6.07	x	82.59	x	0.63	x	0.7	=	153.2	(78)
South	0.9x	0.77	x	5.31	x	82.59	x	0.63	x	0.7	=	134.02	(78)

South	0.9x	0.77	x	1.77	x	82.59	x	0.63	x	0.7	=	44.67	(78)
South	0.9x	0.77	x	4.21	x	82.59	x	0.63	x	0.7	=	106.26	(78)
South	0.9x	0.77	x	5.56	x	55.42	x	0.63	x	0.7	=	94.17	(78)
South	0.9x	0.77	x	7.75	x	55.42	x	0.63	x	0.7	=	131.26	(78)
South	0.9x	0.77	x	1.77	x	55.42	x	0.63	x	0.7	=	29.98	(78)
South	0.9x	0.77	x	6.07	x	55.42	x	0.63	x	0.7	=	102.8	(78)
South	0.9x	0.77	x	5.31	x	55.42	x	0.63	x	0.7	=	89.93	(78)
South	0.9x	0.77	x	1.77	x	55.42	x	0.63	x	0.7	=	29.98	(78)
South	0.9x	0.77	x	4.21	x	55.42	x	0.63	x	0.7	=	71.3	(78)
South	0.9x	0.77	x	5.56	x	40.4	x	0.63	x	0.7	=	68.64	(78)
South	0.9x	0.77	x	7.75	x	40.4	x	0.63	x	0.7	=	95.68	(78)
South	0.9x	0.77	x	1.77	x	40.4	x	0.63	x	0.7	=	21.85	(78)
South	0.9x	0.77	x	6.07	x	40.4	x	0.63	x	0.7	=	74.94	(78)
South	0.9x	0.77	x	5.31	x	40.4	x	0.63	x	0.7	=	65.56	(78)
South	0.9x	0.77	x	1.77	x	40.4	x	0.63	x	0.7	=	21.85	(78)
South	0.9x	0.77	x	4.21	x	40.4	x	0.63	x	0.7	=	51.98	(78)
West	0.9x	0.77	x	5.73	x	19.64	x	0.63	x	0.7	=	34.39	(80)
West	0.9x	0.77	x	5.73	x	38.42	x	0.63	x	0.7	=	67.28	(80)
West	0.9x	0.77	x	5.73	x	63.27	x	0.63	x	0.7	=	110.8	(80)
West	0.9x	0.77	x	5.73	x	92.28	x	0.63	x	0.7	=	161.6	(80)
West	0.9x	0.77	x	5.73	x	113.09	x	0.63	x	0.7	=	198.04	(80)
West	0.9x	0.77	x	5.73	x	115.77	x	0.63	x	0.7	=	202.73	(80)
West	0.9x	0.77	x	5.73	x	110.22	x	0.63	x	0.7	=	193.01	(80)
West	0.9x	0.77	x	5.73	x	94.68	x	0.63	x	0.7	=	165.79	(80)
West	0.9x	0.77	x	5.73	x	73.59	x	0.63	x	0.7	=	128.87	(80)
West	0.9x	0.77	x	5.73	x	45.59	x	0.63	x	0.7	=	79.83	(80)
West	0.9x	0.77	x	5.73	x	24.49	x	0.63	x	0.7	=	42.88	(80)
West	0.9x	0.77	x	5.73	x	16.15	x	0.63	x	0.7	=	28.28	(80)

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

(83)m=	650.46	1122.95	1570.31	1992.67	2267.78	2265.26	2178.31	1972.19	1717.1	1250.8	781.97	554.72	(83)

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

(84)m=	1356.12	1826.3	2249.86	2632.76	2865.77	2824.21	2712.85	2513.58	2279.59	1853	1429.94	1238.97	(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	
(86)m=	1	1	0.99	0.97	0.92	0.8	0.65	0.71	0.9	0.99	1	1	(86)

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

(87)m=	19.17	19.4	19.73	20.16	20.55	20.83	20.95	20.93	20.7	20.17	19.58	19.14	(87)

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

(88)m=	19.67	19.68	19.68	19.69	19.69	19.69	19.69	19.69	19.69	19.69	19.68	19.68	(88)

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

(89)m=	1	1	0.99	0.96	0.88	0.7	0.49	0.55	0.83	0.98	1	1	(89)

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

(90)m=	17.26	17.58	18.08	18.7	19.24	19.58	19.67	19.66	19.44	18.72	17.86	17.21	(90)

fLA = Living area ÷ (4) = 0.1 (91)

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

(92)m=	17.45	17.77	18.24	18.84	19.37	19.7	19.8	19.79	19.57	18.86	18.03	17.4	(92)

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

(93)m=	17.45	17.77	18.24	18.84	19.37	19.7	19.8	19.79	19.57	18.86	18.03	17.4	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.87	0.7	0.5	0.56	0.83	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1353.39	1814.37	2207.83	2493.15	2479.16	1986.61	1362.39	1415.21	1882.86	1794.32	1423.01	1237.23	(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=	5884.75	5749.17	5240.44	4408.85	3397.36	2248.43	1410.42	1491.85	2413.78	3659.15	4854.32	5875.25	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3371.33	2644.19	2256.26	1379.31	683.14	0	0	0	0	1387.43	2470.54	3450.68	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 17642.88 (98)

Space heating requirement in kWh/m²/year 59.81 (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		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	3371.33	2644.19	2256.26	1379.31	683.14	0	0	0	0	1387.43	2470.54	3450.68	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	3605.7	2828.01	2413.11	1475.19	730.64	0	0	0	0	1483.88	2642.29	3690.57	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 18869.39 (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)

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TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

231.78	204.29	214.54	192.31	188.45	168.37	161.69	177.44	177.13	199.41	210.88	226.2

Efficiency of water heater 79.8 (216)

(217)m=	89.73	89.64	89.46	89.04	87.95	79.8	79.8	79.8	79.8	89	89.56	89.76	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	258.32	227.91	239.82	215.98	214.26	210.99	202.62	222.36	221.97	224.06	235.47	252.01

Total = Sum(219a)$_{1...12}$ = 2725.77 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			18869.39	
Water heating fuel used			2725.77	
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			715.11	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			22385.27	(338)

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	=	4075.79	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	588.77	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4664.56	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	371.14	(268)
Total CO2, kg/year			sum of (265)…(271) =		5074.62	(272)

TER = 17.2 (273)

Appendix 2 – 'Be Lean' SAP 10 Spreadsheet

Be Lean - SAP 2012 Methodology SAP 10 Carbon Factors

bluesky UNLIMITED

Project	Vine House, Home Farm, Chislehurst
Client	
Date	Jul-22
Rev	A

SAP 10	Carbon Factor
Gas	0.210
Grid Elec	0.233
Hydrogen	0

TER Energy Demand

Plot	Floor Area	Bedrooms	Space Htg	Water Htg	Pumps/ Lighting	Emissions
Vine House	295.0	3.0	18869	2726	790	4719.1
	295.0					**4719.1**

DER Energy Demand - Gas heating with SAP 10 Carbon Factors

Plot	Space Htg	Water Htg	Pumps/ Lighting	Emissions
Vine House	12360	2622	1686	3539.1
				3539.1

Total Site Target Emissions	**4,719**	$kgCO_2$ per year
Total Site Design Emissions (Be Lean)	**3,539**	$kgCO_2$ per year
Total Reduction	**1,180**	$kgCO_2$ per year
% Reduction	**25.00%**	

Appendix 3 – DER Worksheets for Vine House using a GSHP

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Vine House - GSHP

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	295	(1a)	x	3.2	(2a)	=	944	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	295	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	944	(5)

2. Ventilation rate:

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

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

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

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

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

DER WorkSheet: New dwelling design stage

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) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

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

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

(24a)m=	0.27	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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

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

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

(25)m=	0.27	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			4.32	x	1	=	4.32			(26)
Windows Type 1			8.91	x	1/[1/(1)+ 0.04]	=	8.57			(27)
Windows Type 2			12.42	x	1/[1/(1)+ 0.04]	=	11.94			(27)
Windows Type 3			2.84	x	1/[1/(1)+ 0.04]	=	2.73			(27)
Windows Type 4			9.72	x	1/[1/(1)+ 0.04]	=	9.35			(27)
Windows Type 5			10.8	x	1/[1/(1)+ 0.04]	=	10.38			(27)
Windows Type 6			2.84	x	1/[1/(1)+ 0.04]	=	2.73			(27)
Windows Type 7			18.9	x	1/[1/(1)+ 0.04]	=	18.17			(27)
Windows Type 8			8.51	x	1/[1/(1)+ 0.04]	=	8.18			(27)
Windows Type 9			2.84	x	1/[1/(1)+ 0.04]	=	2.73			(27)
Windows Type 10			6.75	x	1/[1/(1)+ 0.04]	=	6.49			(27)
Windows Type 11			9.18	x	1/[1/(1)+ 0.04]	=	8.83			(27)
Windows Type 12			17.55	x	1/[1/(1)+ 0.04]	=	16.87			(27)
Floor			295	x	0.11	=	32.45			(28)
Walls	401.22	115.58	285.64	x	0.15	=	42.85			(29)
Roof	295	0	295	x	0.1	=	29.5			(30)
Total area of elements, m²			991.22							(31)

** 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) = 216.1 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	41918.4	(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		63	(36)

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

Total fabric heat loss	(33) + (36) =	279.1	(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=	84.6	83.6	82.61	77.65	76.65	71.69	71.69	70.7	73.67	76.65	78.64	80.63	(38)

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

(39)m=	363.7	362.7	361.71	356.75	355.75	350.79	350.79	349.8	352.77	355.75	357.74	359.73	

Average = Sum(39)$_{1…12}$ /12= 356.5 (39)

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

(40)m=	1.23	1.23	1.23	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	1.22	

Average = Sum(40)$_{1…12}$ /12= 1.21 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.13 (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) + 36 108.43 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	119.27	114.93	110.6	106.26	101.92	97.59	97.59	101.92	106.26	110.6	114.93	119.27	

Total = Sum(44)$_{1…12}$ = 1301.15 (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=	176.88	154.7	159.63	139.17	133.54	115.23	106.78	122.53	124	144.51	157.74	171.3	

Total = Sum(45)$_{1…12}$ = 1706.01 (45)

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

(46)m=	26.53	23.2	23.95	20.88	20.03	17.29	16.02	18.38	18.6	21.68	23.66	25.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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):		1.4	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.76	(50)

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

DER WorkSheet: New dwelling design stage

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) | 0.76 | (55)

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

(56)m=	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(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=	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(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	(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=	223.58	196.88	206.33	184.36	180.24	160.43	153.48	169.23	169.19	191.2	202.93	217.99	(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=	223.58	196.88	206.33	184.36	180.24	160.43	153.48	169.23	169.19	191.2	202.93	217.99	

Output from water heater (annual)$_{1...12}$ | 2255.85 | (64)

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

(65)m=	96.17	85.18	90.44	82.43	81.76	74.47	72.86	78.1	77.38	85.41	88.6	94.31	(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=	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	156.27	(66)

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

(67)m=	40.49	35.97	29.25	22.14	16.55	13.97	15.1	19.63	26.34	33.45	39.04	41.62	(67)

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

(68)m=	454.2	458.92	447.04	421.75	389.84	359.84	339.8	335.08	346.96	372.25	404.16	434.16	(68)

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

(69)m=	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	38.63	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	-125.02	(71)

Water heating gains (Table 5)

(72)m=	129.26	126.76	121.56	114.48	109.89	103.43	97.93	104.97	107.48	114.79	123.06	126.77	(72)

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

(73)m=	693.84	691.52	667.72	628.26	586.16	547.12	522.71	529.57	550.66	590.37	636.14	672.43	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.84	x	10.63	x	0.63	x	0.7	=	9.23	(74)
North	0.9x	0.77	x	17.55	x	10.63	x	0.63	x	0.7	=	57.03	(74)
North	0.9x	0.77	x	2.84	x	20.32	x	0.63	x	0.7	=	17.64	(74)
North	0.9x	0.77	x	17.55	x	20.32	x	0.63	x	0.7	=	108.99	(74)
North	0.9x	0.77	x	2.84	x	34.53	x	0.63	x	0.7	=	29.97	(74)
North	0.9x	0.77	x	17.55	x	34.53	x	0.63	x	0.7	=	185.2	(74)
North	0.9x	0.77	x	2.84	x	55.46	x	0.63	x	0.7	=	48.14	(74)
North	0.9x	0.77	x	17.55	x	55.46	x	0.63	x	0.7	=	297.48	(74)
North	0.9x	0.77	x	2.84	x	74.72	x	0.63	x	0.7	=	64.85	(74)
North	0.9x	0.77	x	17.55	x	74.72	x	0.63	x	0.7	=	400.74	(74)
North	0.9x	0.77	x	2.84	x	79.99	x	0.63	x	0.7	=	69.42	(74)
North	0.9x	0.77	x	17.55	x	79.99	x	0.63	x	0.7	=	429	(74)
North	0.9x	0.77	x	2.84	x	74.68	x	0.63	x	0.7	=	64.81	(74)
North	0.9x	0.77	x	17.55	x	74.68	x	0.63	x	0.7	=	400.53	(74)
North	0.9x	0.77	x	2.84	x	59.25	x	0.63	x	0.7	=	51.42	(74)
North	0.9x	0.77	x	17.55	x	59.25	x	0.63	x	0.7	=	317.77	(74)
North	0.9x	0.77	x	2.84	x	41.52	x	0.63	x	0.7	=	36.03	(74)
North	0.9x	0.77	x	17.55	x	41.52	x	0.63	x	0.7	=	222.67	(74)
North	0.9x	0.77	x	2.84	x	24.19	x	0.63	x	0.7	=	21	(74)
North	0.9x	0.77	x	17.55	x	24.19	x	0.63	x	0.7	=	129.74	(74)
North	0.9x	0.77	x	2.84	x	13.12	x	0.63	x	0.7	=	11.39	(74)
North	0.9x	0.77	x	17.55	x	13.12	x	0.63	x	0.7	=	70.36	(74)
North	0.9x	0.77	x	2.84	x	8.86	x	0.63	x	0.7	=	7.69	(74)
North	0.9x	0.77	x	17.55	x	8.86	x	0.63	x	0.7	=	47.54	(74)
East	0.9x	0.77	x	10.8	x	19.64	x	0.63	x	0.7	=	64.83	(76)
East	0.9x	0.77	x	18.9	x	19.64	x	0.63	x	0.7	=	113.44	(76)
East	0.9x	0.77	x	10.8	x	38.42	x	0.63	x	0.7	=	126.81	(76)
East	0.9x	0.77	x	18.9	x	38.42	x	0.63	x	0.7	=	221.92	(76)
East	0.9x	0.77	x	10.8	x	63.27	x	0.63	x	0.7	=	208.84	(76)
East	0.9x	0.77	x	18.9	x	63.27	x	0.63	x	0.7	=	365.47	(76)
East	0.9x	0.77	x	10.8	x	92.28	x	0.63	x	0.7	=	304.58	(76)
East	0.9x	0.77	x	18.9	x	92.28	x	0.63	x	0.7	=	533.02	(76)
East	0.9x	0.77	x	10.8	x	113.09	x	0.63	x	0.7	=	373.28	(76)
East	0.9x	0.77	x	18.9	x	113.09	x	0.63	x	0.7	=	653.23	(76)

East	0.9x	0.77	x	10.8	x	115.77	x	0.63	x	0.7	=	382.11	(76)
East	0.9x	0.77	x	18.9	x	115.77	x	0.63	x	0.7	=	668.7	(76)
East	0.9x	0.77	x	10.8	x	110.22	x	0.63	x	0.7	=	363.79	(76)
East	0.9x	0.77	x	18.9	x	110.22	x	0.63	x	0.7	=	636.63	(76)
East	0.9x	0.77	x	10.8	x	94.68	x	0.63	x	0.7	=	312.49	(76)
East	0.9x	0.77	x	18.9	x	94.68	x	0.63	x	0.7	=	546.86	(76)
East	0.9x	0.77	x	10.8	x	73.59	x	0.63	x	0.7	=	242.89	(76)
East	0.9x	0.77	x	18.9	x	73.59	x	0.63	x	0.7	=	425.06	(76)
East	0.9x	0.77	x	10.8	x	45.59	x	0.63	x	0.7	=	150.47	(76)
East	0.9x	0.77	x	18.9	x	45.59	x	0.63	x	0.7	=	263.33	(76)
East	0.9x	0.77	x	10.8	x	24.49	x	0.63	x	0.7	=	80.83	(76)
East	0.9x	0.77	x	18.9	x	24.49	x	0.63	x	0.7	=	141.45	(76)
East	0.9x	0.77	x	10.8	x	16.15	x	0.63	x	0.7	=	53.31	(76)
East	0.9x	0.77	x	18.9	x	16.15	x	0.63	x	0.7	=	93.29	(76)
South	0.9x	0.77	x	8.91	x	46.75	x	0.63	x	0.7	=	127.31	(78)
South	0.9x	0.77	x	12.42	x	46.75	x	0.63	x	0.7	=	177.46	(78)
South	0.9x	0.77	x	2.84	x	46.75	x	0.63	x	0.7	=	40.58	(78)
South	0.9x	0.77	x	9.72	x	46.75	x	0.63	x	0.7	=	138.88	(78)
South	0.9x	0.77	x	8.51	x	46.75	x	0.63	x	0.7	=	121.59	(78)
South	0.9x	0.77	x	2.84	x	46.75	x	0.63	x	0.7	=	40.58	(78)
South	0.9x	0.77	x	6.75	x	46.75	x	0.63	x	0.7	=	96.44	(78)
South	0.9x	0.77	x	8.91	x	76.57	x	0.63	x	0.7	=	208.5	(78)
South	0.9x	0.77	x	12.42	x	76.57	x	0.63	x	0.7	=	290.63	(78)
South	0.9x	0.77	x	2.84	x	76.57	x	0.63	x	0.7	=	66.46	(78)
South	0.9x	0.77	x	9.72	x	76.57	x	0.63	x	0.7	=	227.45	(78)
South	0.9x	0.77	x	8.51	x	76.57	x	0.63	x	0.7	=	199.14	(78)
South	0.9x	0.77	x	2.84	x	76.57	x	0.63	x	0.7	=	66.46	(78)
South	0.9x	0.77	x	6.75	x	76.57	x	0.63	x	0.7	=	157.95	(78)
South	0.9x	0.77	x	8.91	x	97.53	x	0.63	x	0.7	=	265.59	(78)
South	0.9x	0.77	x	12.42	x	97.53	x	0.63	x	0.7	=	370.21	(78)
South	0.9x	0.77	x	2.84	x	97.53	x	0.63	x	0.7	=	84.65	(78)
South	0.9x	0.77	x	9.72	x	97.53	x	0.63	x	0.7	=	289.73	(78)
South	0.9x	0.77	x	8.51	x	97.53	x	0.63	x	0.7	=	253.66	(78)
South	0.9x	0.77	x	2.84	x	97.53	x	0.63	x	0.7	=	84.65	(78)
South	0.9x	0.77	x	6.75	x	97.53	x	0.63	x	0.7	=	201.2	(78)
South	0.9x	0.77	x	8.91	x	110.23	x	0.63	x	0.7	=	300.17	(78)
South	0.9x	0.77	x	12.42	x	110.23	x	0.63	x	0.7	=	418.42	(78)
South	0.9x	0.77	x	2.84	x	110.23	x	0.63	x	0.7	=	95.68	(78)
South	0.9x	0.77	x	9.72	x	110.23	x	0.63	x	0.7	=	327.46	(78)
South	0.9x	0.77	x	8.51	x	110.23	x	0.63	x	0.7	=	286.69	(78)
South	0.9x	0.77	x	2.84	x	110.23	x	0.63	x	0.7	=	95.68	(78)

South	0.9x	0.77	x	6.75	x	110.23	x	0.63	x	0.7	=	227.4	(78)
South	0.9x	0.77	x	8.91	x	114.87	x	0.63	x	0.7	=	312.8	(78)
South	0.9x	0.77	x	12.42	x	114.87	x	0.63	x	0.7	=	436.02	(78)
South	0.9x	0.77	x	2.84	x	114.87	x	0.63	x	0.7	=	99.7	(78)
South	0.9x	0.77	x	9.72	x	114.87	x	0.63	x	0.7	=	341.23	(78)
South	0.9x	0.77	x	8.51	x	114.87	x	0.63	x	0.7	=	298.75	(78)
South	0.9x	0.77	x	2.84	x	114.87	x	0.63	x	0.7	=	99.7	(78)
South	0.9x	0.77	x	6.75	x	114.87	x	0.63	x	0.7	=	236.97	(78)
South	0.9x	0.77	x	8.91	x	110.55	x	0.63	x	0.7	=	301.02	(78)
South	0.9x	0.77	x	12.42	x	110.55	x	0.63	x	0.7	=	419.61	(78)
South	0.9x	0.77	x	2.84	x	110.55	x	0.63	x	0.7	=	95.95	(78)
South	0.9x	0.77	x	9.72	x	110.55	x	0.63	x	0.7	=	328.39	(78)
South	0.9x	0.77	x	8.51	x	110.55	x	0.63	x	0.7	=	287.51	(78)
South	0.9x	0.77	x	2.84	x	110.55	x	0.63	x	0.7	=	95.95	(78)
South	0.9x	0.77	x	6.75	x	110.55	x	0.63	x	0.7	=	228.05	(78)
South	0.9x	0.77	x	8.91	x	108.01	x	0.63	x	0.7	=	294.12	(78)
South	0.9x	0.77	x	12.42	x	108.01	x	0.63	x	0.7	=	409.98	(78)
South	0.9x	0.77	x	2.84	x	108.01	x	0.63	x	0.7	=	93.75	(78)
South	0.9x	0.77	x	9.72	x	108.01	x	0.63	x	0.7	=	320.86	(78)
South	0.9x	0.77	x	8.51	x	108.01	x	0.63	x	0.7	=	280.91	(78)
South	0.9x	0.77	x	2.84	x	108.01	x	0.63	x	0.7	=	93.75	(78)
South	0.9x	0.77	x	6.75	x	108.01	x	0.63	x	0.7	=	222.82	(78)
South	0.9x	0.77	x	8.91	x	104.89	x	0.63	x	0.7	=	285.63	(78)
South	0.9x	0.77	x	12.42	x	104.89	x	0.63	x	0.7	=	398.15	(78)
South	0.9x	0.77	x	2.84	x	104.89	x	0.63	x	0.7	=	91.04	(78)
South	0.9x	0.77	x	9.72	x	104.89	x	0.63	x	0.7	=	311.6	(78)
South	0.9x	0.77	x	8.51	x	104.89	x	0.63	x	0.7	=	272.81	(78)
South	0.9x	0.77	x	2.84	x	104.89	x	0.63	x	0.7	=	91.04	(78)
South	0.9x	0.77	x	6.75	x	104.89	x	0.63	x	0.7	=	216.39	(78)
South	0.9x	0.77	x	8.91	x	101.89	x	0.63	x	0.7	=	277.44	(78)
South	0.9x	0.77	x	12.42	x	101.89	x	0.63	x	0.7	=	386.73	(78)
South	0.9x	0.77	x	2.84	x	101.89	x	0.63	x	0.7	=	88.43	(78)
South	0.9x	0.77	x	9.72	x	101.89	x	0.63	x	0.7	=	302.66	(78)
South	0.9x	0.77	x	8.51	x	101.89	x	0.63	x	0.7	=	264.98	(78)
South	0.9x	0.77	x	2.84	x	101.89	x	0.63	x	0.7	=	88.43	(78)
South	0.9x	0.77	x	6.75	x	101.89	x	0.63	x	0.7	=	210.18	(78)
South	0.9x	0.77	x	8.91	x	82.59	x	0.63	x	0.7	=	224.88	(78)
South	0.9x	0.77	x	12.42	x	82.59	x	0.63	x	0.7	=	313.47	(78)
South	0.9x	0.77	x	2.84	x	82.59	x	0.63	x	0.7	=	71.68	(78)
South	0.9x	0.77	x	9.72	x	82.59	x	0.63	x	0.7	=	245.33	(78)
South	0.9x	0.77	x	8.51	x	82.59	x	0.63	x	0.7	=	214.79	(78)

South	0.9x	0.77	x	2.84	x	82.59	x	0.63	x	0.7	=	71.68	(78)
South	0.9x	0.77	x	6.75	x	82.59	x	0.63	x	0.7	=	170.36	(78)
South	0.9x	0.77	x	8.91	x	55.42	x	0.63	x	0.7	=	150.9	(78)
South	0.9x	0.77	x	12.42	x	55.42	x	0.63	x	0.7	=	210.35	(78)
South	0.9x	0.77	x	2.84	x	55.42	x	0.63	x	0.7	=	48.1	(78)
South	0.9x	0.77	x	9.72	x	55.42	x	0.63	x	0.7	=	164.62	(78)
South	0.9x	0.77	x	8.51	x	55.42	x	0.63	x	0.7	=	144.13	(78)
South	0.9x	0.77	x	2.84	x	55.42	x	0.63	x	0.7	=	48.1	(78)
South	0.9x	0.77	x	6.75	x	55.42	x	0.63	x	0.7	=	114.32	(78)
South	0.9x	0.77	x	8.91	x	40.4	x	0.63	x	0.7	=	110	(78)
South	0.9x	0.77	x	12.42	x	40.4	x	0.63	x	0.7	=	153.34	(78)
South	0.9x	0.77	x	2.84	x	40.4	x	0.63	x	0.7	=	35.06	(78)
South	0.9x	0.77	x	9.72	x	40.4	x	0.63	x	0.7	=	120	(78)
South	0.9x	0.77	x	8.51	x	40.4	x	0.63	x	0.7	=	105.07	(78)
South	0.9x	0.77	x	2.84	x	40.4	x	0.63	x	0.7	=	35.06	(78)
South	0.9x	0.77	x	6.75	x	40.4	x	0.63	x	0.7	=	83.34	(78)
West	0.9x	0.77	x	9.18	x	19.64	x	0.63	x	0.7	=	55.1	(80)
West	0.9x	0.77	x	9.18	x	38.42	x	0.63	x	0.7	=	107.79	(80)
West	0.9x	0.77	x	9.18	x	63.27	x	0.63	x	0.7	=	177.51	(80)
West	0.9x	0.77	x	9.18	x	92.28	x	0.63	x	0.7	=	258.89	(80)
West	0.9x	0.77	x	9.18	x	113.09	x	0.63	x	0.7	=	317.28	(80)
West	0.9x	0.77	x	9.18	x	115.77	x	0.63	x	0.7	=	324.8	(80)
West	0.9x	0.77	x	9.18	x	110.22	x	0.63	x	0.7	=	309.22	(80)
West	0.9x	0.77	x	9.18	x	94.68	x	0.63	x	0.7	=	265.62	(80)
West	0.9x	0.77	x	9.18	x	73.59	x	0.63	x	0.7	=	206.46	(80)
West	0.9x	0.77	x	9.18	x	45.59	x	0.63	x	0.7	=	127.9	(80)
West	0.9x	0.77	x	9.18	x	24.49	x	0.63	x	0.7	=	68.7	(80)
West	0.9x	0.77	x	9.18	x	16.15	x	0.63	x	0.7	=	45.31	(80)

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

(83)m=	1042.47	1799.72	2516.7	3193.61	3634.55	3630.51	3491.16	3160.8	2751.96	2004.62	1253.24	889.03	(83)

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

(84)m=	1736.3	2491.24	3184.42	3821.88	4220.71	4177.63	4013.88	3690.37	3302.62	2595	1889.38	1561.46	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.87	0.72	0.53	0.38	0.43	0.68	0.94	0.99	1	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.89	19.9	19.9	19.91	19.92	19.93	19.93	19.93	19.92	19.92	19.91	19.9	(88)

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

(89)m=	1	0.99	0.95	0.84	0.65	0.44	0.29	0.33	0.6	0.91	0.99	1	(89)

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

(90)m=	19.89	19.9	19.9	19.91	19.92	19.93	19.93	19.93	19.92	19.92	19.91	19.9	(90)

fLA = Living area ÷ (4) = 0.1 (91)

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

(92)m=	20	20.01	20.01	20.02	20.02	20.04	20.04	20.04	20.03	20.02	20.02	20.01	(92)

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

(93)m=	20	20.01	20.01	20.02	20.02	20.04	20.04	20.04	20.03	20.02	20.02	20.01	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.95	0.84	0.66	0.45	0.3	0.34	0.61	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1732.1	2459.15	3027.69	3223.88	2779.19	1884.29	1202.91	1268.14	2003.21	2376.17	1874.29	1559.16	(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=	5711.65	5479.31	4886.44	3967.48	2961.19	1906.83	1205.26	1272.65	2092.3	3352.52	4621.59	5688.72	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2960.78	2029.55	1382.91	535.39	135.41	0	0	0	0	726.41	1978.06	3072.39	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 12820.91 (98)

Space heating requirement in kWh/m²/year 43.46 (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		382.63	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	2960.78	2029.55	1382.91	535.39	135.41	0	0	0	0	726.41	1978.06	3072.39	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	773.79	530.42	361.42	139.92	35.39	0	0	0	0	189.84	516.96	802.96	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3350.7 (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)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

223.58	196.88	206.33	184.36	180.24	160.43	153.48	169.23	169.19	191.2	202.93	217.99

Efficiency of water heater 191.99 (216)

(217)m=	191.99	191.99	191.99	191.99	191.99	191.99	191.99	191.99	191.99	191.99	191.99	191.99	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	116.45	102.54	107.47	96.03	93.88	83.56	79.94	88.14	88.12	99.59	105.7	113.54

Total = $Sum(219a)_{1...12}$ = 1174.95 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3350.7	
Water heating fuel used		1174.95	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	806.18		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		806.18	(231)
Electricity for lighting		715.11	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6046.94	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	1739.01	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	609.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2348.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	418.41	(267)
Electricity for lighting	(232) x	0.519	=	371.14	(268)
Total CO2, kg/year		sum of (265)…(271) =		3138.36	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.64	(273)
EI rating (section 14)				88	(274)

Appendix 4 – 'Be Green' SAP 10 Spreadsheet

Be Green - SAP 2012 Methodology SAP 10 Carbon Factors

Project	Vine House, Home Farm, Chislehurst
Client	
Date	Jul-22
Rev	A

SAP 10	Carbon Factor
Gas	0.210
Grid Elec	0.233
Hydrogen	0.000

TER Energy Demand

Plot	Floor Area	Bedrooms	Space Htg	Water Htg	Pumps/ Lighting	Emissions
Vine House	295.0	3.0	18869	2726	790	4719.1
	295.0					**4719.1**

DER Energy Demand - GSHP with SAP 10 Carbon Factors

Plot	Space Htg	Water Htg	Pumps/ Lighting	Emissions
Vine House	3351	1175	1521	1408.9
				1408.9

Total Site Target Emissions (from Be Lean)	**4,719**	$kgCO_2$ per year
Total Site Design Emissions	**1,409**	$kgCO_2$ per year
Total Reduction	**3,310**	$kgCO_2$ per year
% Reduction	**70.14%**	

Appendix 5 – Site Plan showing Indicative Location of Photovoltaic Panels

NOTE:

To be read in conjunction with Floor plans - Drawing Nos. 200.201, 200.202 & 200.203

SITE PLAN - PROPOSED

1:500 @ A1

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Project | HOME FARM CHISLEHURST

Client | JOE SELBY

Title | PROPOSED SITE PLAN

Status | PRELIMINARY

Scale@A1 | 1:100 **Date** | APR '22 **Drawn** | AS **Chk'd** | LD

Project Number 20.104 Bim Number

Drawing Number 200.100

Revision P5