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Sustainability Report and Energy Statement for:

62 Avenue Road, St Johns Wood, Camden, NW8 6HT.

Planning Ref No: 2016/4931/P

Report by: Mark Fagan
Ref: L3394

Date: 28th Jan 2017

Contents

Executive Summary

This document has been prepared by **Leema Technologies Ltd** for **VV Media**, setting out the sustainability commitments in support of the detailed planning application for the development of: **62 Avenue Road, St Johns Wood, Camden, NW8 6HT.**

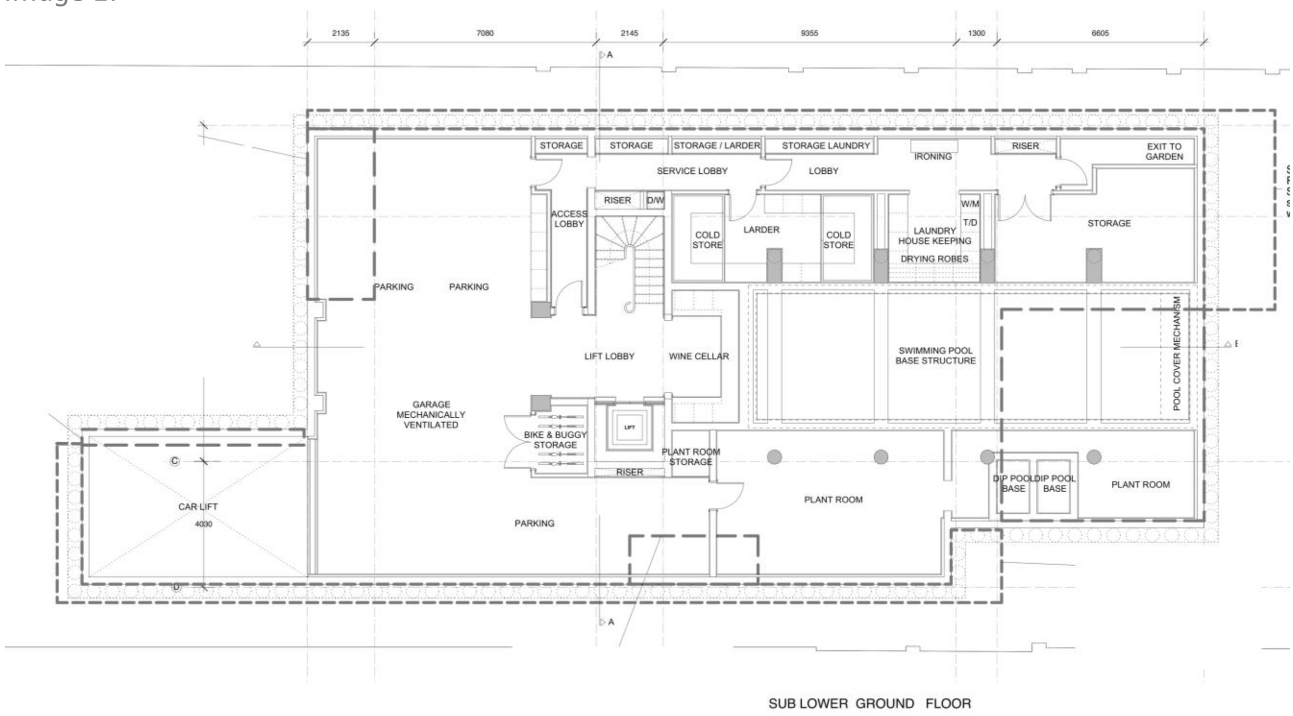
Each commitment accords with London Borough of Camden planning policy and support policies. Targets set out within the strategy are for the residential development application area.

The application site is located in the London Borough of Camden, Greater London. The development of **62 Avenue Road, St Johns Wood, Camden, NW8 6HT** includes the demolition of the existing outdated dwelling. The proposal involves the erection of a new 4 storey family home. Comprising of basement, lower ground, ground and first floor levels with Garage, swimming pool and plant located in the basement and lower ground levels.

A bin store containing recycling and general waste bins shall be provided. Landscaping shall be provided to the front and rear gardens, with car parking spaces also available on the front forecourt of the property. The landscaping shall contribute towards the biodiversity of the area. Additionally bird/bat boxes shall also be provided.

Dedicated cycle storage is being provided in the basement / garage area as indicated in *Image 1:* below.

Image 1:



A site specific Flood Risk Assessment has been carried out for this site, which should be read in conjunction with this Report.

Energy efficiency measures will be implemented to provide carbon savings of **25.1%** in comparison to a baseline building that is fully compliant with the standard set by Part L 2010. The energy efficiency measures include: improved fabric insulation; improved air tightness; improvements to Thermal Bridging and the use of Photovoltaic panels. This will ensure the development achieves a good portion of the part L 2010 compliance through energy efficiency measures alone. With the use a Photovoltaic system to assist in achieving the remainder.

The carbon emissions at the end of the 'be clean' stage are identical to those at the end of the 'be lean' stage. In addition to the improved fabric, the property will be served by a **2kw Photovoltaic** (5m² array PV Collector). This renewable system will be sufficient to provide carbon savings in addition to the 'be lean' measures and will satisfy the requirement to achieve a total carbon emissions saving of more than the required 20% relative to the baseline case for the dwelling.

The aim of this document is to clearly and comprehensively demonstrate how the proposed development complies with, and wherever possible, exceeds sustainability policy requirements as well as following best practice sustainability principles.

The technical appendix contains a number of documents referred to in the Sustainability Statement which detail how key sustainability measures outlined in the statement can be achieved.

Key Targets:

- The site will achieve a 20% improvement in CO_2 emissions over TER (Part L 2010 compliant).
- Improvements to the fabric efficiency that will be 34% improvement against Part L 2010
- A PV collector installation of 2kw (5m² array) will be provided.
- Water consumption will not exceed 125 litres per person per day.
- Space for 4 bicycles is being provided.

The client recognises the importance of ensuring development is sustainable and commits to ensuring the redevelopment of **62 Avenue Road** delivers on sustainability, where feasible, during both the construction and occupation phase.

1. Introduction

This Sustainability Statement presents the commitments made by the client and:

- outlines the national, regional and local policy that applies to the proposed development;
- details the assessment methodology to be used in conducting a sustainability assessment;
- assesses the proposed development and outlines targets and measures which will be implemented to achieve sustainability requirements and where necessary, comments and links to further information about the measures are included in the table;
- makes a conclusion about the sustainability of the proposed development

1.1. Project Description

The application site is located at **62 Avenue Road, Camden. NW8 6HT** and includes the demolition of the existing outdated dwelling. The proposal involves the erection of a new 4 storey 7x bedroom family home. The dwelling will comprise of a basement, lower ground, ground and first floor levels. The development also offers extensive gardens and landscaped amenity space.

A bin store containing recycling and general waste bins are being provided in the basement, along with dedicated cycle storage.

2. Policy: context and compliance

Camden Planning Guidance (CPG23) on Sustainability provides further guidance on reducing carbon emissions, in line with Policy CS13 and DM22. Within this document it is stated that developments should target a 35% reduction in carbon emissions. Sustainable development is a core principle underpinning planning, and has a key role to play in the creation of sustainable communities. In order to ensure the implementation of sustainable developments and to determine the target of standards to be met by the proposed development, it is necessary to review the relevant national, regional and local planning policies with respect to sustainability and the site location. A summary of the planning policy context for the site and propose development is provided below.

2.2. National policy

The Government White Paper of 2003, *'Our Energy Future – Creating a Low Carbon Economy'* marked a change in energy policy in bringing environmental concerns to the fore by defining a long-term strategic vision for energy policy, combining environmental, security of supply, competitiveness and social goals.

One stated aim is for government to 'set an example throughout the public sector by improving energy efficiency in buildings and procurement'. National Energy reduction targets set out in: *The UK Fuel Poverty Strategy, 2001DTI; Energy White Paper 2003, DEFRA: and the Government's Strategy (2004) for combined Heat and Power,* are as follows:

- 2050 60% reduction in CO_2
- 2020 To increase renewable generation by 20%
- 2018 Eradicate fuel poverty in vulnerable households
- 2010 Reduce domestic energy consumption by 30%
- 2010 10% of electricity generation from renewables
- 2010 Good quality Combined Heat and Power generation of 10,000 MW

The aforementioned subject areas are embedded in Government Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) which set out national policy on land use planning. These policies complement but do not replace other national planning policies. All PPS's and PPG's are embedded in Regional Spatial Strategies (RSS's), the London Plan and local planning authorities in the preparation of local development documents. They may also be material to decisions on individual planning applications.

PPS 1: Delivering Sustainable Development: (February 2005) sets out the relationship between planning, land use and sustainable development. It places an emphasis on community involvement in the process of building a high quality environment. Inclusive and accessible design, as well as health and safety are also prioritised.

PPS 1: A Supplement - Planning and Climate Change: (December 2007) strengthens the emphasis on sustainable development and sets out guidelines for local planning authorities in relation to regional mitigation and adaptation measures for current and future climate change.

PPS 3: Housing: (June 2010) sets out the Governments strategic housing policy. Objectives aim to ensure that everyone has the opportunity to live in a decent home, which they can afford in a community where they want to live. This policy seeks to improve housing choice, widen access to affordable homes; develope more opportunities for home ownership and create sustainable and inclusive mixed communities.

PPS 10: **Planning for Sustainable Waste Management:** (May 2006) identifies the production of less waste and its use as a resource wherever possible as the key objective. Disposing of waste is only to be considered as a last resort. The Government seeks to break the link between economic growth and the environmental impact of waste. This policy also specifies the decision making responsibilities, to the extent appropriate, of regional planning bodies and all planning authorities in waste management.

PPS 22: Renewable Energy (August 2004) calls for regional strategies and local authorities to actively encourage renewable energy development through local planning policies. Technologies such as combined heat and power systems (CHP), wind turbines, photo voltaic cells and biomass heating should be considered in all new developments.

PPS 25: Development and Flood Risk (March 2005) aims to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall. It advises that developments on sites in excess of 1 hectare should be accompanied by a Flood Risk Assessment in order to evaluate the risks and order that they are appropriately mitigated or minimised.

2.3. Regional policy

The current London Plan was adopted in February 2008 with an updated Chapter 4A on ***Climate Change and London's Metabolism*.** Strengthened policies emphasising energy efficient design and decentralised energy supply are introduced promoting adaptation as well as mitigation in sustainable building design.

Policy 4A.1 ***Tackling Climate Change*** requires developments to minimise CO2 emissions and states that the following hierarchy will be used to assess applications:

- using less energy, in particular by adopting sustainable design and construction measures (Policy 4A.3)
- supplying energy efficiently, in particular by prioritising decentralised energy generation (Policy 4A.6), and
- Using renewable energy (Policy 4A.7)

Policy 4A.3 ***Sustainable Design and Construction*,** requires future developments to make the most efficient use of land and existing buildings, and to reduce the need to travel. Passive solar design, natural ventilation, heating and cooling are advocated as ways to reduce energy use in policies 4A.3, *Decentralised Heat*, 4A.6 *Cooling and Power*, 4A.9 *Adaptation*, and 4A.10 *Overheating*.

Policy 4A.2 *Mitigating Climate Change* specifies minimum reduction targets for London as a whole from 1990 levels of:

- 15% by 2010
- 20% by 2015
- 25% by 2020
- 30% by 2025.
-

Policy 4A.7 *Renewable Energy* requires all new developments to reduce CO2 emissions by 20% through the use of on-site renewable energy generation where feasible

Draft Replacement London Plan

After a consultation in 2008, the Mayor decided to create a Replacement Plan rather than amend the previous London Plan. The new plan is currently going through consultation with a view to adoption in 2011. The new London Plan (LP) retains a strong stance on the issues of sustainability and climate change adaptation and mitigation, but has altered some of the methodology by which it seeks to achieve the capital's environmental targets.

The main areas of change are:

- Move from renewable energy targets to CO2 reduction targets
- Increased focus on decentralised energy
- More detailed targets for renewable energy capacity
- Encouragement for innovative energy technologies including non-incineration energy from waste
- Stronger and more detailed policy on overheating and cooling
- Encouragement of Green Roofs

Policy 5.2 CO2 minimisation in new development
The new LP has moved away from the Merton Rule type renewable energy target found in the 2008 LP towards an overall CO2 emissions reduction target expressed as a percentage, bringing it in line with national policy. However, the required targets are in advance of national targets in the Building Regulations. These are as follows:

Year	Domestic Buildings	Non Domestic Buildings
2010-2013	44%	44%
2013-2016	55%	55%
2016-2019	Zero carbon	As per Building Regs
2019-2031	Zero carbon	Zero carbon

These CO2 reductions should be expressed in terms of non-regulated emissions as well as regulated emissions.

Policy 5.3 Sustainable Design and Construction
This policy condenses much of the requirements of various policies and guidance in the 2008 LP into one policy. It requires new development to demonstrate how it will meet the minimum standards outlined in a yet to be published SPG and lists the areas concerned. The list contains most of the issues addressed in both the Code for Sustainable Homes (Code) and BREEAM standards.

Policy 5.6 Decentralised energy in development proposals
A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

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

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

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

2.4. Local policy
Camden Replacement Unitary Development Plan 2006, Saved Policies
The Replacement Unitary Development Plan (UDP) is was replaced by the Core Strategy in November 2010, in accordance with the Planning and Compulsory Purchase Act 2005 which replaces UDPs with Local Development Frameworks (LDF). However, as part of the transitional arrangements, the ‘saved policies’ will retain their ‘development plan’ status in planning decisions for three years after adoption of the LDF. Therefore, the Sustainability Statement includes relevant saved policies from the Replacement UDP.

Policy SD9 Resources and energy
The UDP includes a raft of policies under the heading Sustainable Development but Policy SD9 is the most relevant to key sustainability issues for the Gondar Gardens development and has therefore been considered whilst developing the Sustainability Statement.
Policy SD9 covers three main areas:

A - Air quality
Where the Council considers that development could potentially cause significant harm to air quality, applicants will be required to submit an air quality assessment. The Council will not grant planning permission for development that would significantly harm air quality, unless mitigation measures are adopted to reduce the impact to acceptable levels.

B – Water
In considering proposals for development, the Council will need to be satisfied that adequate provision can be made for water supply and waste treatment. The Council will only grant planning permission for development that it considers is sited and designed in a manner that does not cause harm to the water environment, water quality or drainage systems and prevents or mitigates flooding. The Council will require developers to include measures to conserve water and where appropriate incorporate Sustainable Urban Drainage Systems.

C - Use of energy and resources
The Council will seek developments that conserve energy and resources through:

a) designs for energy efficiency;

b) renewable energy use;

c) optimising energy supply;

d) the use of recycled and renewable building materials. The Council will require major developments to demonstrate the energy demand of their proposals and how they would generate a proportion of the site's electricity and heating needs from renewables wherever feasible. The Council may use conditions or planning obligations to secure recycling of materials on site and/or use of recycled aggregates in major schemes.

Camden Core Strategy, adopted 10th November 2010
Policy DP22 Promoting sustainable design and construction
The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation;

b) incorporate green or brown roofs and green walls wherever suitable.
The Council will promote and measure sustainable design and construction by:

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.

d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve “very good” in EcoHomes assessments prior to 2013 and encouraging “excellent” from 2013;

e) expecting non-domestic developments of 500sqm of floorspace or above to achieve “very good” in BREEAM assessments and “excellent” from 2016 and encouraging zero carbon from 2019.
The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;

g) limiting run-off;

h) reducing water consumption;

i) reducing air pollution;

j) not locating vulnerable uses in basements in flood-prone areas.

Policy DP23 Water
The Council will require developments to reduce their water consumption, the pressure on the combined sewer network and the risk of flooding by:

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

b) limiting the amount and rate of run-off and waste water entering the combined storm water and sewer network through the methods outlined in part a) and other sustainable urban drainage methods to reduce the risk of flooding;

c) reducing the pressure placed on the combined storm water and sewer network from foul water and surface water run-off and ensuring developments in the areas identified by the North London Strategic Flood Risk Assessment and shown on Map 2 as being at risk of surface water flooding are designed to cope with the potential flooding;

d) ensuring that developments are assessed for upstream and downstream groundwater flood risks in areas where historic underground streams are known to have been present; and e) encouraging the provision of attractive and efficient water features.

Policy CS13 - Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change
The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and expect all development to meet the highest feasible environmental standards during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

b) promoting the efficient use of land and buildings;

c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

1. ensuring developments use less energy,
2. Where appropriate, making use of: Bloomsbury and proposed Euston Road decentralised energy networks;
3. generating renewable energy on-site; and

d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

Local energy generation
The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:

- housing estates with community heating or the potential for community heating and other uses with large heating loads;
- the growth areas of King’s Cross, Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
- schools to be redeveloped as part of Building Schools for the Future programme;
- existing or approved combined heat and power/local energy networks (see Map 4); and other locations where land ownership would facilitate their implementation.

f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Water and surface water flooding
We will make Camden a water efficient borough and minimise the potential for surface water flooding by:

g) protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;

h) making sure development incorporates efficient water and foul water infrastructure;

i) requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and down-stream flooding, especially in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross (see Map 5).

Camden's carbon reduction measures
The Council will take a lead in tackling climate change by:

j) taking measures to reduce its own carbon emissions;

k) trialling new energy efficient technologies, where feasible; and

l) raising awareness on mitigation and adaptation measures.

Camden Planning Guidance, December 2006
This document is due to be replaced with updated guidance in March 2011 and as yet there is no draft document available. The Sustainability Statement therefore uses the 2006 document to inform targets and measures. In particular, the following sections of the guidance document are relevant to the statement:

- Energy and onsite renewable facilities
- Sustainable design and construction
- Water

Compliance with Policy
Any development must comply with all relevant local, regional and national policies covering energy and the environment. Wherever possible, best practice sustainability guidance will be targeted.

2.5. Summary of references

The Table below sets out a list of the documents used to research and identify the Sustainability Statement requirements.

Table – Summary of references

Reference	Document
LPlan	London Plan - Feb 2008
LPlan-DR	Draft Replacement London Plan – Oct 2009 EAD: late 2011
LHDG-DR	Draft London Housing Design Guide – July 2009 EAD: Summer 2010
IH SPG	Interim Housing SPG – April 2010 (Mayor of London)
UDP2006-saved	Camden Unitary Development Plan – June 2006, Saved Policies

Core2010	Camden Core Strategy - 2010
DP2010	Camden Development Policies - 2010
PG2006	Camden Planning Guidance – December 2006
Cycle Parking	Cycle Parking - Proposed-TfL-Guidelines
Travel planning	Guidance for residential travel planning in London-2008
BRE SCD	BRE London Sustainability Checklist for Developments 2010

3. Sustainability Assessment

In this section we give a summary of the Sustainability Strategy for the redevelopment of **62 Avenue Road**. We have developed a target driven approach, with targets being drawn from relevant Policy Context section above.

Development proposals of any scale are required to demonstrate sustainability principles in a supporting statement. The information provided should be proportionate to the scale of the proposed development and its likely impact on, and vulnerability to, climate change. Minimum information requirements are set out within London Plan Sustainable Design and Construction SPG and included within the council's local validation requirements.

The purpose of this section is to evidence the requirements set out within the London Plan Sustainable Design and Construction SPG. This development is considered a 'Minor Application' and therefore this Sustainability Statement is proportionate to the scale of this proposed development.

3.1. Land use and re-use of land

The development is located on a site there is currently has a single dwelling and ancillary buildings on this site plus amenity space/garden. The London Plan encourages the re-use of existing buildings, however as this development results in the demolition of one dwelling to be replaced by a larger and more energy efficient family home which we believe is considered favourable by London Borough of Camden. The diversion of materials from landfill shall be considered by the Main Contractor in their Site Waste Management Plan.

3.2. Surface Water Run-off, SUDs and Flood Risk Assessment

- **Flood Risk Assessment**
  Full report completed separately.

3.3. Landscaping and Biodiversity

Landscaping is being proposed for the front gardens and the rear gardens. The landscaping will consist of native species and contribute towards the biodiversity of the site. Additionally bird/bat boxes will also be included in each dwelling. The exact location of the bird/bat boxes will be confirmed as the design progresses.

Fig1: Proposed Landscaping.

- **Biodiversity and Ecology**
  Full report completed separately.

3.4. Re-use of building

The London Plan encourages the re-use of existing buildings, however as this development results in the demolition of one dwelling to be replaced by a new larger family home. The diversion of materials from landfill shall be considered by the Main Contractor in their Site Waste Management Plan.

3.5. Energy and CO2 Emissions

An Energy Assessment has been prepared by **Leema Technologies Ltd** for the proposed development at **62 Avenue Road**, Camden. It sets out the energy efficiency and carbon reduction measures that will be incorporated into the development.
Energy efficiency measures will be implemented to provide carbon savings of **25.1%** in comparison to a baseline building that is fully compliant with the standard set by Part L 2010. The energy efficiency measures include: improved fabric insulation; improved air tightness; Improvements to Thermal Bridging and the use of Photovoltaic panels. This will ensure the development achieves part L2010 compliance through energy efficiency measures alone.
The proposed development is to have localised heating and hot water systems. It is considered the development infrastructure is not adequate to provide centralized heating and hot water from CHP and concerns over pollution to the air quality have also steered the development away from this solution.

For the purposes of this development, CHP has been considered but disregarded due to the factors outlined above.

The London Heat Map has been utilised to check if the development can connect into an existing distribution network. Currently there are no existing or proposed heat distribution networks in the vicinity. The development will not be provided with a communal heating system due to the technical and management disadvantages.

3.6. Overheating

The glazing on the rear elevation shall be set back to reduce solar gain. Additionally the glazing shall be specified to performance levels that will help reduce solar gain.

Internal blinds shall also be specified to the glazing of the rear elevation. The dual aspect of the dwelling will allow for adequate cross ventilation to counterbalance the solar gain.

3.7. Water Efficiency

- **Water Consumption**
  Water consumption shall meet the requirements of the London Plan policy and the London Borough of Camden Local plan to ensure that water consumption would be no more than 125L/per person/ per day. This will be achieved by specifying low water flow rate sanitary ware and domestic white goods.

- **Water Monitoring**
  A water meter shall be specified to monitor the water supply to each dwelling.

3.8. Materials and Waste

- **Household Waste and Recycling**
  Internal recycling and refuse bins shall be provided in the kitchen.

- **Construction Waste**
  The Main Contractor shall be required to prepare a Construction Method Statement which shall include a Site Waste Management Plan. This plan shall also include the excavation waste generated in the construction of the basement and demolition waste generated from the demolition of the existing dwelling and ancillary buildings. The Main Contractor shall ensure that as much of the waste as possible is re-used where possible and/or diverted from landfill.

- **Green Guide Rating of Major Building Elements**
  Environmentally low impact materials will be specified for the building envelope elements (roof, windows, internal walls, external walls and upper and ground floors) using the BRE Green Guide.

- **Sustainably Sourced Timber**
  Timber and wood-derived products will be sourced in accordance with UK Governments Timber Procurement Policy and have FSC certification.

- **Insulation**
  All insulation used in the building fabric and building services shall have low Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP). Additionally all insulation shall have a Green Guide Rating of A/A+ and be responsibly sourced.

3.9. Public Transport, Cycling & Walking

- **Cycling**
  Dedicated cycle storage is being provided within the basement / lower ground level of the dwelling.

- **Public Transport**
  The site is located in an area with excellent transport links. The site has access to several bus services and tube stations within the immediate vicinity. With South Hempstead Train Station less than a kilometre away.

- **Walking and Amenities**
  The local area is largely residential and offers a variety of shops and local amenities. The site is also well situated in terms of access to public space; being a short distance from Regents Park. The site, amenities and public transport are all accessible along safe pedestrian routes.

3.10. Light Pollution

Lighting will be appropriate for the intended use; provide the minimum amount of light necessary to achieve its purpose; provide adequate protection from glare and light spill and be energy efficient.

3.11. Site Contamination

There is no change of use on this site, a dwelling was previously located on this site. A site contamination investigation was not considered applicable to this development.

3.12. Noise from Plant

There is no external mechanical equipment being specified as part of this development.

3.13. Air Pollution

The Main Contractor shall conduct a pre-construction dust monitoring risk assessment, using competent person(s) in line with Best Practice Guidance ensuring that suitable, adequate and effective mitigation control measures are implemented where there is a potential for dust / odour and NOx emissions.
Any systems installed in the dwelling (gas boilers) shall have low emissions.

3.14. Amenity Space

The proposed dwelling shall be provided with accessible and private amenity space.

4. Technical Detail

In addition to this document which sets out the overarching strategy and targets a separate Technical Appendix has been provided which give additional detail on how key targets are to be met.
This document includes:

Appendix	Details
Energy Statement	Summarises the energy strategy for the Re-development detailing the embracement of the energy hierarchy to deliver significant reduction in associated site-wide CO2 emissions.

Flexibility through the detailed design process is important and so the information in these sections is provided only to show how the targets could be achieved and are based upon the design proposals as they stand. These documents do not represent a firm commitment to use the exact specifications shown; rather they are put forward to give an indication of how the targets set out in this document can be achieved.

5. Conclusion

5.1 Summary

- The proposed redevelopment at 62 Avenue Road has sustainability at the core of its design principles.
- Design principles address the need to tackle climate change and energy consumption, community cohesion, place-making, transport, resources and sustainable construction.
- The proposed development will meet good and best practice in terms of sustainable construction methods.

5.2 Conclusion

This Sustainability Statement has demonstrated how redevelopment at 62 Avenue Road meets planning policy sustainability requirements at the National, Regional and Local level. The application has been shown to be a sustainable development that commits to apply sustainable principles and practices.

The client recognises the importance of ensuring development is sustainable and as outlined in the Sustainability Statement proposes measures to address relevant policy targets across a wide range of issues including energy consumption and CO^2 emissions, sustainable construction, water management, waste management, place-making and community cohesion.

The proposed redevelopment aspires to provide a high quality development that serves the local community and aids the region’s commitment to meeting on-going sustainability targets. The measures proposed in the Sustainability Statement support the delivery of sustainable practices during the construction and occupation phases and therefore contribute to local sustainability targets.

APPENDICES

Appendix A: Energy Statement

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Appendix A

Energy Statement:

62 Avenue Road, St Johns Wood, Camden, NW8 6HT

Planning Ref No: 2016/4931/P

Client: V V Media

Date: 28th Jan 2017

CONTENTS

1.0 Executive Summary

The proposed development of a new 4 storey family home set over Basement, Lower Ground, Ground and first floor levels at **62 Avenue Road, St Johns Wood, Camden, NW8 6HT** is required to achieve a minimum 20**%** reduction in Regulated Carbon Emissions against Part L 2010.

The Baseline carbon emissions derived from the SAP calculations (using SAP 2009) confirms total carbon emissions of 13.13 tonnes CO_2/pa for Hierarchy A.

Applying a range of energy demand reduction techniques such as significant improvements in the insulation levels to the building envelope, air tightness, reducing heat loss through thermal bridging, utilising highly efficient boilers with modern controls, and the use of Photovoltaic panels we are able to reduce the carbon emissions by 25.1% to 9.84 tonnes CO_2/pa for Hierarchy B.

Combined Heat and Power is discounted due to lack of onsite infrastructure and the scale of the development. District Heating is also not a viable option for this development

This results in a total reduction of 3.29 tonnes CO_2/annum.

Air pollution is minimized through the use of low NOx boilers that have 40% lower NOx emissions than Code for Sustainable Homes best practice.

2.0 Introduction

The proposed development of a new family home at 62 Avenue Road is required to achieve a 20% reduction in Regulated Carbon Emissions over Part L 2010 Baseline regulations.

This report is based upon the requirements set out in 'Energy Planning: Greater London Authority guidance on preparing energy assessments (April 2014)' and in line with the London Borough of Camden Policies.

Please note, the Code for Sustainable Homes has been deregulated, and therefore excluded from this assessment.

This will report will outline the following requirements:

a) Calculate the Baseline carbon emissions (Target Emission Rate) using SAP 2010. (HIERARCHY A)
b) Provide a specification to achieve an 'energy demand reduction' to reduce carbon emissions. (HIERARCHY B)
c) Review Combined Heat & Power. (HIERARCHY C)
d) Review local district heating systems

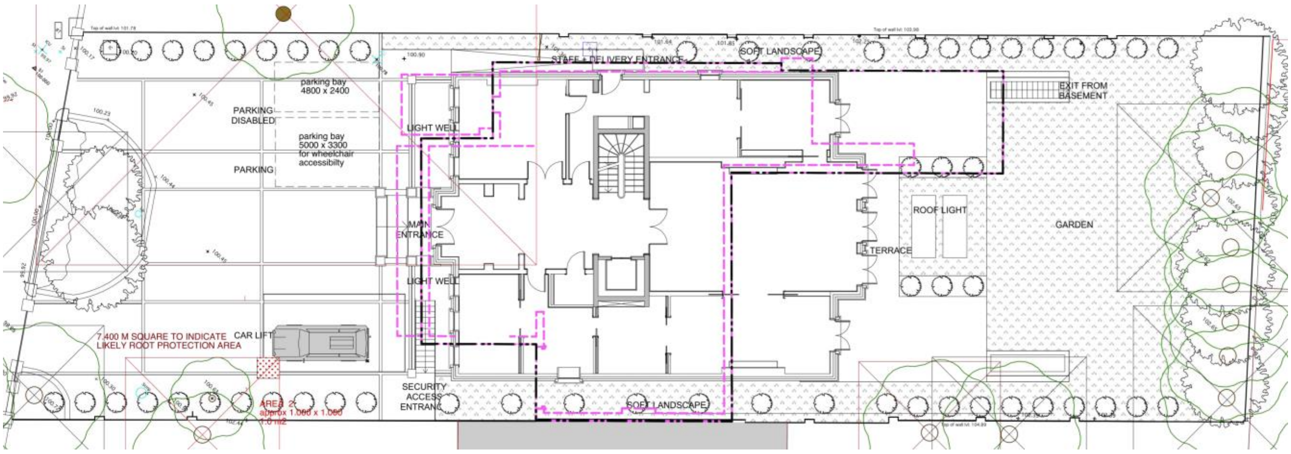
e) Review and implement renewable energy technology to further reduce carbon emissions. (HIERARCHY D)
f) Summarise the findings to confirm a minimum of 20% reduction in annual carbon emissions in line with the Energy Hierarchy is achievable with the proposed development.

This report will start with the proposed methods of reducing carbon emissions using a fabric first approach, energy efficiency and then finally, renewable energy technology.

It will also consider other factors such as air pollution.

The proposed dwellings will be assessed using SAP 2009 (Part L 2010) On-Construction Domestic Energy Assessor and non-domestic energy assessor.

The site plan is outlined below in figure 1:



3.0 Energy Statement

3.1 Carbon emissions of the Baseline development and energy demand reduction: (Hierarchy A & B)

The Baseline scenario will use the input information to achieve the 'energy demand reduction' for the development. SAP 2009 will then calculate the baseline carbon emissions using the Target Emission Rate (TER) and the 'energy demand reduction' carbon emissions based (Dwelling Emission Rate or DER) upon the results for the dwelling.

The current input specification is as follows:

Table 1: Proposed U values for the building envelope

Element	Building Regs (W/m2.K)	Proposed (W/m2.K)	Improvement
Walls	**0.30 W/m^2.K**	**0.20 W/m^2.K**	**33%**
Mansard	**0.20 W/m².K**	**0.15 W/m^2.K**	**25%**
Roof	**0.20 W/m^2.K**	**0.10 W/m^2.K**	**50%**
Floor	**0.25 W/m^2.K**	**0.11 W/m^2.K**	**56%**
Windows	**2.00 W/m^2.K**	**1.4 W/m^2.K**	**30%**
Doors	**2.00 W/m^2.K**	**1.8 W/m^2.K**	**10%**

The proposed dwelling is to exceed the current building regulations Part L1a by 34% on the fabric values. In addition, the target design air permeability is to be 5m^3/hr/m^2. This is a 50% improvement on current building regulation values.

Thermal bridge is an area of building fabric that is less well insulated than surrounding areas, and therefore allows a greater rate of heat loss, as a result of the construction of the building; thermal bridges typically occur where structural members penetrate through insulation layers, at corners and junctions between elements (i.e. between floors, walls and roofs) and around openings such as windows and external doors.

In order to combat this the design of the dwelling will consider the impact and will adopt thermal bridging measures such as Accredited Construction Detail. This format will aim to reduce the thermal bridging by 50%.

The baseline results (TER) result in total carbon emissions of 13.13 tonnes CO_2 /annum. To achieve a 20% reduction, then the development therefore needs to achieve a total reduction of 3.2 tonnes CO_2 /annum.

The proposed input data outlined in Table 1 results using the DER multiplied by the floor area achieve a total of 9.84 tonnes CO_2 /annum. This is a reduction of 3.3 tonnes CO_2 /annum, equivalent to a reduction of 25.05%.

3.2 Combined Heat & Power and District Heating: (Hierarchy C)

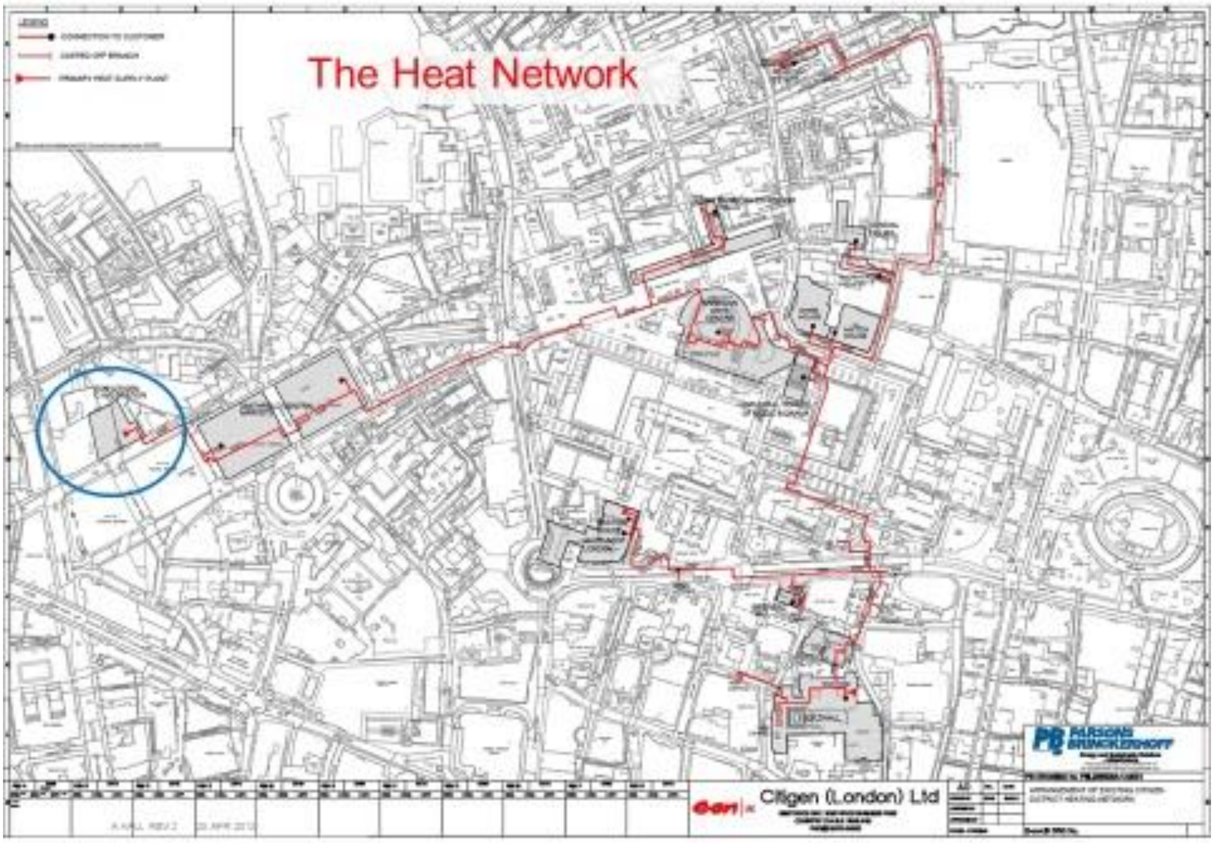
The proposed development is to have on-site heating and hot water systems. it is considered the development infrastructure is not adequate to provide centralized heating and hot water from

CHP and concerns over pollution to the air quality have also steered the development away from this solution.

For the purposes of this development, CHP has been considered but disregarded due to the factors outlined above.

Consideration for district heating has been researched. Referring to the Heat Map (http://www.londonheatmap.org.uk) in figure 2, we can see the current district heating by the North Circular Road (red circle), this is approximately 2 miles from the proposed site.

Figure 2: District heat network local to the site



At this stage, the proposed development is decentralized but could be adapted in the future should the district heating system be implemented.

3.3 Renewable Energy (Hierarchy D)

The project team wishes to utilise Photovoltaic panels (PV) to provide renewable energy for the development.

Air source heat pumps are currently discounted due to the fact that they are ineffective at significantly reducing on-site carbon emissions

Wind turbines are not viable in this built up area and biomass fired boilers are likely to increase local air pollution and infrastructure for storage and delivery is not adequate given the nature of the development and location.

Biomass boilers can cause air pollution issues so have been discounted. See Appendix A for further details.

3.3.1 Photovoltaic panels

Photovoltaic (PV) systems generate electricity from sunshine (direct or indirect).

This development benefits from a tall building with horizontal roof-space, so the panels can be angled to the south for maximum effect.

For this development, it is proposed to apply a PV system to meet and exceed the required 20% reduction in carbon emissions.

Figure 2: Typical PV installation to pitched roof

It has been calculated that a 2kWp PV system (4 PV panels at 250W each) at an angle of 30 degrees, south facing will reduce the carbon emissions by a further 5.1% to annual carbon emissions of 9.84tonnes CO_2/year for Hierarchy D.

See Appendix B for SAP calculations.

3.4 Results

The results for each Hierarchy (excluding Hierarchy C) are summarised in table 4 below:

Table 4: Summary of results for each Hierarchy (A, B & D)

Regulated Carbon dioxide emissions and savings			
Hierarchy	Total regulated emissions (Tonnes Co2/year)	Co2 Savings (Tonnes CO2/year)	Percentage saving
Building Regulations 2010 Part L	**13.13**	**NA**	**NA**
Energy demand reductions	**10.51**	**2.62**	**19.9%**
After CHP	**10.51**	**0.0**	**0.0%**
After Low to Zero Carbon Technologies	**9.84**	**3.29**	**25.05%**

Baseline Hierarchy A (Target Emission rate) achieves 13.13CO_2/annum for the Baseline.

Applying the energy demand reduction (Hierarchy B) features (indicated in Tables 1 and 2), reduces the carbon emissions by 19.9% to 10.51tonnes CO_2/annum. *(See Appendix A for SAPs)*

No CHP or district heating has been applied so there is no benefit from Hierarchy C.

For renewable energy, apply 2kWp PV via 4 Photovoltaic panels located on the roof provides a further reduction 0.67tonnes CO_2/annum for Hierarchy D. *(See Appendix B for SAPs with PV)*

The results indicate the total carbon dioxide savings are 25.05%.

3.5 Air pollution

The only potential source of pollution from the development is the gas fired system boilers.

The boilers have been selected for the excellent efficient, but also the low NOx emissions (Nitrogen Oxide).

The Code for Sustainable Homes awards full credits if the NOx emissions are below 40 mg/kWh. The proposed Ideal Logix + System 18 boiler has dry NOx emissions of 24mg/kWh. This is 40% better than the Code for Sustainable Homes best practice.

4.0 Summary

The proposed development 62 Avenue Road, Camden, NW8 6HT is required to achieve a minimum 20% reduction in Regulated Carbon Emissions against Part L 2010.

Please note, the Code for Sustainable Homes has been deregulated, and therefore excluded from this assessment.

The Baseline carbon emissions derived from the SAP calculations (using SAP 2009) confirms total carbon emissions of 13.13tonnes CO_2/annum for Hierarchy A.

Applying a range of energy demand reduction techniques such as significant improvements in the insulation levels to the building envelope, air tightness, reducing heat loss through thermal bridging and utilising highly efficient boilers with modern controls reduce the carbon emissions by 19.9% to 10.51tonnes CO_2/annum for Hierarchy B.

The building fabric has an improvement of 34% over Part L 2010.

Combined Heat and Power is discounted due to lack of onsite infrastructure and the scale of the development. District Heating is approximately 2 miles from the site and cannot currently be connected.

Applying 2kwp Photovoltaic array of panels to the flat roof, facing south, provides a further reduction of 5.15% in carbon emissions to 9.84tonnes CO_2/annum for Hierarchy D.

This results in a total reduction of 3.29tonnes CO_2/annum which achieves a cumulative reduction of 25.05%.

Air pollution is minimized through the use of low NOx boilers that have 40% lower NOx emissions than Code for Sustainable Homes best practice.

5.0 Notes

This report has been generated for the purpose of demonstrating how the proposed development can achieve a minimum 20% reduction in regulated carbon emissions. The developed detail design may result in different solutions.

This is not a design report or specification. Leema Technologies Ltd recommends that the client appoints a specialist engineer to advise and design an integrated heating and hot water system and photovoltaic panels system that will allow the energy generation to achieve the required energy generation on site to satisfy the Planning Condition that may be associated with any Planning Permission granted and meet all requirements of Building Regulations.

The results of this report are based on the following drawing references provided by BB Partnership Architects Limited:-

EZR-32	Proposed Basement
EZR-33	Proposed Lower Ground
EZR-34	Proposed Ground Floor
EZR-35	Proposed 1st Floor Plan
EZR-36	Proposed 2nd Floor Plan
EZR-37	Proposed Front Elevation
EZR-38	Proposed Rear Elevation
EZR-39	Proposed Side Elevation
EZR-40	Proposed Side Elevation
EZR-41	Proposed Section AA
EZR-42	Proposed Section BB
EZR-43	Proposed Site Plans

SAP assessments were carried out by accredited Energy Assessor (Mark Fagan: Leema Technologies Ltd) using SAP 2009.

Floor areas have been calculated from the drawings provided.

A full energy assessment for the whole building will be required to meet Part L 2010. At this stage, the client and design team should review the information and ensure the targets are met in accordance with the Planning Policy targets set.

Appendix A: SAP Calculations

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.95

Property Address: 62 AVENUE ROAD Mark Base

Address : 62, Avenue Road, LONDON, NW8 6HT

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Basement	382.22	(1a)	x	3.2	(2a)	=	1223.1	(3a)
Ground floor	319.56	(1b)	x	3.2	(2b)	=	1022.59	(3b)
First floor	301.73	(1c)	x	3	(2c)	=	905.19	(3c)
Second floor	219.26	(1d)	x	2.8	(2d)	=	613.93	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	1222.77	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	3764.81	(5)

2. Ventilation rate:

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.01	(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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.51	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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

0.58	0.55	0.55	0.49	0.44	0.42	0.4	0.4	0.45	0.49	0.52	0.55

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=	0.67	0.65	0.65	0.62	0.6	0.59	0.58	0.58	0.6	0.62	0.63	0.65	(24d)

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

(25)m=	0.67	0.65	0.65	0.62	0.6	0.59	0.58	0.58	0.6	0.62	0.63	0.65	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.85	x	2	=	3.7			(26)
Windows			303.8425	x	1/[1/(2)+ 0.04]	=	562.67			(27)
Floor Type 1			382.22	x	0.25	=	95.56			(28)
Floor Type 2			319.56	x	0.25	=	79.89			(28)
Walls	978.5	305.69	672.81	x	0.35	=	235.48			(29)
Roof Type1	62.66	0	62.66	x	0.16	=	10.03			(30)
Roof Type2	158.87	0	158.87	x	0.16	=	25.42			(30)
Total area of elements, m²			1901.81							(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) = 1012.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 54627.2699 (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.

TER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K | 209.2 | (36)

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

Total fabric heat loss (33) + (36) = | 1221.94 | (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=	832.25	809.45	809.45	767.76	742.87	731.28	720.28	720.28	748.87	767.76	787.96	809.45	(38)

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

(39)m=	2054.2	2031.4	2031.4	1989.71	1964.81	1953.23	1942.23	1942.23	1970.82	1989.71	2009.9	2031.4	

Average = $Sum(39)_{1...12}$ /12= | 1992.58 | (39)

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

(40)m=	1.68	1.66	1.66	1.63	1.61	1.6	1.59	1.59	1.61	1.63	1.64	1.66	

Average = $Sum(40)_{1...12}$ /12= | 1.63 | (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 | 4.33 | (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 | 144.29 | (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=	158.72	152.95	147.17	141.4	135.63	129.86	129.86	135.63	141.4	147.17	152.95	158.72	

Total = $Sum(44)_{1...12}$ = | 1731.46 | (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=	235.94	206.35	212.94	185.64	178.13	153.71	142.44	163.45	165.4	192.76	210.41	228.49	

Total = $Sum(45)_{1...12}$ = | 2275.65 | (45)

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

(46)m=	35.39	30.95	31.94	27.85	26.72	23.06	21.37	24.52	24.81	28.91	31.56	34.27	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (47)

Temperature factor from Table 2b | 0 | (48)

Energy lost from water storage, kWh/year (47) x (48) = | 0 | (49)

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

Cylinder volume (litres) including any solar storage within same | 150 | (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

Volume factor from Table 2a | 0.93 | (52)

Temperature factor from Table 2b | 0.54 | (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = | 1.44 | (54)

Enter (49) or (54) in (55) | 1.44 | (55)

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

(56)m=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(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=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(57)

Primary circuit loss (annual) from Table 3 610 (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=	51.81	46.79	51.81	50.14	51.81	50.14	51.81	51.81	50.14	51.81	50.14	51.81	(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=	332.27	293.36	309.27	278.87	274.46	246.94	238.77	259.78	258.63	289.09	303.64	324.83	(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=	332.27	293.36	309.27	278.87	274.46	246.94	238.77	259.78	258.63	289.09	303.64	324.83

Output from water heater (annual)$_{1...12}$ 3409.93 (64)

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

(65)m=	155.52	138.22	147.87	136.31	136.3	125.69	124.43	131.42	129.58	141.16	144.54	153.04	(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=	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	(66)

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

(67)m=	156.94	139.39	113.36	85.82	64.15	54.16	58.52	76.07	102.1	129.64	151.31	161.3	(67)

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

(68)m=	1035.53	1046.28	1019.2	961.55	888.78	820.39	774.7	763.95	791.03	848.68	921.45	989.84	(68)

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

(69)m=	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	(71)

Water heating gains (Table 5)

(72)m=	209.03	205.69	198.75	189.32	183.19	174.57	167.24	176.63	179.97	189.73	200.76	205.7	(72)

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

(73)m=	1499.47	1489.33	1429.28	1334.66	1234.1	1147.1	1098.44	1114.63	1171.08	1266.02	1371.49	1454.82	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	303.84	x	19.87	x	0.72	x	0.7	=	2108.95	(76)
East	0.9x	1	x	303.84	x	38.52	x	0.72	x	0.7	=	4087.74	(76)
East	0.9x	1	x	303.84	x	61.57	x	0.72	x	0.7	=	6533.53	(76)
East	0.9x	1	x	303.84	x	91.41	x	0.72	x	0.7	=	9700.74	(76)
East	0.9x	1	x	303.84	x	111.22	x	0.72	x	0.7	=	11803.04	(76)
East	0.9x	1	x	303.84	x	116.05	x	0.72	x	0.7	=	12315.87	(76)
East	0.9x	1	x	303.84	x	112.64	x	0.72	x	0.7	=	11953.95	(76)
East	0.9x	1	x	303.84	x	98.03	x	0.72	x	0.7	=	10403.79	(76)
East	0.9x	1	x	303.84	x	73.6	x	0.72	x	0.7	=	7811.1	(76)
East	0.9x	1	x	303.84	x	46.91	x	0.72	x	0.7	=	4978.1	(76)
East	0.9x	1	x	303.84	x	24.71	x	0.72	x	0.7	=	2621.97	(76)
East	0.9x	1	x	303.84	x	16.39	x	0.72	x	0.7	=	1739.68	(76)

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

(83)m=	2108.95	4087.74	6533.53	9700.74	11803.04	12315.87	11953.95	10403.79	7811.1	4978.1	2621.97	1739.68	(83)

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

(84)m=	3608.42	5577.07	7962.81	11035.41	13037.14	13462.97	13052.39	11518.42	8982.18	6244.13	3993.46	3194.49	(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	0.9	0.77	0.57	0.63	0.92	0.99	1	1	(86)

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

(87)m=	18.88	19.11	19.53	20.03	20.54	20.84	20.96	20.95	20.65	20	19.3	18.93	(87)

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

(88)m=	19.56	19.57	19.57	19.6	19.61	19.62	19.63	19.63	19.61	19.6	19.59	19.57	(88)

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

(89)m=	1	1	0.99	0.96	0.86	0.66	0.4	0.45	0.85	0.99	1	1	(89)

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

(90)m=	17.65	17.88	18.31	18.82	19.3	19.55	19.62	19.62	19.41	18.8	18.08	17.7	(90)

fLA = Living area ÷ (4) = 0.04 (91)

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

(92)m=	17.7	17.93	18.36	18.87	19.35	19.6	19.67	19.67	19.46	18.85	18.13	17.75	(92)

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

(93)m=	17.7	17.93	18.36	18.87	19.35	19.6	19.67	19.67	19.46	18.85	18.13	17.75	(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

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	1	0.99	0.95	0.85	0.65	0.41	0.45	0.84	0.98	1	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	3606.82	5564.66	7874.57	10519.98	11051.81	8801.43	5288.22	5232.05	7553.31	6141.07	3988.89	3193.51	(95)

Monthly average external temperature from Table 8

(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	27107.43	26275.18	23473.32	20226.2	15039.69	9771.44	5388.64	5381.36	10168.74	16009.26	22378.56	26110.32	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	17484.46	13917.47	11605.47	6988.48	2966.98	0	0	0	0	7341.93	13240.56	17050.11

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 90595.46 (98)

Space heating requirement in kWh/m²/year 74.09 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0.1	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	0.9	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	0.9	(204)
Efficiency of main space heating system 1		78.9	(206)
Efficiency of secondary/supplementary heating system, %		100	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	17484.46	13917.47	11605.47	6988.48	2966.98	0	0	0	0	7341.93	13240.56	17050.11		
(211)m = {[(98)m x (204)]} x 100 ÷ (206)														(211)
	19944.25	15875.45	13238.18	7971.65	3384.39	0	0	0	0	8374.82	15103.3	19448.79		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													103340.83	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	1748.45	1391.75	1160.55	698.85	296.7	0	0	0	0	734.19	1324.06	1705.01		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													9059.55	(215)

Water heating

Output from water heater (calculated above)														
	332.27	293.36	309.27	278.87	274.46	246.94	238.77	259.78	258.63	289.09	303.64	324.83		
Efficiency of water heater													68.8	(216)
(217)m=	78.66	78.64	78.57	78.41	77.83	68.8	68.8	68.8	68.8	78.42	78.61	78.66		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	422.41	373.07	393.63	355.65	352.62	358.92	347.05	377.59	375.91	368.66	386.24	412.95		
Total = Sum(219a)$_{1...12}$ =													4524.72	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		103340.83
Space heating fuel used, secondary		9059.55
Water heating fuel used		4524.72
Electricity for pumps, fans and electric keep-hot		

central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			2771.63	(232)

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	0.194	=	20048.12	(261)
Space heating (secondary)	(215) x	0.422	=	3823.13	(263)
Water heating	(219) x	0.194	=	877.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			24749.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.422	=	73.85	(267)
Electricity for lighting	(232) x	0.422	=	1169.63	(268)
Total CO2, kg/year		sum of (265)…(271) =		25992.52	(272)

TEI (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2009

Software Version: Version: 1.5.0.95

Property Address: 62 AVENUE ROAD Mark Lean

Address : 62, Avenue Road, LONDON, NW8 6HT

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Basement	382.22	(1a)	x	3.2	(2a)	=	1223.1	(3a)
Ground floor	319.56	(1b)	x	3.2	(2b)	=	1022.59	(3b)
First floor	301.73	(1c)	x	3	(2c)	=	905.19	(3c)
Second floor	219.26	(1d)	x	2.8	(2d)	=	613.93	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	1222.77	(4)						
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =					3764.81	(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)

			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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.21	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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

	0.29	0.27	0.27	0.24	0.22	0.21	0.2	0.2	0.22	0.24	0.26	0.27

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=	0.54	0.54	0.54	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.54	(24d)

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

(25)m=	0.54	0.54	0.54	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	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 Type 1			3.09	x 1.8	= 5.562			(26)
Doors Type 2			2.4	x 1.8	= 4.32			(26)
Doors Type 3			2.69	x 1.8	= 4.842			(26)
Windows Type 1			3.356	x1/[1/(1.4)+ 0.04]	= 4.45			(27)
Windows Type 2			2.41	x1/[1/(1.4)+ 0.04]	= 3.2			(27)
Windows Type 3			1.35	x1/[1/(1.4)+ 0.04]	= 1.79			(27)
Windows Type 4			4.69	x1/[1/(1.4)+ 0.04]	= 6.22			(27)
Windows Type 5			2.34	x1/[1/(1.4)+ 0.04]	= 3.1			(27)
Windows Type 6			3.36	x1/[1/(1.4)+ 0.04]	= 4.45			(27)
Windows Type 7			1.4	x1/[1/(1.4)+ 0.04]	= 1.86			(27)
Windows Type 8			1.83	x1/[1/(1.4)+ 0.04]	= 2.43			(27)
Windows Type 9			2.4	x1/[1/(1.4)+ 0.04]	= 3.18			(27)
Windows Type 10			2.42	x1/[1/(1.4)+ 0.04]	= 3.21			(27)
Windows Type 11			1.81	x1/[1/(1.4)+ 0.04]	= 2.4			(27)

DER WorkSheet: New dwelling design stage

Windows Type 12			1.28	x1/[1/(1.4)+ 0.04]		=	1.7				(27)
Windows Type 13			1.37	x1/[1/(1.4)+ 0.04]		=	1.82				(27)
Windows Type 14			2.38	x1/[1/(1.4)+ 0.04]		=	3.16				(27)
Rooflights			6.13	x1/[1/(1.4) + 0.04]		=	8.582				(27b)
Floor Type 1			382.22	x	0.11	=	42.04				(28)
Floor Type 2			319.56	x	0.11	=	35.15				(28)
Walls Type1	765.4	94.8	670.6	x	0.2	=	134.12				(29)
Walls Type2	213.1	15.81	197.29	x	0.15	=	29.59				(29)
Roof Type1	62.66	6.13	56.53	x	0.1	=	5.65				(30)
Roof Type2	158.87	0	158.87	x	0.1	=	15.89				(30)
Total area of elements, m²			1901.81								(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) =	421.09	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	67747.9783	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(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		76.07	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	497.17	(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=	672.32	666.79	666.79	656.7	650.67	647.86	645.2	645.2	652.12	656.7	661.59	666.79	(38)

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

(39)m=	1169.48	1163.96	1163.96	1153.86	1147.83	1145.03	1142.36	1142.36	1149.29	1153.86	1158.75	1163.96

Average = Sum(39)$_{1…12}$ /12= 1154.56 (39)

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

(40)m=	0.96	0.95	0.95	0.94	0.94	0.94	0.93	0.93	0.94	0.94	0.95	0.95

Average = Sum(40)$_{1…12}$ /12= 0.94 (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 4.33 (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) + 36 144.29 (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=	158.72	152.95	147.17	141.4	135.63	129.86	129.86	135.63	141.4	147.17	152.95	158.72

Total = Sum(44)$_{1…12}$ = 1731.46 (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=	235.94	206.35	212.94	185.64	178.13	153.71	142.44	163.45	165.4	192.76	210.41	228.49	

Total = Sum(45)$_{1...12}$ = 2275.65 (45)

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

(46)m=	35.39	30.95	31.94	27.85	26.72	23.06	21.37	24.52	24.81	28.91	31.56	34.27	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.5 (47)

Temperature factor from Table 2b 0.54 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0.81 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0.81 (55)

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

(56)m=	25.11	22.68	25.11	24.3	25.11	24.3	25.11	25.11	24.3	25.11	24.3	25.11	(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=	25.11	22.68	25.11	24.3	25.11	24.3	25.11	25.11	24.3	25.11	24.3	25.11	(57)

Primary circuit loss (annual) from Table 3 360 (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=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(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=	291.62	256.65	268.62	239.53	233.81	207.6	198.12	219.13	219.29	248.44	264.3	284.18	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	291.62	256.65	268.62	239.53	233.81	207.6	198.12	219.13	219.29	248.44	264.3	284.18

Output from water heater (annual)$_{1...12}$ 2931.3 (64)

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

(65)m=	123	108.85	115.35	104.84	103.78	94.22	91.91	98.89	98.11	108.64	113.07	120.52	(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=	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	(66)

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

(67)m=	108.98	96.79	78.72	59.59	44.55	37.61	40.64	52.82	70.9	90.02	105.07	112.01	(67)

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

(68)m=	1035.53	1046.28	1019.2	961.55	888.78	820.39	774.7	763.95	791.03	848.68	921.45	989.84	(68)

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

(69)m=	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	(71)

Water heating gains (Table 5)

(72)m=	165.32	161.98	155.04	145.61	139.48	130.86	123.53	132.92	136.26	146.02	157.05	161.99	(72)

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

(73)m=	1407.8	1403.02	1350.93	1264.73	1170.79	1086.83	1036.84	1047.67	1096.16	1182.69	1281.53	1361.81	(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)	
Northeast	0.9x	0.77	x	4.69	x	11.51	x	0.63	x	0.7	=	82.49	(75)
Northeast	0.9x	0.77	x	2.34	x	11.51	x	0.63	x	0.7	=	16.46	(75)
Northeast	0.9x	0.77	x	3.36	x	11.51	x	0.63	x	0.7	=	35.46	(75)
Northeast	0.9x	0.77	x	1.4	x	11.51	x	0.63	x	0.7	=	9.85	(75)
Northeast	0.9x	0.77	x	1.83	x	11.51	x	0.63	x	0.7	=	12.87	(75)
Northeast	0.9x	0.77	x	2.4	x	11.51	x	0.63	x	0.7	=	8.44	(75)
Northeast	0.9x	0.77	x	2.42	x	11.51	x	0.63	x	0.7	=	17.02	(75)
Northeast	0.9x	0.77	x	1.81	x	11.51	x	0.63	x	0.7	=	6.37	(75)
Northeast	0.9x	0.77	x	4.69	x	23.55	x	0.63	x	0.7	=	168.81	(75)
Northeast	0.9x	0.77	x	2.34	x	23.55	x	0.63	x	0.7	=	33.69	(75)
Northeast	0.9x	0.77	x	3.36	x	23.55	x	0.63	x	0.7	=	72.56	(75)
Northeast	0.9x	0.77	x	1.4	x	23.55	x	0.63	x	0.7	=	20.16	(75)
Northeast	0.9x	0.77	x	1.83	x	23.55	x	0.63	x	0.7	=	26.35	(75)
Northeast	0.9x	0.77	x	2.4	x	23.55	x	0.63	x	0.7	=	17.28	(75)
Northeast	0.9x	0.77	x	2.42	x	23.55	x	0.63	x	0.7	=	34.84	(75)
Northeast	0.9x	0.77	x	1.81	x	23.55	x	0.63	x	0.7	=	13.03	(75)
Northeast	0.9x	0.77	x	4.69	x	41.13	x	0.63	x	0.7	=	294.74	(75)
Northeast	0.9x	0.77	x	2.34	x	41.13	x	0.63	x	0.7	=	58.82	(75)
Northeast	0.9x	0.77	x	3.36	x	41.13	x	0.63	x	0.7	=	126.69	(75)
Northeast	0.9x	0.77	x	1.4	x	41.13	x	0.63	x	0.7	=	35.19	(75)
Northeast	0.9x	0.77	x	1.83	x	41.13	x	0.63	x	0.7	=	46	(75)
Northeast	0.9x	0.77	x	2.4	x	41.13	x	0.63	x	0.7	=	30.17	(75)

Northeast 0.9x	0.77	x	2.42	x	41.13	x	0.63	x	0.7	=	60.83	(75)
Northeast 0.9x	0.77	x	1.81	x	41.13	x	0.63	x	0.7	=	22.75	(75)
Northeast 0.9x	0.77	x	4.69	x	67.8	x	0.63	x	0.7	=	485.88	(75)
Northeast 0.9x	0.77	x	2.34	x	67.8	x	0.63	x	0.7	=	96.97	(75)
Northeast 0.9x	0.77	x	3.36	x	67.8	x	0.63	x	0.7	=	208.86	(75)
Northeast 0.9x	0.77	x	1.4	x	67.8	x	0.63	x	0.7	=	58.02	(75)
Northeast 0.9x	0.77	x	1.83	x	67.8	x	0.63	x	0.7	=	75.83	(75)
Northeast 0.9x	0.77	x	2.4	x	67.8	x	0.63	x	0.7	=	49.73	(75)
Northeast 0.9x	0.77	x	2.42	x	67.8	x	0.63	x	0.7	=	100.28	(75)
Northeast 0.9x	0.77	x	1.81	x	67.8	x	0.63	x	0.7	=	37.5	(75)
Northeast 0.9x	0.77	x	4.69	x	89.77	x	0.63	x	0.7	=	643.32	(75)
Northeast 0.9x	0.77	x	2.34	x	89.77	x	0.63	x	0.7	=	128.39	(75)
Northeast 0.9x	0.77	x	3.36	x	89.77	x	0.63	x	0.7	=	276.53	(75)
Northeast 0.9x	0.77	x	1.4	x	89.77	x	0.63	x	0.7	=	76.81	(75)
Northeast 0.9x	0.77	x	1.83	x	89.77	x	0.63	x	0.7	=	100.41	(75)
Northeast 0.9x	0.77	x	2.4	x	89.77	x	0.63	x	0.7	=	65.84	(75)
Northeast 0.9x	0.77	x	2.42	x	89.77	x	0.63	x	0.7	=	132.78	(75)
Northeast 0.9x	0.77	x	1.81	x	89.77	x	0.63	x	0.7	=	49.65	(75)
Northeast 0.9x	0.77	x	4.69	x	97.5	x	0.63	x	0.7	=	698.76	(75)
Northeast 0.9x	0.77	x	2.34	x	97.5	x	0.63	x	0.7	=	139.45	(75)
Northeast 0.9x	0.77	x	3.36	x	97.5	x	0.63	x	0.7	=	300.36	(75)
Northeast 0.9x	0.77	x	1.4	x	97.5	x	0.63	x	0.7	=	83.43	(75)
Northeast 0.9x	0.77	x	1.83	x	97.5	x	0.63	x	0.7	=	109.06	(75)
Northeast 0.9x	0.77	x	2.4	x	97.5	x	0.63	x	0.7	=	71.51	(75)
Northeast 0.9x	0.77	x	2.42	x	97.5	x	0.63	x	0.7	=	144.22	(75)
Northeast 0.9x	0.77	x	1.81	x	97.5	x	0.63	x	0.7	=	53.93	(75)
Northeast 0.9x	0.77	x	4.69	x	92.98	x	0.63	x	0.7	=	666.35	(75)
Northeast 0.9x	0.77	x	2.34	x	92.98	x	0.63	x	0.7	=	132.99	(75)
Northeast 0.9x	0.77	x	3.36	x	92.98	x	0.63	x	0.7	=	286.43	(75)
Northeast 0.9x	0.77	x	1.4	x	92.98	x	0.63	x	0.7	=	79.56	(75)
Northeast 0.9x	0.77	x	1.83	x	92.98	x	0.63	x	0.7	=	104	(75)
Northeast 0.9x	0.77	x	2.4	x	92.98	x	0.63	x	0.7	=	68.2	(75)
Northeast 0.9x	0.77	x	2.42	x	92.98	x	0.63	x	0.7	=	137.53	(75)
Northeast 0.9x	0.77	x	1.81	x	92.98	x	0.63	x	0.7	=	51.43	(75)
Northeast 0.9x	0.77	x	4.69	x	75.42	x	0.63	x	0.7	=	540.49	(75)
Northeast 0.9x	0.77	x	2.34	x	75.42	x	0.63	x	0.7	=	107.87	(75)
Northeast 0.9x	0.77	x	3.36	x	75.42	x	0.63	x	0.7	=	232.33	(75)
Northeast 0.9x	0.77	x	1.4	x	75.42	x	0.63	x	0.7	=	64.54	(75)
Northeast 0.9x	0.77	x	1.83	x	75.42	x	0.63	x	0.7	=	84.36	(75)
Northeast 0.9x	0.77	x	2.4	x	75.42	x	0.63	x	0.7	=	55.32	(75)
Northeast 0.9x	0.77	x	2.42	x	75.42	x	0.63	x	0.7	=	111.56	(75)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.81	x	75.42	x	0.63	x	0.7	=	41.72	(75)
Northeast	0.9x	0.77	x	4.69	x	51.24	x	0.63	x	0.7	=	367.25	(75)
Northeast	0.9x	0.77	x	2.34	x	51.24	x	0.63	x	0.7	=	73.29	(75)
Northeast	0.9x	0.77	x	3.36	x	51.24	x	0.63	x	0.7	=	157.86	(75)
Northeast	0.9x	0.77	x	1.4	x	51.24	x	0.63	x	0.7	=	43.85	(75)
Northeast	0.9x	0.77	x	1.83	x	51.24	x	0.63	x	0.7	=	57.32	(75)
Northeast	0.9x	0.77	x	2.4	x	51.24	x	0.63	x	0.7	=	37.59	(75)
Northeast	0.9x	0.77	x	2.42	x	51.24	x	0.63	x	0.7	=	75.8	(75)
Northeast	0.9x	0.77	x	1.81	x	51.24	x	0.63	x	0.7	=	28.35	(75)
Northeast	0.9x	0.77	x	4.69	x	29.6	x	0.63	x	0.7	=	212.12	(75)
Northeast	0.9x	0.77	x	2.34	x	29.6	x	0.63	x	0.7	=	42.33	(75)
Northeast	0.9x	0.77	x	3.36	x	29.6	x	0.63	x	0.7	=	91.18	(75)
Northeast	0.9x	0.77	x	1.4	x	29.6	x	0.63	x	0.7	=	25.33	(75)
Northeast	0.9x	0.77	x	1.83	x	29.6	x	0.63	x	0.7	=	33.11	(75)
Northeast	0.9x	0.77	x	2.4	x	29.6	x	0.63	x	0.7	=	21.71	(75)
Northeast	0.9x	0.77	x	2.42	x	29.6	x	0.63	x	0.7	=	43.78	(75)
Northeast	0.9x	0.77	x	1.81	x	29.6	x	0.63	x	0.7	=	16.37	(75)
Northeast	0.9x	0.77	x	4.69	x	14.52	x	0.63	x	0.7	=	104.1	(75)
Northeast	0.9x	0.77	x	2.34	x	14.52	x	0.63	x	0.7	=	20.77	(75)
Northeast	0.9x	0.77	x	3.36	x	14.52	x	0.63	x	0.7	=	44.75	(75)
Northeast	0.9x	0.77	x	1.4	x	14.52	x	0.63	x	0.7	=	12.43	(75)
Northeast	0.9x	0.77	x	1.83	x	14.52	x	0.63	x	0.7	=	16.25	(75)
Northeast	0.9x	0.77	x	2.4	x	14.52	x	0.63	x	0.7	=	10.65	(75)
Northeast	0.9x	0.77	x	2.42	x	14.52	x	0.63	x	0.7	=	21.48	(75)
Northeast	0.9x	0.77	x	1.81	x	14.52	x	0.63	x	0.7	=	8.03	(75)
Northeast	0.9x	0.77	x	4.69	x	9.36	x	0.63	x	0.7	=	67.08	(75)
Northeast	0.9x	0.77	x	2.34	x	9.36	x	0.63	x	0.7	=	13.39	(75)
Northeast	0.9x	0.77	x	3.36	x	9.36	x	0.63	x	0.7	=	28.84	(75)
Northeast	0.9x	0.77	x	1.4	x	9.36	x	0.63	x	0.7	=	8.01	(75)
Northeast	0.9x	0.77	x	1.83	x	9.36	x	0.63	x	0.7	=	10.47	(75)
Northeast	0.9x	0.77	x	2.4	x	9.36	x	0.63	x	0.7	=	6.87	(75)
Northeast	0.9x	0.77	x	2.42	x	9.36	x	0.63	x	0.7	=	13.85	(75)
Northeast	0.9x	0.77	x	1.81	x	9.36	x	0.63	x	0.7	=	5.18	(75)
Southeast	0.9x	0.77	x	1.28	x	37.39	x	0.63	x	0.7	=	29.25	(77)
Southeast	0.9x	0.77	x	2.38	x	37.39	x	0.63	x	0.7	=	54.39	(77)
Southeast	0.9x	0.77	x	1.28	x	63.74	x	0.63	x	0.7	=	49.86	(77)
Southeast	0.9x	0.77	x	2.38	x	63.74	x	0.63	x	0.7	=	92.72	(77)
Southeast	0.9x	0.77	x	1.28	x	84.22	x	0.63	x	0.7	=	65.89	(77)
Southeast	0.9x	0.77	x	2.38	x	84.22	x	0.63	x	0.7	=	122.51	(77)
Southeast	0.9x	0.77	x	1.28	x	103.49	x	0.63	x	0.7	=	80.97	(77)
Southeast	0.9x	0.77	x	2.38	x	103.49	x	0.63	x	0.7	=	150.55	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	1.28	x	113.34	x	0.63	x	0.7	=	88.67	(77)
Southeast	0.9x	0.77	x	2.38	x	113.34	x	0.63	x	0.7	=	164.87	(77)
Southeast	0.9x	0.77	x	1.28	x	115.04	x	0.63	x	0.7	=	90.01	(77)
Southeast	0.9x	0.77	x	2.38	x	115.04	x	0.63	x	0.7	=	167.36	(77)
Southeast	0.9x	0.77	x	1.28	x	112.79	x	0.63	x	0.7	=	88.24	(77)
Southeast	0.9x	0.77	x	2.38	x	112.79	x	0.63	x	0.7	=	164.08	(77)
Southeast	0.9x	0.77	x	1.28	x	105.34	x	0.63	x	0.7	=	82.42	(77)
Southeast	0.9x	0.77	x	2.38	x	105.34	x	0.63	x	0.7	=	153.24	(77)
Southeast	0.9x	0.77	x	1.28	x	92.9	x	0.63	x	0.7	=	72.68	(77)
Southeast	0.9x	0.77	x	2.38	x	92.9	x	0.63	x	0.7	=	135.14	(77)
Southeast	0.9x	0.77	x	1.28	x	72.36	x	0.63	x	0.7	=	56.61	(77)
Southeast	0.9x	0.77	x	2.38	x	72.36	x	0.63	x	0.7	=	105.27	(77)
Southeast	0.9x	0.77	x	1.28	x	44.83	x	0.63	x	0.7	=	35.07	(77)
Southeast	0.9x	0.77	x	2.38	x	44.83	x	0.63	x	0.7	=	65.21	(77)
Southeast	0.9x	0.77	x	1.28	x	31.95	x	0.63	x	0.7	=	25	(77)
Southeast	0.9x	0.77	x	2.38	x	31.95	x	0.63	x	0.7	=	46.48	(77)
Southwest	0.9x	0.77	x	3.36	x	37.39		0.63	x	0.7	=	230.08	(79)
Southwest	0.9x	0.77	x	2.41	x	37.39		0.63	x	0.7	=	165.22	(79)
Southwest	0.9x	0.77	x	1.35	x	37.39		0.63	x	0.7	=	46.28	(79)
Southwest	0.9x	0.77	x	3.36	x	63.74		0.63	x	0.7	=	392.22	(79)
Southwest	0.9x	0.77	x	2.41	x	63.74		0.63	x	0.7	=	281.66	(79)
Southwest	0.9x	0.77	x	1.35	x	63.74		0.63	x	0.7	=	78.89	(79)
Southwest	0.9x	0.77	x	3.36	x	84.22		0.63	x	0.7	=	518.25	(79)
Southwest	0.9x	0.77	x	2.41	x	84.22		0.63	x	0.7	=	372.16	(79)
Southwest	0.9x	0.77	x	1.35	x	84.22		0.63	x	0.7	=	104.24	(79)
Southwest	0.9x	0.77	x	3.36	x	103.49		0.63	x	0.7	=	636.85	(79)
Southwest	0.9x	0.77	x	2.41	x	103.49		0.63	x	0.7	=	457.33	(79)
Southwest	0.9x	0.77	x	1.35	x	103.49		0.63	x	0.7	=	128.09	(79)
Southwest	0.9x	0.77	x	3.36	x	113.34		0.63	x	0.7	=	697.45	(79)
Southwest	0.9x	0.77	x	2.41	x	113.34		0.63	x	0.7	=	500.85	(79)
Southwest	0.9x	0.77	x	1.35	x	113.34		0.63	x	0.7	=	140.28	(79)
Southwest	0.9x	0.77	x	3.36	x	115.04		0.63	x	0.7	=	707.96	(79)
Southwest	0.9x	0.77	x	2.41	x	115.04		0.63	x	0.7	=	508.4	(79)
Southwest	0.9x	0.77	x	1.35	x	115.04		0.63	x	0.7	=	142.39	(79)
Southwest	0.9x	0.77	x	3.36	x	112.79		0.63	x	0.7	=	694.1	(79)
Southwest	0.9x	0.77	x	2.41	x	112.79		0.63	x	0.7	=	498.44	(79)
Southwest	0.9x	0.77	x	1.35	x	112.79		0.63	x	0.7	=	139.6	(79)
Southwest	0.9x	0.77	x	3.36	x	105.34		0.63	x	0.7	=	648.25	(79)
Southwest	0.9x	0.77	x	2.41	x	105.34		0.63	x	0.7	=	465.52	(79)
Southwest	0.9x	0.77	x	1.35	x	105.34		0.63	x	0.7	=	130.38	(79)
Southwest	0.9x	0.77	x	3.36	x	92.9		0.63	x	0.7	=	571.67	(79)

Southwest	0.9x	0.77	x	2.41	x	92.9		0.63	x	0.7	=	410.53	(79)
Southwest	0.9x	0.77	x	1.35	x	92.9		0.63	x	0.7	=	114.98	(79)
Southwest	0.9x	0.77	x	3.36	x	72.36		0.63	x	0.7	=	445.31	(79)
Southwest	0.9x	0.77	x	2.41	x	72.36		0.63	x	0.7	=	319.78	(79)
Southwest	0.9x	0.77	x	1.35	x	72.36		0.63	x	0.7	=	89.57	(79)
Southwest	0.9x	0.77	x	3.36	x	44.83		0.63	x	0.7	=	275.85	(79)
Southwest	0.9x	0.77	x	2.41	x	44.83		0.63	x	0.7	=	198.09	(79)
Southwest	0.9x	0.77	x	1.35	x	44.83		0.63	x	0.7	=	55.48	(79)
Southwest	0.9x	0.77	x	3.36	x	31.95		0.63	x	0.7	=	196.61	(79)
Southwest	0.9x	0.77	x	2.41	x	31.95		0.63	x	0.7	=	141.19	(79)
Southwest	0.9x	0.77	x	1.35	x	31.95		0.63	x	0.7	=	39.55	(79)
Northwest	0.9x	0.77	x	1.37	x	11.51	x	0.63	x	0.7	=	9.64	(81)
Northwest	0.9x	0.77	x	1.37	x	23.55	x	0.63	x	0.7	=	19.72	(81)
Northwest	0.9x	0.77	x	1.37	x	41.13	x	0.63	x	0.7	=	34.44	(81)
Northwest	0.9x	0.77	x	1.37	x	67.8	x	0.63	x	0.7	=	56.77	(81)
Northwest	0.9x	0.77	x	1.37	x	89.77	x	0.63	x	0.7	=	75.17	(81)
Northwest	0.9x	0.77	x	1.37	x	97.5	x	0.63	x	0.7	=	81.65	(81)
Northwest	0.9x	0.77	x	1.37	x	92.98	x	0.63	x	0.7	=	77.86	(81)
Northwest	0.9x	0.77	x	1.37	x	75.42	x	0.63	x	0.7	=	63.15	(81)
Northwest	0.9x	0.77	x	1.37	x	51.24	x	0.63	x	0.7	=	42.91	(81)
Northwest	0.9x	0.77	x	1.37	x	29.6	x	0.63	x	0.7	=	24.79	(81)
Northwest	0.9x	0.77	x	1.37	x	14.52	x	0.63	x	0.7	=	12.16	(81)
Northwest	0.9x	0.77	x	1.37	x	9.36	x	0.63	x	0.7	=	7.84	(81)
Rooflights	0.9x	1	x	6.13	x	26	x	0.63	x	0.7	=	63.26	(82)
Rooflights	0.9x	1	x	6.13	x	54	x	0.63	x	0.7	=	131.38	(82)
Rooflights	0.9x	1	x	6.13	x	94	x	0.63	x	0.7	=	228.7	(82)
Rooflights	0.9x	1	x	6.13	x	150	x	0.63	x	0.7	=	364.95	(82)
Rooflights	0.9x	1	x	6.13	x	190	x	0.63	x	0.7	=	462.27	(82)
Rooflights	0.9x	1	x	6.13	x	201	x	0.63	x	0.7	=	489.03	(82)
Rooflights	0.9x	1	x	6.13	x	194	x	0.63	x	0.7	=	472	(82)
Rooflights	0.9x	1	x	6.13	x	164	x	0.63	x	0.7	=	399.01	(82)
Rooflights	0.9x	1	x	6.13	x	116	x	0.63	x	0.7	=	282.23	(82)
Rooflights	0.9x	1	x	6.13	x	68	x	0.63	x	0.7	=	165.44	(82)
Rooflights	0.9x	1	x	6.13	x	33	x	0.63	x	0.7	=	80.29	(82)
Rooflights	0.9x	1	x	6.13	x	21	x	0.63	x	0.7	=	51.09	(82)

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

(83)m=	787.07	1433.15	2121.39	2988.59	3603.3	3787.53	3660.81	3180.14	2471.45	1692.71	960.62	661.43	(83)

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

(84)m=	2194.87	2836.17	3472.32	4253.31	4774.09	4874.36	4697.66	4227.81	3567.61	2875.4	2242.15	2023.24	(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	0.98	0.95	0.88	0.75	0.79	0.94	0.99	1	1	(86)

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

(87)m=	18.32	18.52	18.95	19.42	20.03	20.52	20.82	20.78	20.32	19.6	18.8	18.38	(87)

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

(88)m=	20.12	20.13	20.13	20.13	20.14	20.14	20.14	20.14	20.14	20.13	20.13	20.13	(88)

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

(89)m=	1	1	0.99	0.98	0.93	0.84	0.65	0.7	0.92	0.99	1	1	(89)

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

(90)m=	16.43	16.73	17.35	18.05	18.93	19.62	19.99	19.97	19.35	18.3	17.14	16.52	(90)

fLA = Living area ÷ (4) = 0.04 (91)

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

(92)m=	16.51	16.8	17.42	18.1	18.98	19.65	20.03	20	19.39	18.36	17.21	16.59	(92)

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

(93)m=	16.51	16.8	17.42	18.1	18.98	19.65	20.03	20	19.39	18.36	17.21	16.59	(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	0.96	0.91	0.81	0.64	0.68	0.9	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	2186.91	2814.54	3412.56	4087.98	4338.93	3941.78	3003.32	2871.08	3194.31	2802.43	2228.78	2016.96	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	14046.12	13737.61	12357.71	10851.84	8350.43	5785.25	3573.33	3540.27	5845.36	8718.66	11830.92	13610.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	8823.25	7340.3	6655.19	4869.98	2984.56	0	0	0	0	4401.67	6913.54	8625.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 50614.3 (98)

Space heating requirement in kWh/m²/year 41.39 (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)
Fraction of total heating from main system 2	(205) = (202) × (203) =	0	(205)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of main space heating system 2		90.5	(207)
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)												
8823.25	7340.3	6655.19	4869.98	2984.56	0	0	0	0	4401.67	6913.54	8625.81	

(211)m = {[(98)m x (204)]} x 100 ÷ (206) (211)

9749.45	8110.83	7353.8	5381.2	3297.86	0	0	0	0	4863.72	7639.27	9531.28

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 55927.4 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

291.62	256.65	268.62	239.53	233.81	207.6	198.12	219.13	219.29	248.44	264.3	284.18

Efficiency of water heater 79.8 (216)

(217)m=	90.11	90.09	90.03	89.93	89.63	79.8	79.8	79.8	79.8	89.86	90.06	90.11

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	323.62	284.87	298.36	266.34	260.87	260.15	248.27	274.6	274.8	276.49	293.48	315.35

Total = Sum(219a)$_{1...12}$ = 3377.21 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			55927.4	
Water heating fuel used			3377.21	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		90		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		220	(231)
Electricity for lighting			1924.6	(232)

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	0.198	=	11073.63	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	668.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =			11742.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	113.74	(267)
Electricity for lighting	(232) x	0.517	=	995.02	(268)
Total CO2, kg/year		sum of (265)…(271) =		12851.07	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.51	(273)
EI rating (section 14)				86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.95

Property Address: 62 AVENUE ROAD Mark Clean

Address : 62, Avenue Road, LONDON, NW8 6HT

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Basement	382.22	(1a)	x	3.2	(2a)	=	1223.1	(3a)
Ground floor	319.56	(1b)	x	3.2	(2b)	=	1022.59	(3b)
First floor	301.73	(1c)	x	3	(2c)	=	905.19	(3c)
Second floor	219.26	(1d)	x	2.8	(2d)	=	613.93	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	1222.77	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	3764.81	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.21	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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

0.29	0.27	0.27	0.24	0.22	0.21	0.2	0.2	0.22	0.24	0.26	0.27

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=	0.54	0.54	0.54	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.54	(24d)

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

(25)m=	0.54	0.54	0.54	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	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 Type 1			3.09	x	1.8	=	5.562			(26)
Doors Type 2			2.4	x	1.8	=	4.32			(26)
Doors Type 3			2.69	x	1.8	=	4.842			(26)
Windows Type 1			3.356	x1/[1/(1.4)+ 0.04]		=	4.45			(27)
Windows Type 2			2.41	x1/[1/(1.4)+ 0.04]		=	3.2			(27)
Windows Type 3			1.35	x1/[1/(1.4)+ 0.04]		=	1.79			(27)
Windows Type 4			4.69	x1/[1/(1.4)+ 0.04]		=	6.22			(27)
Windows Type 5			2.34	x1/[1/(1.4)+ 0.04]		=	3.1			(27)
Windows Type 6			3.36	x1/[1/(1.4)+ 0.04]		=	4.45			(27)
Windows Type 7			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 8			1.83	x1/[1/(1.4)+ 0.04]		=	2.43			(27)
Windows Type 9			2.4	x1/[1/(1.4)+ 0.04]		=	3.18			(27)
Windows Type 10			2.42	x1/[1/(1.4)+ 0.04]		=	3.21			(27)
Windows Type 11			1.81	x1/[1/(1.4)+ 0.04]		=	2.4			(27)

DER WorkSheet: New dwelling design stage

Windows Type 12			1.28	x1/[1/(1.4)+ 0.04] =		1.7			(27)
Windows Type 13			1.37	x1/[1/(1.4)+ 0.04] =		1.82			(27)
Windows Type 14			2.38	x1/[1/(1.4)+ 0.04] =		3.16			(27)
Rooflights			6.13	x1/[1/(1.4) + 0.04] =		8.582			(27b)
Floor Type 1			382.22	x	0.11	= 42.04			(28)
Floor Type 2			319.56	x	0.11	= 35.15			(28)
Walls Type1	765.4	94.8	670.6	x	0.2	= 134.12			(29)
Walls Type2	213.1	15.81	197.29	x	0.15	= 29.59			(29)
Roof Type1	62.66	6.13	56.53	x	0.1	= 5.65			(30)
Roof Type2	158.87	0	158.87	x	0.1	= 15.89			(30)
Total area of elements, m²			1901.81						(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) = 421.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 67747.9783 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 76.07 (36)

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

Total fabric heat loss (33) + (36) = 497.17 (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=	672.32	666.79	666.79	656.7	650.67	647.86	645.2	645.2	652.12	656.7	661.59	666.79	(38)

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

(39)m=	1169.48	1163.96	1163.96	1153.86	1147.83	1145.03	1142.36	1142.36	1149.29	1153.86	1158.75	1163.96

Average = Sum(39)$_{1…12}$ /12= 1154.56 (39)

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

(40)m=	0.96	0.95	0.95	0.94	0.94	0.94	0.93	0.93	0.94	0.94	0.95	0.95

Average = Sum(40)$_{1…12}$ /12= 0.94 (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 4.33 (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) + 36 144.29 (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=	158.72	152.95	147.17	141.4	135.63	129.86	129.86	135.63	141.4	147.17	152.95	158.72

Total = Sum(44)$_{1…12}$ = 1731.46 (44)

DER WorkSheet: New dwelling design stage

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=	235.94	206.35	212.94	185.64	178.13	153.71	142.44	163.45	165.4	192.76	210.41	228.49

Total = Sum(45)$_{1...12}$ = 2275.65 (45)

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

(46)m=	35.39	30.95	31.94	27.85	26.72	23.06	21.37	24.52	24.81	28.91	31.56	34.27	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.5 (47)

Temperature factor from Table 2b 0.54 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0.81 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0.81 (55)

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

(56)m=	25.11	22.68	25.11	24.3	25.11	24.3	25.11	25.11	24.3	25.11	24.3	25.11	(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=	25.11	22.68	25.11	24.3	25.11	24.3	25.11	25.11	24.3	25.11	24.3	25.11	(57)

Primary circuit loss (annual) from Table 3 360 (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=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(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=	291.62	256.65	268.62	239.53	233.81	207.6	198.12	219.13	219.29	248.44	264.3	284.18	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	291.62	256.65	268.62	239.53	233.81	207.6	198.12	219.13	219.29	248.44	264.3	284.18

Output from water heater (annual)$_{1...12}$ 2931.3 (64)

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

(65)m=	123	108.85	115.35	104.84	103.78	94.22	91.91	98.89	98.11	108.64	113.07	120.52	(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=	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	216.58	(66)

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

(67)m=	108.98	96.79	78.72	59.59	44.55	37.61	40.64	52.82	70.9	90.02	105.07	112.01	(67)

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

(68)m=	1035.53	1046.28	1019.2	961.55	888.78	820.39	774.7	763.95	791.03	848.68	921.45	989.84	(68)

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

(69)m=	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	44.66	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	-173.26	(71)

Water heating gains (Table 5)

(72)m=	165.32	161.98	155.04	145.61	139.48	130.86	123.53	132.92	136.26	146.02	157.05	161.99	(72)

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

(73)m=	1407.8	1403.02	1350.93	1264.73	1170.79	1086.83	1036.84	1047.67	1096.16	1182.69	1281.53	1361.81	(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)	
Northeast 0.9x	0.77	x	4.69	x	11.51	x	0.63	x	0.7	=	82.49	(75)
Northeast 0.9x	0.77	x	2.34	x	11.51	x	0.63	x	0.7	=	16.46	(75)
Northeast 0.9x	0.77	x	3.36	x	11.51	x	0.63	x	0.7	=	35.46	(75)
Northeast 0.9x	0.77	x	1.4	x	11.51	x	0.63	x	0.7	=	9.85	(75)
Northeast 0.9x	0.77	x	1.83	x	11.51	x	0.63	x	0.7	=	12.87	(75)
Northeast 0.9x	0.77	x	2.4	x	11.51	x	0.63	x	0.7	=	8.44	(75)
Northeast 0.9x	0.77	x	2.42	x	11.51	x	0.63	x	0.7	=	17.02	(75)
Northeast 0.9x	0.77	x	1.81	x	11.51	x	0.63	x	0.7	=	6.37	(75)
Northeast 0.9x	0.77	x	4.69	x	23.55	x	0.63	x	0.7	=	168.81	(75)
Northeast 0.9x	0.77	x	2.34	x	23.55	x	0.63	x	0.7	=	33.69	(75)
Northeast 0.9x	0.77	x	3.36	x	23.55	x	0.63	x	0.7	=	72.56	(75)
Northeast 0.9x	0.77	x	1.4	x	23.55	x	0.63	x	0.7	=	20.16	(75)
Northeast 0.9x	0.77	x	1.83	x	23.55	x	0.63	x	0.7	=	26.35	(75)
Northeast 0.9x	0.77	x	2.4	x	23.55	x	0.63	x	0.7	=	17.28	(75)
Northeast 0.9x	0.77	x	2.42	x	23.55	x	0.63	x	0.7	=	34.84	(75)
Northeast 0.9x	0.77	x	1.81	x	23.55	x	0.63	x	0.7	=	13.03	(75)
Northeast 0.9x	0.77	x	4.69	x	41.13	x	0.63	x	0.7	=	294.74	(75)
Northeast 0.9x	0.77	x	2.34	x	41.13	x	0.63	x	0.7	=	58.82	(75)
Northeast 0.9x	0.77	x	3.36	x	41.13	x	0.63	x	0.7	=	126.69	(75)
Northeast 0.9x	0.77	x	1.4	x	41.13	x	0.63	x	0.7	=	35.19	(75)
Northeast 0.9x	0.77	x	1.83	x	41.13	x	0.63	x	0.7	=	46	(75)
Northeast 0.9x	0.77	x	2.4	x	41.13	x	0.63	x	0.7	=	30.17	(75)

Northeast	0.9x	0.77	x	2.42	x	41.13	x	0.63	x	0.7	=	60.83	(75)
Northeast	0.9x	0.77	x	1.81	x	41.13	x	0.63	x	0.7	=	22.75	(75)
Northeast	0.9x	0.77	x	4.69	x	67.8	x	0.63	x	0.7	=	485.88	(75)
Northeast	0.9x	0.77	x	2.34	x	67.8	x	0.63	x	0.7	=	96.97	(75)
Northeast	0.9x	0.77	x	3.36	x	67.8	x	0.63	x	0.7	=	208.86	(75)
Northeast	0.9x	0.77	x	1.4	x	67.8	x	0.63	x	0.7	=	58.02	(75)
Northeast	0.9x	0.77	x	1.83	x	67.8	x	0.63	x	0.7	=	75.83	(75)
Northeast	0.9x	0.77	x	2.4	x	67.8	x	0.63	x	0.7	=	49.73	(75)
Northeast	0.9x	0.77	x	2.42	x	67.8	x	0.63	x	0.7	=	100.28	(75)
Northeast	0.9x	0.77	x	1.81	x	67.8	x	0.63	x	0.7	=	37.5	(75)
Northeast	0.9x	0.77	x	4.69	x	89.77	x	0.63	x	0.7	=	643.32	(75)
Northeast	0.9x	0.77	x	2.34	x	89.77	x	0.63	x	0.7	=	128.39	(75)
Northeast	0.9x	0.77	x	3.36	x	89.77	x	0.63	x	0.7	=	276.53	(75)
Northeast	0.9x	0.77	x	1.4	x	89.77	x	0.63	x	0.7	=	76.81	(75)
Northeast	0.9x	0.77	x	1.83	x	89.77	x	0.63	x	0.7	=	100.41	(75)
Northeast	0.9x	0.77	x	2.4	x	89.77	x	0.63	x	0.7	=	65.84	(75)
Northeast	0.9x	0.77	x	2.42	x	89.77	x	0.63	x	0.7	=	132.78	(75)
Northeast	0.9x	0.77	x	1.81	x	89.77	x	0.63	x	0.7	=	49.65	(75)
Northeast	0.9x	0.77	x	4.69	x	97.5	x	0.63	x	0.7	=	698.76	(75)
Northeast	0.9x	0.77	x	2.34	x	97.5	x	0.63	x	0.7	=	139.45	(75)
Northeast	0.9x	0.77	x	3.36	x	97.5	x	0.63	x	0.7	=	300.36	(75)
Northeast	0.9x	0.77	x	1.4	x	97.5	x	0.63	x	0.7	=	83.43	(75)
Northeast	0.9x	0.77	x	1.83	x	97.5	x	0.63	x	0.7	=	109.06	(75)
Northeast	0.9x	0.77	x	2.4	x	97.5	x	0.63	x	0.7	=	71.51	(75)
Northeast	0.9x	0.77	x	2.42	x	97.5	x	0.63	x	0.7	=	144.22	(75)
Northeast	0.9x	0.77	x	1.81	x	97.5	x	0.63	x	0.7	=	53.93	(75)
Northeast	0.9x	0.77	x	4.69	x	92.98	x	0.63	x	0.7	=	666.35	(75)
Northeast	0.9x	0.77	x	2.34	x	92.98	x	0.63	x	0.7	=	132.99	(75)
Northeast	0.9x	0.77	x	3.36	x	92.98	x	0.63	x	0.7	=	286.43	(75)
Northeast	0.9x	0.77	x	1.4	x	92.98	x	0.63	x	0.7	=	79.56	(75)
Northeast	0.9x	0.77	x	1.83	x	92.98	x	0.63	x	0.7	=	104	(75)
Northeast	0.9x	0.77	x	2.4	x	92.98	x	0.63	x	0.7	=	68.2	(75)
Northeast	0.9x	0.77	x	2.42	x	92.98	x	0.63	x	0.7	=	137.53	(75)
Northeast	0.9x	0.77	x	1.81	x	92.98	x	0.63	x	0.7	=	51.43	(75)
Northeast	0.9x	0.77	x	4.69	x	75.42	x	0.63	x	0.7	=	540.49	(75)
Northeast	0.9x	0.77	x	2.34	x	75.42	x	0.63	x	0.7	=	107.87	(75)
Northeast	0.9x	0.77	x	3.36	x	75.42	x	0.63	x	0.7	=	232.33	(75)
Northeast	0.9x	0.77	x	1.4	x	75.42	x	0.63	x	0.7	=	64.54	(75)
Northeast	0.9x	0.77	x	1.83	x	75.42	x	0.63	x	0.7	=	84.36	(75)
Northeast	0.9x	0.77	x	2.4	x	75.42	x	0.63	x	0.7	=	55.32	(75)
Northeast	0.9x	0.77	x	2.42	x	75.42	x	0.63	x	0.7	=	111.56	(75)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	1.81	x	75.42	x	0.63	x	0.7	=	41.72	(75)
Northeast 0.9x	0.77	x	4.69	x	51.24	x	0.63	x	0.7	=	367.25	(75)
Northeast 0.9x	0.77	x	2.34	x	51.24	x	0.63	x	0.7	=	73.29	(75)
Northeast 0.9x	0.77	x	3.36	x	51.24	x	0.63	x	0.7	=	157.86	(75)
Northeast 0.9x	0.77	x	1.4	x	51.24	x	0.63	x	0.7	=	43.85	(75)
Northeast 0.9x	0.77	x	1.83	x	51.24	x	0.63	x	0.7	=	57.32	(75)
Northeast 0.9x	0.77	x	2.4	x	51.24	x	0.63	x	0.7	=	37.59	(75)
Northeast 0.9x	0.77	x	2.42	x	51.24	x	0.63	x	0.7	=	75.8	(75)
Northeast 0.9x	0.77	x	1.81	x	51.24	x	0.63	x	0.7	=	28.35	(75)
Northeast 0.9x	0.77	x	4.69	x	29.6	x	0.63	x	0.7	=	212.12	(75)
Northeast 0.9x	0.77	x	2.34	x	29.6	x	0.63	x	0.7	=	42.33	(75)
Northeast 0.9x	0.77	x	3.36	x	29.6	x	0.63	x	0.7	=	91.18	(75)
Northeast 0.9x	0.77	x	1.4	x	29.6	x	0.63	x	0.7	=	25.33	(75)
Northeast 0.9x	0.77	x	1.83	x	29.6	x	0.63	x	0.7	=	33.11	(75)
Northeast 0.9x	0.77	x	2.4	x	29.6	x	0.63	x	0.7	=	21.71	(75)
Northeast 0.9x	0.77	x	2.42	x	29.6	x	0.63	x	0.7	=	43.78	(75)
Northeast 0.9x	0.77	x	1.81	x	29.6	x	0.63	x	0.7	=	16.37	(75)
Northeast 0.9x	0.77	x	4.69	x	14.52	x	0.63	x	0.7	=	104.1	(75)
Northeast 0.9x	0.77	x	2.34	x	14.52	x	0.63	x	0.7	=	20.77	(75)
Northeast 0.9x	0.77	x	3.36	x	14.52	x	0.63	x	0.7	=	44.75	(75)
Northeast 0.9x	0.77	x	1.4	x	14.52	x	0.63	x	0.7	=	12.43	(75)
Northeast 0.9x	0.77	x	1.83	x	14.52	x	0.63	x	0.7	=	16.25	(75)
Northeast 0.9x	0.77	x	2.4	x	14.52	x	0.63	x	0.7	=	10.65	(75)
Northeast 0.9x	0.77	x	2.42	x	14.52	x	0.63	x	0.7	=	21.48	(75)
Northeast 0.9x	0.77	x	1.81	x	14.52	x	0.63	x	0.7	=	8.03	(75)
Northeast 0.9x	0.77	x	4.69	x	9.36	x	0.63	x	0.7	=	67.08	(75)
Northeast 0.9x	0.77	x	2.34	x	9.36	x	0.63	x	0.7	=	13.39	(75)
Northeast 0.9x	0.77	x	3.36	x	9.36	x	0.63	x	0.7	=	28.84	(75)
Northeast 0.9x	0.77	x	1.4	x	9.36	x	0.63	x	0.7	=	8.01	(75)
Northeast 0.9x	0.77	x	1.83	x	9.36	x	0.63	x	0.7	=	10.47	(75)
Northeast 0.9x	0.77	x	2.4	x	9.36	x	0.63	x	0.7	=	6.87	(75)
Northeast 0.9x	0.77	x	2.42	x	9.36	x	0.63	x	0.7	=	13.85	(75)
Northeast 0.9x	0.77	x	1.81	x	9.36	x	0.63	x	0.7	=	5.18	(75)
Southeast 0.9x	0.77	x	1.28	x	37.39	x	0.63	x	0.7	=	29.25	(77)
Southeast 0.9x	0.77	x	2.38	x	37.39	x	0.63	x	0.7	=	54.39	(77)
Southeast 0.9x	0.77	x	1.28	x	63.74	x	0.63	x	0.7	=	49.86	(77)
Southeast 0.9x	0.77	x	2.38	x	63.74	x	0.63	x	0.7	=	92.72	(77)
Southeast 0.9x	0.77	x	1.28	x	84.22	x	0.63	x	0.7	=	65.89	(77)
Southeast 0.9x	0.77	x	2.38	x	84.22	x	0.63	x	0.7	=	122.51	(77)
Southeast 0.9x	0.77	x	1.28	x	103.49	x	0.63	x	0.7	=	80.97	(77)
Southeast 0.9x	0.77	x	2.38	x	103.49	x	0.63	x	0.7	=	150.55	(77)

Southeast	0.9x	0.77	x	1.28	x	113.34	x	0.63	x	0.7	=	88.67	(77)
Southeast	0.9x	0.77	x	2.38	x	113.34	x	0.63	x	0.7	=	164.87	(77)
Southeast	0.9x	0.77	x	1.28	x	115.04	x	0.63	x	0.7	=	90.01	(77)
Southeast	0.9x	0.77	x	2.38	x	115.04	x	0.63	x	0.7	=	167.36	(77)
Southeast	0.9x	0.77	x	1.28	x	112.79	x	0.63	x	0.7	=	88.24	(77)
Southeast	0.9x	0.77	x	2.38	x	112.79	x	0.63	x	0.7	=	164.08	(77)
Southeast	0.9x	0.77	x	1.28	x	105.34	x	0.63	x	0.7	=	82.42	(77)
Southeast	0.9x	0.77	x	2.38	x	105.34	x	0.63	x	0.7	=	153.24	(77)
Southeast	0.9x	0.77	x	1.28	x	92.9	x	0.63	x	0.7	=	72.68	(77)
Southeast	0.9x	0.77	x	2.38	x	92.9	x	0.63	x	0.7	=	135.14	(77)
Southeast	0.9x	0.77	x	1.28	x	72.36	x	0.63	x	0.7	=	56.61	(77)
Southeast	0.9x	0.77	x	2.38	x	72.36	x	0.63	x	0.7	=	105.27	(77)
Southeast	0.9x	0.77	x	1.28	x	44.83	x	0.63	x	0.7	=	35.07	(77)
Southeast	0.9x	0.77	x	2.38	x	44.83	x	0.63	x	0.7	=	65.21	(77)
Southeast	0.9x	0.77	x	1.28	x	31.95	x	0.63	x	0.7	=	25	(77)
Southeast	0.9x	0.77	x	2.38	x	31.95	x	0.63	x	0.7	=	46.48	(77)
Southwest	0.9x	0.77	x	3.36	x	37.39		0.63	x	0.7	=	230.08	(79)
Southwest	0.9x	0.77	x	2.41	x	37.39		0.63	x	0.7	=	165.22	(79)
Southwest	0.9x	0.77	x	1.35	x	37.39		0.63	x	0.7	=	46.28	(79)
Southwest	0.9x	0.77	x	3.36	x	63.74		0.63	x	0.7	=	392.22	(79)
Southwest	0.9x	0.77	x	2.41	x	63.74		0.63	x	0.7	=	281.66	(79)
Southwest	0.9x	0.77	x	1.35	x	63.74		0.63	x	0.7	=	78.89	(79)
Southwest	0.9x	0.77	x	3.36	x	84.22		0.63	x	0.7	=	518.25	(79)
Southwest	0.9x	0.77	x	2.41	x	84.22		0.63	x	0.7	=	372.16	(79)
Southwest	0.9x	0.77	x	1.35	x	84.22		0.63	x	0.7	=	104.24	(79)
Southwest	0.9x	0.77	x	3.36	x	103.49		0.63	x	0.7	=	636.85	(79)
Southwest	0.9x	0.77	x	2.41	x	103.49		0.63	x	0.7	=	457.33	(79)
Southwest	0.9x	0.77	x	1.35	x	103.49		0.63	x	0.7	=	128.09	(79)
Southwest	0.9x	0.77	x	3.36	x	113.34		0.63	x	0.7	=	697.45	(79)
Southwest	0.9x	0.77	x	2.41	x	113.34		0.63	x	0.7	=	500.85	(79)
Southwest	0.9x	0.77	x	1.35	x	113.34		0.63	x	0.7	=	140.28	(79)
Southwest	0.9x	0.77	x	3.36	x	115.04		0.63	x	0.7	=	707.96	(79)
Southwest	0.9x	0.77	x	2.41	x	115.04		0.63	x	0.7	=	508.4	(79)
Southwest	0.9x	0.77	x	1.35	x	115.04		0.63	x	0.7	=	142.39	(79)
Southwest	0.9x	0.77	x	3.36	x	112.79		0.63	x	0.7	=	694.1	(79)
Southwest	0.9x	0.77	x	2.41	x	112.79		0.63	x	0.7	=	498.44	(79)
Southwest	0.9x	0.77	x	1.35	x	112.79		0.63	x	0.7	=	139.6	(79)
Southwest	0.9x	0.77	x	3.36	x	105.34		0.63	x	0.7	=	648.25	(79)
Southwest	0.9x	0.77	x	2.41	x	105.34		0.63	x	0.7	=	465.52	(79)
Southwest	0.9x	0.77	x	1.35	x	105.34		0.63	x	0.7	=	130.38	(79)
Southwest	0.9x	0.77	x	3.36	x	92.9		0.63	x	0.7	=	571.67	(79)

Southwest	0.9x	0.77	x	2.41	x	92.9		0.63	x	0.7	=	410.53	(79)
Southwest	0.9x	0.77	x	1.35	x	92.9		0.63	x	0.7	=	114.98	(79)
Southwest	0.9x	0.77	x	3.36	x	72.36		0.63	x	0.7	=	445.31	(79)
Southwest	0.9x	0.77	x	2.41	x	72.36		0.63	x	0.7	=	319.78	(79)
Southwest	0.9x	0.77	x	1.35	x	72.36		0.63	x	0.7	=	89.57	(79)
Southwest	0.9x	0.77	x	3.36	x	44.83		0.63	x	0.7	=	275.85	(79)
Southwest	0.9x	0.77	x	2.41	x	44.83		0.63	x	0.7	=	198.09	(79)
Southwest	0.9x	0.77	x	1.35	x	44.83		0.63	x	0.7	=	55.48	(79)
Southwest	0.9x	0.77	x	3.36	x	31.95		0.63	x	0.7	=	196.61	(79)
Southwest	0.9x	0.77	x	2.41	x	31.95		0.63	x	0.7	=	141.19	(79)
Southwest	0.9x	0.77	x	1.35	x	31.95		0.63	x	0.7	=	39.55	(79)
Northwest	0.9x	0.77	x	1.37	x	11.51	x	0.63	x	0.7	=	9.64	(81)
Northwest	0.9x	0.77	x	1.37	x	23.55	x	0.63	x	0.7	=	19.72	(81)
Northwest	0.9x	0.77	x	1.37	x	41.13	x	0.63	x	0.7	=	34.44	(81)
Northwest	0.9x	0.77	x	1.37	x	67.8	x	0.63	x	0.7	=	56.77	(81)
Northwest	0.9x	0.77	x	1.37	x	89.77	x	0.63	x	0.7	=	75.17	(81)
Northwest	0.9x	0.77	x	1.37	x	97.5	x	0.63	x	0.7	=	81.65	(81)
Northwest	0.9x	0.77	x	1.37	x	92.98	x	0.63	x	0.7	=	77.86	(81)
Northwest	0.9x	0.77	x	1.37	x	75.42	x	0.63	x	0.7	=	63.15	(81)
Northwest	0.9x	0.77	x	1.37	x	51.24	x	0.63	x	0.7	=	42.91	(81)
Northwest	0.9x	0.77	x	1.37	x	29.6	x	0.63	x	0.7	=	24.79	(81)
Northwest	0.9x	0.77	x	1.37	x	14.52	x	0.63	x	0.7	=	12.16	(81)
Northwest	0.9x	0.77	x	1.37	x	9.36	x	0.63	x	0.7	=	7.84	(81)
Rooflights	0.9x	1	x	6.13	x	26	x	0.63	x	0.7	=	63.26	(82)
Rooflights	0.9x	1	x	6.13	x	54	x	0.63	x	0.7	=	131.38	(82)
Rooflights	0.9x	1	x	6.13	x	94	x	0.63	x	0.7	=	228.7	(82)
Rooflights	0.9x	1	x	6.13	x	150	x	0.63	x	0.7	=	364.95	(82)
Rooflights	0.9x	1	x	6.13	x	190	x	0.63	x	0.7	=	462.27	(82)
Rooflights	0.9x	1	x	6.13	x	201	x	0.63	x	0.7	=	489.03	(82)
Rooflights	0.9x	1	x	6.13	x	194	x	0.63	x	0.7	=	472	(82)
Rooflights	0.9x	1	x	6.13	x	164	x	0.63	x	0.7	=	399.01	(82)
Rooflights	0.9x	1	x	6.13	x	116	x	0.63	x	0.7	=	282.23	(82)
Rooflights	0.9x	1	x	6.13	x	68	x	0.63	x	0.7	=	165.44	(82)
Rooflights	0.9x	1	x	6.13	x	33	x	0.63	x	0.7	=	80.29	(82)
Rooflights	0.9x	1	x	6.13	x	21	x	0.63	x	0.7	=	51.09	(82)

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

(83)m=	787.07	1433.15	2121.39	2988.59	3603.3	3787.53	3660.81	3180.14	2471.45	1692.71	960.62	661.43	(83)

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

(84)m=	2194.87	2836.17	3472.32	4253.31	4774.09	4874.36	4697.66	4227.81	3567.61	2875.4	2242.15	2023.24	(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

DER WorkSheet: New dwelling design stage

(86)m=	1	1	0.99	0.98	0.95	0.88	0.75	0.79	0.94	0.99	1	1	(86)

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

(87)m=	18.32	18.52	18.95	19.42	20.03	20.52	20.82	20.78	20.32	19.6	18.8	18.38	(87)

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

(88)m=	20.12	20.13	20.13	20.13	20.14	20.14	20.14	20.14	20.14	20.13	20.13	20.13	(88)

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

(89)m=	1	1	0.99	0.98	0.93	0.84	0.65	0.7	0.92	0.99	1	1	(89)

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

(90)m=	16.43	16.73	17.35	18.05	18.93	19.62	19.99	19.97	19.35	18.3	17.14	16.52	(90)

fLA = Living area ÷ (4) = 0.04 (91)

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

(92)m=	16.51	16.8	17.42	18.1	18.98	19.65	20.03	20	19.39	18.36	17.21	16.59	(92)

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

(93)m=	16.51	16.8	17.42	18.1	18.98	19.65	20.03	20	19.39	18.36	17.21	16.59	(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	0.96	0.91	0.81	0.64	0.68	0.9	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	2186.91	2814.54	3412.56	4087.98	4338.93	3941.78	3003.32	2871.08	3194.31	2802.43	2228.78	2016.96	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	14046.12	13737.61	12357.71	10851.84	8350.43	5785.25	3573.33	3540.27	5845.36	8718.66	11830.92	13610.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	8823.25	7340.3	6655.19	4869.98	2984.56	0	0	0	0	4401.67	6913.54	8625.81	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 50614.3 (98)

Space heating requirement in kWh/m²/year 41.39 (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)
Fraction of total heating from main system 2	(205) = (202) × (203) =	0	(205)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of main space heating system 2		90.5	(207)
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)												
8823.25	7340.3	6655.19	4869.98	2984.56	0	0	0	0	4401.67	6913.54	8625.81	

(211)m = {[(98)m x (204)]} x 100 ÷ (206) (211)

9749.45	8110.83	7353.8	5381.2	3297.86	0	0	0	0	4863.72	7639.27	9531.28

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 55927.4 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

291.62	256.65	268.62	239.53	233.81	207.6	198.12	219.13	219.29	248.44	264.3	284.18

Efficiency of water heater 79.8 (216)

(217)m=	90.11	90.09	90.03	89.93	89.63	79.8	79.8	79.8	79.8	89.86	90.06	90.11	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	323.62	284.87	298.36	266.34	260.87	260.15	248.27	274.6	274.8	276.49	293.48	315.35

Total = Sum(219a)$_{1...12}$ = 3377.21 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		55927.4	
Water heating fuel used		3377.21	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	130		(230c)
boiler with a fan-assisted flue	90		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	220	(231)
Electricity for lighting		1924.6	(232)
Electricity generated by PVs		-1537.6	(233)

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	0.198	=	11073.63	(261)
Space heating (secondary)	(215)	x	0	=	0	(263)
Water heating	(219)	x	0.198	=	668.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =				11742.31	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.517	=	113.74	(267)
Electricity for lighting	(232)	x	0.517	=	995.02	(268)
Energy saving/generation technologies Item 1			0.529	=	-813.39	(269)
Total CO2, kg/year			sum of (265)…(271) =		12037.68	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		9.84	(273)
EI rating (section 14)					87	(274)