LOVE
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STUD/O

ENERGY AND SUSTAINABILITY STATEMENT

61 Redington Road, Hampstead
by Love Design Studio

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PR462_V2

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EXECUTIVE SUMMARY

An assessment of the site's sustainability and energy credentials has been carried out for 61 Redington Road, Hampstead.

The proposal is to convert the three existing residential units into one family dwelling and a one-bedroom flat at lower ground floor level.

The energy strategy follows the energy hierarchy; Use Less Energy (Be Lean), Supply energy efficiently (Be Clean) and use Renewable and low carbon energy (Be Green) as per the Camden Local Plan (2017).

The scheme adopts a fabric-first and passive design approach to reduce energy demand for space heating and reduce the active cooling load. Key passive design elements of the proposals comprise:

- An orientation that suits daylight and sunlight access.
- A well-insulated building fabric shell.
- Low-energy ventilation extract.
- 100% efficient lighting.
- Dual aspect spaces to improve cross-ventilation.
- Passive solar shade solutions.

The overheating mitigation results indicate that the sauna and gym spaces will likely require active cooling under each modelling scenario. Air conditioning to bedrooms is also predicted to be required for this site within the bedroom areas when considering future weather files.

The goal of building electrification is to move from fossil fuels to electricity provided by solar, wind and other sources. One technology that is leading the change is the heat pump, a technology which drastically reduces the energy consumed for heating and or domestic hot water. Heat pumps still require electricity to operate. However around 75 percent the energy required is generated from the outside air with only the remaining 25 percent is provided via electricity. This means that approximately three quarters of the energy use will be from a renewable source, significantly reducing emissions and carbon impact.

An all-electric, air source heat-pump system is proposed to deliver the space heating, and hot water demand.

The vast majority of net zero future scenarios include the electrification of heating.

Based on the assessment undertaken, the energy strategy set out within this report delivers an on-site cumulative **regulated CO_2 reduction of 62%** compared to the baseline**.**

The annual carbon emissions for the baseline and proposed scheme are set out below. Further detail may be found in the body of the report.

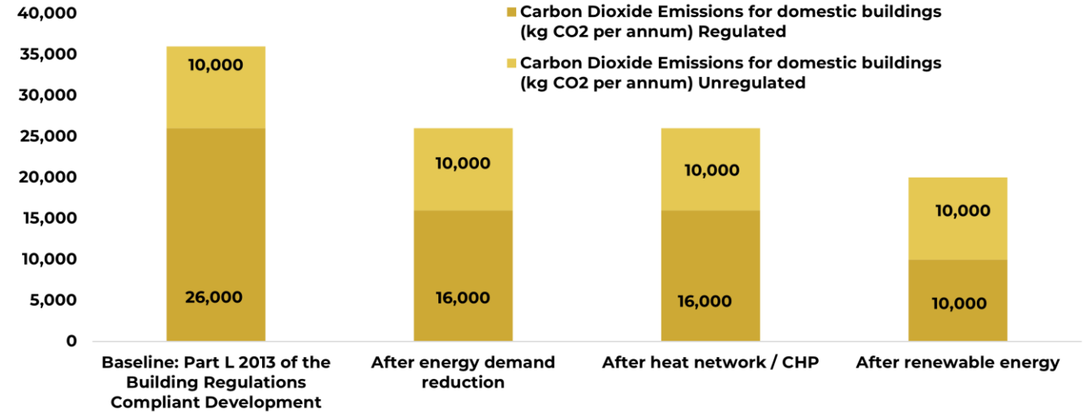


Figure 1 Total site-wide savings at each stage of the energy hierarchy

	Regulated domestic carbon dioxide savings	
	(t CO_2 per annum)	(%)
Savings from energy demand reduction	1	38%
Savings from heat network / CHP	0	0%
Savings from renewable energy	6	23%
Cumulative on-site savings	**1.6**	**62%**

Table 1 Total site-wide savings at each stage of the energy hierarchy

INTRODUCTION

Love Design Studio have been appointed to prepare this energy and sustainability statement for the proposed development at 61 Redington Road, Hampstead, London, NW37RP situated within the jurisdiction of the London Borough of Camden.

Redington Road is a residential street that runs between West Heath Road and Frognal. This property is very close proximity to the Heath (less than 0.1m) and within reach of Hampstead Village (0.8m) where there is an array of shops, bars, and restaurants as well as excellent transport links to the City & the West End.

The proposal is to convert the three existing residential units into one family dwelling and a one-bedroom flat at the lower ground floor level.

The purpose of this statement is to outline the sustainability credentials of the scheme and demonstrate the alignment of the proposed energy strategy with relevant national, regional, and local planning policy requirements.

ENERGY AND SUSTAINABILITY PLANNING POLICY

The local authority, London Borough of Camden, have a statutory duty to guide development within the borough and use policies and guides to do so. The London Borough of Camden adopted the Local Plan as a development plan document (DPD) on 3rd July 2017. The Camden Local Plan sets out the planning strategy and policies for the borough until 2031 and includes an appendix which will appear on the Policies Map.

The Camden Local Plan supersedes the Core Planning Strategy and the Development Policies as the basis for planning decisions and future development in Camden. Camden, along with six other London waste planning authorities is preparing North London Waste Plan. When approved, this will identify a range of suitable sites for the management of all North London's waste up to 2031 and include policies and guidelines for determining planning applications for waste developments.

The Local Plan of Camden is principally influenced by sustainability elements from the National Planning Policy Framework (NPPF), London Plan, public consultations, habitats regulations, monitoring of existing policies, along with others. These are set out in the following sub-sections.

NATIONAL PLANNING POLICY

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced.

Planning law requires that applications for planning permission be determined in accordance with the development plan unless material considerations indicate otherwise. The National Planning Policy Framework must be considered in preparing the development plan and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

The purpose of the planning system is to contribute to the achievement of sustainable development. In summary the framework advises:

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

New development should be planned for in ways that:

- ***Avoid increased vulnerability to the range of impacts arising from climate change. when new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and***
- ***Can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. any local requirements for the sustainability of buildings should reflect the government's policy for national technical standards.***

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- ***Provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);***
- ***Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and***
- ***Identify opportunities for development to draw its energy supply from decentralised, renewable, or low carbon energy supply systems and for co-locating potential heat customers and suppliers."***

LOCAL POLICY

Policy within the Borough of Camden is formed of the Camden Local Plan (2017) and it is the key document in Camden's development plan which is a group of documents that set out Council's planning policies.

In November 2019, the council declared a climate and ecological emergency, committing to achieving zero carbon emissions. Council planning policies include requirements relating to carbon reduction, flood risk measures, cycle parking and biodiversity improvements.

The Council aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies. Camden Planning Guidance (CPG) is prepared by the Council on Energy and resources to support the policies in the Camden Local Plan 2017.It provides key energy and resource issues within the borough and supports following policies. Here are the extracts that are deemed relevant to Sustainability and/or Energy have been set out below for reference:

- **POLICY H3: PROTECTING EXISTING HOMES**
- **POLICY C1: HEALTH AND WELLBEING**
- **POLICY A1: OPEN SPACE**
- **POLICY D1: DESIGN**
- **POLICY CC1: CLIMATE CHANGE MITIGATION**
- **POLICY CC2: ADAPTING TO CLIMATE CHANGE**
- **POLICY CC3: WATER AND FLOODING**
- **POLICY CC4: AIR QUALITY**
- **POLICY CC5: WASTE**

PERFORMANCE ANALYSIS FRAMEWORK

To achieve compliance with the energy and sustainability policy contained in the Local Plan, and to consider future policy, the following assumptions, definitions, and methodology have been undertaken:

- Elmhurst software has been used to calculate the carbon dioxide emissions for the scheme using SAP 2012 carbon factors which are then converted using SAP 10 carbon factors. SAP 10 was formulated to replace the increasingly outdated SAP 2012 methodology. Probably the most significant change between SAP 10 and its predecessor is a reduction in the CO2 emission factor for electricity. The new methodology has adjusted the prices, CO2 and primary energy factors of various fuel types recognised in SAP. Electricity's CO2 emission factor has decreased from 0.519 kgCO2/kWh to 0.233 kgCO2/kWh, reflecting a much greener national grid which increasingly benefits from electricity produced by renewable energy technologies.
- Completed checklists at this stage represent anticipated targets, post construction testing will be required to confirm airtightness, ventilation, and thermal bridging
- Building fabric product specification will aim to adhere to the proposed target U-values as per minimum and further efficiencies will be sought where feasible as-built U-values will be confirmed at project completion based on manufacturers' data
  For the purposes of this report, heat pump technology is considered as "renewable" with impacts assessed under the "Be Green" stage of the Energy Hierarchy. This is consistent with Draft Local Plan. Heat pumps still require electricity to operate. However around 75 percent of the energy required is generated from the outside air with only the remaining 25 percent coming from electricity. This means that three quarters of the energy will be from a renewable source, which will significantly reduce emissions and your carbon impact.
- Drawings used to model the scheme are based on the submitted drawing set as part of this Application (received 14th March 2022).

DEMAND REDUCTION (BE LEAN)

The scheme benefits from a range of passive and active design measures that benefit occupant health, comfort, and operational energy demand. These include a high-performance fabric (optimal insulation and an airtight enclosure), openings that enhance natural cross-ventilation and strike a balance between daylight, and solar gains, thermal mass and solar shading that help mitigate overheating risks.

Active design measures incorporated in the proposals include high efficiency lighting and efficient low-energy extract systems.

The sections below elaborate on these passive and active design measures, providing further details of targeted performance for the building fabric and active systems of the scheme.

Building Insulation

The thermal performance (insulating properties) of the building fabric is a key determinant of operational energy use for space heating and cooling. The thermal transmittance of a building element (its U-value, W/m^2.K) is the measure of its effectiveness to retain heat (or resist heat transfer through its structure), therefore low U-values are targeted in a passive building design.

The scheme targets low U-values across all elements of the fabric (including windows) that improve upon the Building Regulations Standard. Special care will be given to minimise the effects of thermal bridges at detailed design stages.

Standard insulation materials are typically constructed from petrochemicals and include fibreglass, mineral wool, polystyrene, polyurethane foam, and multi-foils. These materials are typically inexpensive to both buy and install. However, these insulation materials contain many additives, and their process embodied energy is higher than natural insulation. Natural insulation products are typically defined as low impact to nature, generally being organic resources that have low embodied energy. They can be reused and recycled and are usually biodegradable. They tend to be more absorbent properties than standard man-made insulation materials reducing condensation issues.

Both standard and natural insulation materials will be considered on merit, feasibility, and pricing at detailed design stages.

Thermal mass

Thermal mass is related to materials and the ability to absorb and store heat. High density materials like concrete, bricks and tiles require more energy to heat up; they are therefore considered to have high thermal mass. Lightweight materials such as timber have low thermal mass. For residential uses thermal mass is not commonly preferred as a means of controlling heat build-up within spaces as it can contribute to overheating risks, especially in bedrooms, when the heat that that has been absorbed by the mass during the day is released during the occupants' sleeping period. The thermal mass of the proposed materials is not above the standard levels found in homes, therefore, for the SAP calculations the assumption of the thermal mass parameter is 'medium' (250 kJ/m^{2}K).

Orientation & Site layout

Working within the constraints of any given site, considerate orientation of dwellings and the internal layout of living spaces can contribute to better utilising

the local microclimate (thermal and wind environment) and achieve high solar gains in the winter, good daylight & sunlight access, whilst mitigating against overheating risks.

The scheme is predominantly southwest and northeast facing with dual aspect facades that promote better daylight and sunlight access and allow cross ventilation.

Lighting

Good lighting enhances the mood and desirability of these spaces. It contributes greatly to people's sense of well-being. Furthermore, efficient lighting can lead to decreased energy bills.

Within the property, all fixed light fittings will be low-energy lamps, including storage and infrequently accessed areas. The lux levels within each space will be designed to match relevant Building Regulations and industry guidance to reduce the requirement for additional unregulated lighting.

The lighting to rooms used less frequently, will be provided with PIR movement detectors and daylight control where appropriate.

Natural Ventilation

Natural ventilation is a method of supplying fresh air to a space through passive means, typically by utilising differences in pressure and/or temperatures within a space. Cross-ventilation is the most effective for dissipation of heat and CO_2 build-up through wind and pressure differences across spaces and has been given priority in this scheme, which comprises dual aspect spaces. During winter, fresh air will be passively supplied into spaces via trickle vents, designed in line with Building Regulations Part F.

All windows to habitable rooms will be openable to allow for maximum dispersion of heat and pollution build-up such as CO_2.

Air Tightness

Airtightness focuses on the level of air leakage from a home.

Airtightness is an essential part of creating a healthy, comfortable, energy-efficient living environment. In contrast, air leakage is where leaks occur due to gaps and cracks that should not be there in the first place. Air leakage is defined as the flow (or more aptly, escape) of air through the gaps and cracks in the building fabric: to the walls, floors, and roof.

This can account for up to 50% of all heat losses through the external envelope of a building. There are many factors which can cause air leakage such as poor build design, poor workmanship, or indeed the inappropriate materials used. It is important to remember that an airtight building does not mean it is hermetically sealed, rather it means that the air leakage has been reduced to a minimum.

The dwelling is likely to perform better with improvement of airtightness overall; low-energy, easy-installation systems with low maintenance mechanical ventilation extract systems are proposed.

Mechanical Extract Ventilation

Although passive ventilation is maximised, there is still the need to provide the capacity for intermittent mechanical extract in kitchens, bathrooms and utility cupboards, to avoid the potential build-up of odours, grease, and condensation dampness. Such systems contribute towards a healthier living environment, help avoid heat losses (resulting from occupants opening windows in winter for fresh air) but also internal excessive heat gains (from utility cupboards).

Figure 2: ©Nuaire image of a typical Mechanical Extract system

Overheating mitigation

A passive building design is one that effectively mitigates against overheating risks, primarily utilising passive techniques, so that energy expenditure is kept to a minimum and the need for active cooling is avoided altogether. The scheme will utilise deep window reveals, and internal blinds, where feasible, to reduce summer solar gains. Spaces will benefit from natural cross-ventilation to improve thermal comfort and dissipate heat build-up.

To minimise internal heat gains, lateral hot-water pipework runs will be minimised; where there is hot water pipework and/or heat exchangers, these will be fully insulated.

A Dynamic Software Model (DSM) has been used to assess the scheme's likelihood of overheating against the CIBSE TM59 'Design methodology for the assessment of overheating risk in homes (2017)' criteria and targets. The design of the building(s) responds to site and building orientation.

The site is within a conservation area and there are strict regulations on what can be incorporated to the external façade; therefore, external shutters and louvres have not been modelled as part of the scheme. The results indicate that the sauna and gym spaces likely require active cooling under each modelling scenario. All five bedrooms exceed 26degC for more than 32 hours of the year in accordance with TM59 Criterion 2 under the 2080 and DSY03 2020 weather files. Therefore, air conditioning may be required for this site for the bedroom areas when considering future weather files.

Results of the TM59 Overheating assessment are provided below and further detail may be found in Appendix B.

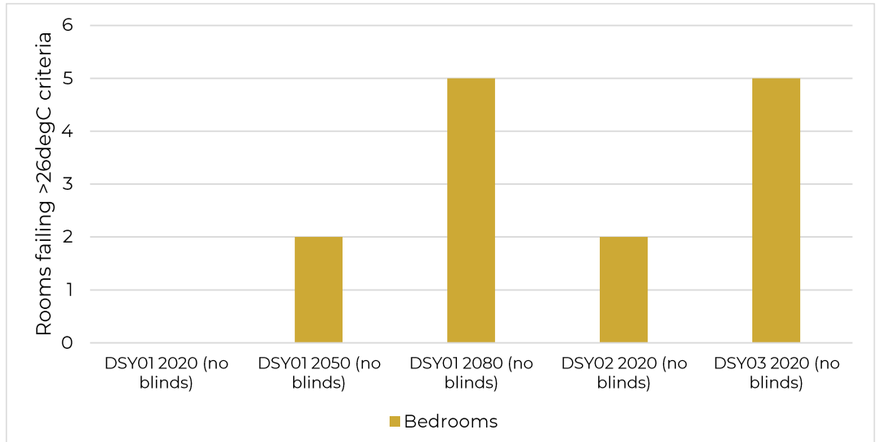


Figure 3: Criterion 2 results for individual bedrooms.

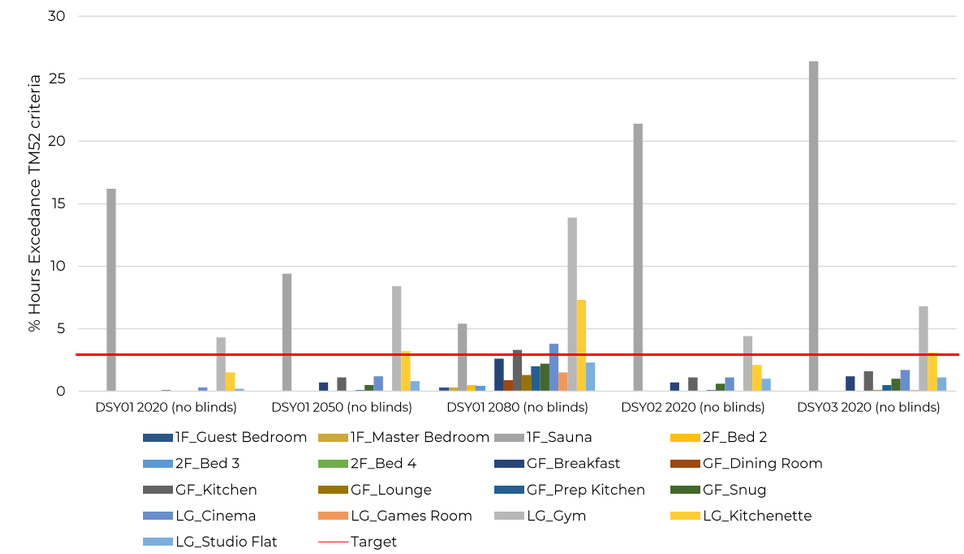


Figure 4: Criterion 1 results for the individual rooms.

Passive Design Measures Summary

In summary, the scheme benefits from:

- An orientation that promotes good daylight and sunlight access.
- A well-insulated building fabric, with room for further improvement should low airtightness levels are achieved;
- Low-energy ventilation extract.
- 100% efficient lighting.
- Dual aspect spaces with openable windows to enhance cross-ventilation and mitigate overheating risks.

Table 2 sets out the design inputs used for the SAP calculations to establish the scheme's energy efficiency and carbon performance.

The Dwelling Fabric Energy Efficiency (DFEE) rating is greater than a 42% improvement upon building regulations standards (Table 4).

Table 2: The SAP model input variables for reference

Whole Scheme Technical Information			
Building Fabric	**Input**	**Unit**	**Comment**
External Wall U-value	0.30	W/m2K	Include unheated areas
Roof U-value	0.16	W/m2K	Include roof to terraces
Ground Floor U-value	0.25	W/m2K	-
Windows U-value	1.60	W/m2K	-
Domestic Technical Information			
Building Fabric	**Input**	**Unit**	**Comment**
Windows g-value	0.4/0.7	-	Reduced g-value to southerly windows
Frame-Factor	0.7	-	-
Thermal Mass Parameter	Medium (250 kJ/m²K)		Default value
Thermal Bridge Y-value	-	-	Default value
Ventilation Method	Natural ventilation		Natural ventilation with intermittent fans
System Assumptions			Three rooms including kitchen
Air permeability	-		Default value. A low air permeability required to incorporate mech vent.

Table 3: The scheme overheating mitigation measures

Overheating Mitigation Measures	
1. Minimising Internal Heat	Pipe lengths minimised, insulated pipework.
2. Reducing heat entering	Balconies, internal blinds, ~100mm window reveals
3. Use of thermal mass	-
4. Passive ventilation	Openable windows, dual aspect (where feasible)
5. Mechanical ventilation	None
6. Active cooling	**Yes, for the gym uses and to future proof potential overheating risk to bedrooms.**

Demand figures are set out in the table below.

Table 4: Area weighted Fabric Energy Efficiency ratings for the domestic portion of the development

	TFEE (kWh/m²)	**DFEE (kWh/m²)**	**Improvement (%)**
Development total	168.58	98.22	42%

HEATING INFRASTRUCTURE (BE CLEAN)

Once demand for energy has been minimised, planning applications should demonstrate how their energy systems will exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly to reduce CO_2 emissions.

As well as carbon dioxide emissions, all combustion processes can emit oxides of Nitrogen (NOx) and, solid or liquid fuelled appliances (such as those using biomass or biodiesel) can also emit Particulate Matter. These pollutants contribute to poor air quality and can have negative impacts on the health of residents and occupiers of the development. It is important that these impacts are considered in determining the heating strategy of a development.

Existing Networks, Planned Networks and Supplying heat beyond the site boundary

Where a heat network exists in the vicinity of the proposed development, the applicant should look to prioritise connection and provide evidence of active two-way correspondence with the network operator.

Applicants should investigate the potential for connecting the development to an existing heat network system by using the London Heat Map and by contacting the local borough, local heat network operators and nearby developments.

If there is not an existing network, the applicant must investigate whether a network is being planned for the area. Applicants should also investigate opportunities for expanding their heat network to supply heat to local developments and buildings outside the boundaries of their site, particularly if this has the potential to facilitate an area-wide heat network. The scheme is located at too greater distance from any existing or proposed heat networks.

Therefore, individual efficient space heating and domestic hot water systems are advised.

There are no CO_2 savings at this stage of the energy hierarchy.

RENEWABLE ENERGY (BE GREEN)

For the last step of the Energy Hierarchy, opportunities for producing, storing, and using renewable energy on-site are investigated and maximised to the extent feasible.

The capacity for renewable technologies at the site has been explored with the wider design team. The following technologies were considered:

- Biomass boilers
- Air Source Heat Pump (ASHP)
- Ground Source Heat Pump (GSHP)
- Photovoltaic Solar Panels
- Solar Thermal Hot Water
- Wind Technology

Of the above technologies ASHPs were deemed the most appropriate to supply heat, on the grounds of feasibility, viability and scale of whole life energy and carbon savings. Further details on the specification and operation of the ASHP system is given on the page that follows.

Table 5 sets out the energy systems' design inputs used for the SAP calculations to establish the scheme's energy efficiency and carbon performance for this stage.

Table 5: A summary of the SAP inputs for the Be Green stage of the energy hierarchy

Technical Information		
Domestic Be Green Stage		
Space Heating System	Individual Air Source Heat Pumps	>170% default efficiency, MCS certified
Heating Emitter	Underfloor heating	-
Domestic Hot Water System	Same as space heating	-
Storage	Yes	>240 litres, 80mm foam insulation
Space Cooling System	No	
Low/Zero Carbon Technologies used	Air Source Heat Pumps	>170% default efficiency, MCS certified

Air Source Heat Pumps (ASHPs)

If the output is too low, then the heat pump will have to run for longer periods of time to meet demand. On the other hand, a heat pump that's too powerful for the demands of home will be turning on and off frequently. This is known as short cycling and puts unnecessary strain on the heat pump which can lead to faults.

Because air source heat pumps move the outside air to heat the internal space of the home, they are dependent on the seasonal fluctuations of the outside temperature. To reflect that dependence, the performance of heat pumps is rated with a Seasonal Performance Factor (SPF). SPF shows the average Coefficient of Performance of a heat pump over a full heating season.

This applies to any type of heat pump proposals including air source heat pumps (ASHPs), ground source heat pumps (GSHPs), water source heat pumps (WSHPs) or hybrid and ambient loop types of systems.

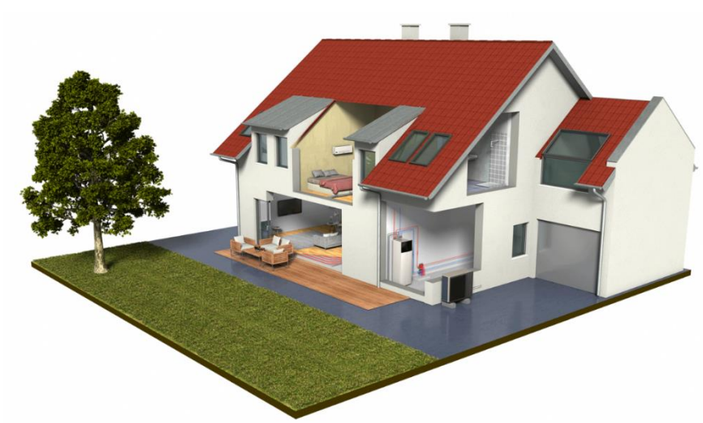
Specifically, for ASHPs, it is advised that the heat pump complies with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) product criteria as well as with other relevant issues as outlined in the Microgeneration Certification Scheme (MCS) Heat Pump Product Certification.

The details of the air source heat pump system will be provided at the detailed design stage; therefore, conservative efficiencies for space heating and hot water have been used for the purpose of this report based on default SAP figures for the residential uses.

Refrigerant pipe-runs will be minimised and in accordance with guidance from the specific supplier.

The location of the outdoor condenser will be situated in the rear garden of the property as indicated in the plans submitted with this application.

Further detail will be mapped out at the detailed design stage.



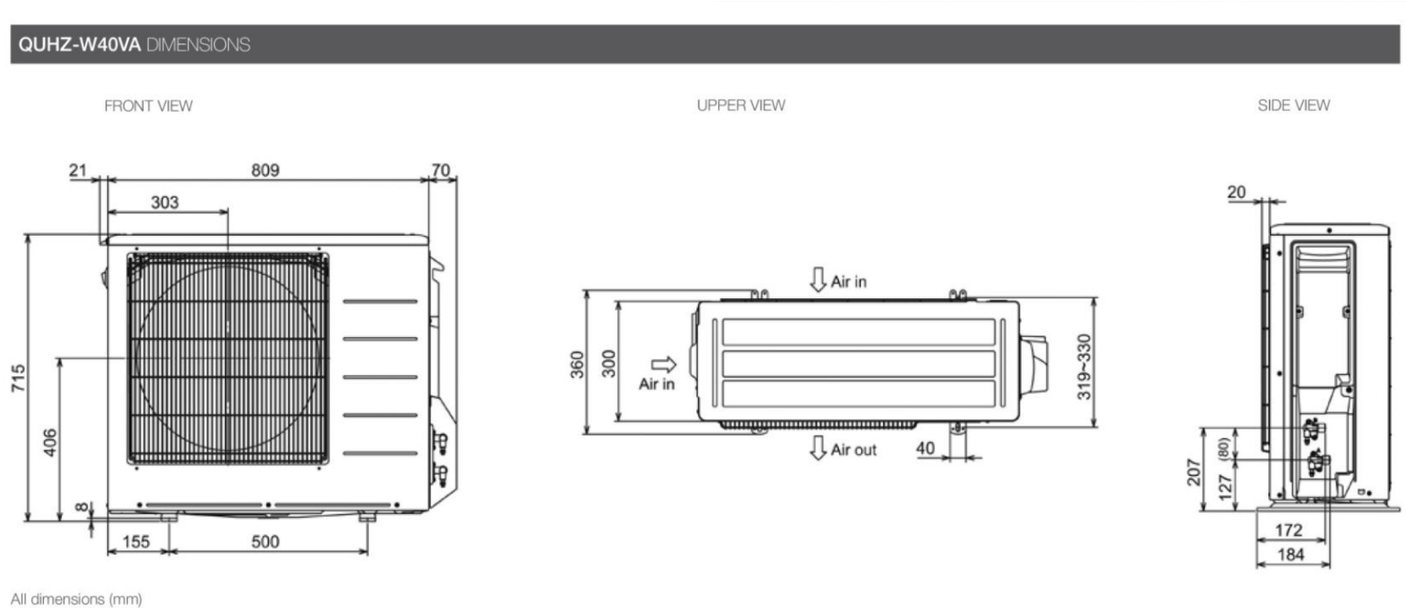


Figure 5: (top-left and top-right) ©Daikin Altherma 3 application in a house and the H Ht outdoor unit model. (Bottom) ©Mitsubishi QUHZ-W40VA example dimensions

CARBON EMISSION RESULTS SUMMARY

Following the energy hierarchy process, the applicant has opted for passive design features, a highly efficient fabric and an air source heat pump solution for space heating and domestic hot water; the scheme will be naturally ventilated with intermittent mechanical extract fans and active cooling for the gym use and bedrooms.

Based on the SAP energy modelling, the regulated carbon emissions of the scheme are 62% lower than the baseline scheme. The proposed energy strategy therefore delivers a highly efficient, low carbon dwellings that substantially exceeds the on-site carbon reduction target of 20% stipulated by Building Regulations.

Table 6: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings (SAP 10)

	Carbon Dioxide Emissions for domestic buildings (tCO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	26	10
After energy demand reduction	16	10
After heat network / CHP	16	10
After renewable energy	10	10

Table 7: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings (SAP 10)

	Regulated domestic carbon dioxide savings	
	(tCO_2 per annum)	**(%)**
Savings from energy demand reduction	10	38%
Savings from heat network / CHP	0	0%
Savings from renewable energy	6	23%
Cumulative on-site savings	**10**	**62%**

Table 8: Technical Input details for the domestic CO2 calculations

Item	**Comment**		
General			
Description	Conversion of three dwellings to one family dwelling and a one-bed apartment		
Calculation method	Elmhurst 2012 & Approved Document Part L1A & Part L1B		
Technical Information			
Building Fabric	**Input**	**Unit**	**Comment**
External Wall U-value	0.30	W/m^2K	Including wall to unheated corridor spaces
Roof U-value	0.16	W/m^2K	Including roof to terraces
Ground Floor U-value	0.25	W/m^2K	-
Windows U-value	1.6	W/m^2K	Not including frame
Windows g-value	0.4/0.7	-	Lower g-value to southerly windows
Window Frame-Factor	0.7	-	-
Thermal Mass Parameter	Medium	TMP	Default value
Thermal Bridging Y-value	default	-	-
Ventilation Method	Natural ventilation with intermittent fans	-	-
System Assumptions			nine wet rooms including kitchen
Air permeability	default	-	A low air permeability required to install mech vent
Be Lean Stage			
Space Heating System	Gas Boiler		89.5% efficiency
Heating Emitter	Underfloor heating		-
Domestic Hot Water System	Same as space heating		-
Storage	no		-
Space Cooling System	no		-
Be Clean Stage			
Space Heating System	Gas Boiler		89.5% efficiency
Heating Emitter	Underfloor heating		-
Domestic Hot Water System	Same as space heating		-
Storage	no		-
Space Cooling System	no		-
Be Green Stage			
Space Heating System	Air Source Heat Pumps		170% default efficiency, MCS certified
Heating Emitter	Underfloor heating		-
Domestic Hot Water System	Same as space heating		-
Storage	no		-
Space Cooling System	Yes		For gym uses and upper floor bedrooms
Low/Zero Carbon Technologies used	Air Source Heat Pumps		170% default efficiency, MCS certified

Table 9: Area weighted Fabric Energy Efficiency ratings for the domestic portion of the development

	TFEE (kWh/m^2)	**DFEE (kWh/m^2)**	**Improvement (%)**
Development total	168.58	98.22	42%

SUSTAINABILITY AND CLIMATE CHANGE APPRAISAL

To meet the Local Authority's sustainability requirements, we have set out the sustainability credentials of the scheme in similar format to that of the, now defunct, Code for Sustainable Homes.

In a statement made on 25 March 2015, the Secretary of State for Communities and Local Government, Eric Pickles, confirmed that from 27 March 2015, changes to the 2008 Climate Change Act would mean local authorities in England could no longer require code level 3, 4, 5 or 6 as part of the conditions imposed on planning permissions. However, energy requirements for dwellings in the UK are now typically set by the Building Regulations equivalent to code level 4.

For the purpose of this assessment, we have used the Code in combination with the Sustainability Checklist categories as a method for assessing and demonstrating the residential part of the scheme's sustainability credentials and summarised the scheme's aspirations against each category.

Energy Display Devices

The scheme will be provided with the ability to display energy consumption data and record energy use; this is to promote the specification of equipment to display energy consumption data, thus empowering dwelling occupants to reduce energy use.

Drying Space

To promote a reduced energy means of drying clothes. Space will be made available for the ability to dry clothes to avoid utilising heat energy.

Energy Labelled White Goods

Where white goods will be provided these will be classified as energy efficient with at least an A-rating, where feasible; this is to promote the provision or purchase of energy efficient white goods, thus reducing the CO_2 emissions from appliance use in the dwelling.

External Lighting

All external space lighting, including lighting in common areas, will be provided by dedicated energy efficient fittings with appropriate control systems in-line with Building Regulations standards; this is to promote the provision of energy efficient external lighting, thus reducing CO_2 emissions associated with the dwelling.

Home Office

Either the living spaces or main bedrooms will have space to allow for a desk, chair and filing cabinet or bookshelf to be installed, with space to move around the front and side of the desk; this is to promote working from home by providing occupants with the necessary space and services thus reducing the need to commute.

In all cases, the room will be large enough to allow the intended use of that room, e.g. if a home office is to be set up in the main bedroom, that room also will be able to fit in a double bed and other necessary furnishing.

Water

Indoor Water Use

The water consumption criteria for the dwellings will be in line with the 110l/p/day in compliance with local policy.

To reduce the consumption of potable water in the home from all sources, including borehole well water, using water efficient fittings, appliances and water recycling systems.

External Water Use

External water use refers to the use of water for the irrigation of gardens, lawns, car washing etc. This is to promote the recycling of rainwater and reduce the number of mains potable water used for external water uses.

Space is made available for the provision of water butts in private amenity spaces.

Materials

Environmental Impact of Materials

To specify materials with lower environmental impacts over their life cycle; where feasible, key elements of the building Envelope will achieve an equivalent rating of A+ to D in the 2008 version of The Green Guide:

- Roof
- External walls
- Internal walls (including separating walls)
- Upper and ground floors (including separating floors)
- Windows.

Responsible Sourcing of Materials - Basic Building Elements

To promote the specification of responsibly sourced materials for the basic building elements; materials in the following Building Elements will be responsibly sourced:

a) Frame
b) Ground floor
c) Upper floors (including separating floors)
d) Roof
e) External walls
f) Internal walls (including separating walls)
g) Foundation/substructure (excluding sub-base materials)
h) Staircase
Additionally, timber in these elements will be legally sourced

Responsible Sourcing of Materials - Finishing Elements

To promote the specification of responsibly sourced materials for the finishing elements; materials in the following Finishing Elements will be responsibly sourced:

a) Staircase
b) Windows
c) External & internal doors
d) Skirting
e) Panelling
f) Furniture
g) Fascias
h) Any other significant use
Additionally, timber in these elements will be legally sourced

Surface Water Run-Off

Management of Surface Water Run-off from Developments

To design surface water drainage for housing developments which avoid, reduce and delay the discharge of rainfall run-off to watercourses and public sewers the scheme will use SuDS techniques; this will protect receiving waters from pollution and minimise the risk of flooding and other environmental damage in watercourses.

Flood Risk

There are no known watercourses within or adjacent to the site. The site is located within Flood Zone 1 on the EA flood map, which indicates a 'low' risk of flooding from fluvial and tidal sources. 'Low' risk areas have an annual probability of flooding of less than 0.1% (or 1 in 1000 years).

Waste

Storage of Non-recyclable Waste and Recyclable Household Waste

To provide adequate internal and external storage space for non-recyclable waste and recyclable household waste, a recycling scheme operator will be appointed based on the local authority's requirements to maintain bins and collect recyclable waste regularly. Space for recycling containers will:

- be located in an adequate external space
- be sized according to the frequency of collection, based on guidance from the
- recycling scheme operator
- store recyclable waste in identifiably different bins

Construction Site Waste Management

A compliant Site Waste Management Plan (SWMP) will be carried out setting out target benchmarks for waste, procedures for minimising hazardous waste and monitoring/measuring/reporting of hazardous and non-hazardous waste groups; this is to promote resource efficiency via the effective and appropriate management of construction site waste.

The Site Waste Management Plan (SWMP) will include procedures to sort and divert waste from landfill, through either.
a. Re-use on site (in situ or for new applications)
b. Re-use on other sites
c. Salvage/reclaim for re-use
d. Return to the supplier via a 'take-back' scheme
e. Recovery and recycling using an approved waste management contractor
f. Compost

according to the defined waste groups (in line with the waste streams generated by the scope of the works).

Composting

Space for individual home composting facilities will be provided to promote the provision of compost facilities to reduce the amount of household waste sent to landfill.

Pollution

Global Warming Potential (GWP) of Insulants

To promote the reduction of emissions of gases with high GWP associated with the manufacture, installation, use and disposal of foamed thermal and acoustic insulating materials; where feasible, insulating materials in the elements of the scheme listed below will have a low GWP (in manufacture AND installation):

- Roofs: including loft access
- Walls: internal and external including lintels and all acoustic insulation
- Floors: including ground and upper floors
- Hot water cylinder: pipe insulation and other thermal stores
- Cold water storage tanks: where provided
- External doors

NOx Emissions

To promote the reduction of nitrogen oxide (NOX) emissions into the atmosphere; there will be no combustion boilers provided on-site within the dwellings.

Health & Well-being

Daylighting

Living/kitchen spaces will look to meet at least a 1.5% Average Daylight Factor (ADF) and bedrooms meet at least a 1% ADF, where feasible; this is to promote good daylighting and thereby improve quality of life and reduce the need for energy to light the home.

Sound Insulation

Building materials will be chosen as such to improve the sound insulation between dwellings and to the main road; in-line with BS8223; this is to promote the provision of improved sound insulation to reduce the likelihood of noise complaints from neighbours.

Private Space

To improve quality of life by promoting the provision of an inclusive outdoor space which is at least partially private outdoor space (private or semi-private) has been provided that is:

- Of a minimum size that allows all occupants to use the space.
- Provided with inclusive access and usability.
- Accessible only to occupants of designated dwellings.

Management

Home User Guide

A Home User Guide will be provided to the owner prior to handover to promote the provision of guidance enabling occupants to understand and operate their home efficiently and make the best use of local facilities.

Considers Constructors Scheme

There is a commitment to meet best practice under a nationally or locally recognised certification scheme such as the Considerate Constructors Scheme; this is to promote the environmentally and socially considerate, and accountable management of construction sites.

Construction Site Impacts

To promote construction sites managed in a manner that mitigates environmental impacts; where feasible, there will be procedures that will typically cover one or more of the following items:

- Monitor, report and set targets for CO_2 production or energy use arising from site activities
- Monitor and report CO_2 or energy use arising from commercial transport to and from site
- Monitor, report and set targets for water consumption from site activities
- Adopt best practice policies in respect of air (dust) pollution arising from site activities
- Adopt best practice policies in respect of water (ground and surface) pollution occurring on the site

Where feasible, 80% of site timber is reclaimed, re-used or responsibly sourced

Security

The principles of Secure by Design will be carried out for the scheme, to promote the design of developments where people feel safe and secure- where crime and disorder, or the fear of crime, does not undermine quality of life or community cohesion.

Ecology

To minimise reductions and promote an improvement in ecological value and enhance the ecological value of the site, the scheme will look to promote:

- development on land that already has a limited value to wildlife and discourage the development of ecologically valuable sites.
- the protection of existing ecological features from substantial damage during the clearing of the site and the completion of construction works.
- the most efficient use of a building's footprint by ensuring that land and material use is optimised across the development.

No overriding constraints to development of the Site have been identified. Recommendations have been provided for ecological enhancement measures that could be delivered as part of the proposed development.

CONCLUSION

An assessment of the site's sustainability and energy credentials has been carried out for 61 Redington Road, Hampstead, London, NW3 7RP.

The proposal is to convert the three existing residential units into one family dwelling and a one-bedroom flat at lower ground floor level.

The energy strategy follows the energy hierarchy; Use Less Energy (Be Lean), Supply energy efficiently (Be Clean) and use Renewable and low carbon energy (Be Green) as per the Camden Local Plan (2017). The overall energy strategy capitalises on passive design measures to maximise the fabric energy efficiency and energy demand. The scheme then makes use of air source heat pumps for space heating with domestic hot water combined.

Heat-pump solutions for space heating, cooling and hot water reduce combustion on-site significantly. Air Source Heat Pumps will be considered as the primary source for domestic hot water and space heating.

The scheme utilises window reveals, and internal blinds, where feasible, to reduce the requirement for active cooling. The building will be capable of utilising passive opening methods for ventilation purposes; in most cases capitalising on cross-ventilation techniques to dissipate heat in the most efficient manner.

The scheme has adopted a passive design measure first approach prior to adopting active methods and zero-carbon technologies; this is to reduce the demand for active heating and cooling. Despite this, the overheating mitigation results indicate that the sauna and gym spaces will likely require active cooling under each modelling scenario. Air conditioning to bedrooms is also likely to be required for this site within the bedroom areas when considering future weather files.

The energy strategy has been set out within this report and the scheme meets an on-site cumulative **CO_2 reduction of 62%.**

The site-wide results summary for the carbon emissions are set out below. Further detail may be found in the body of the report.

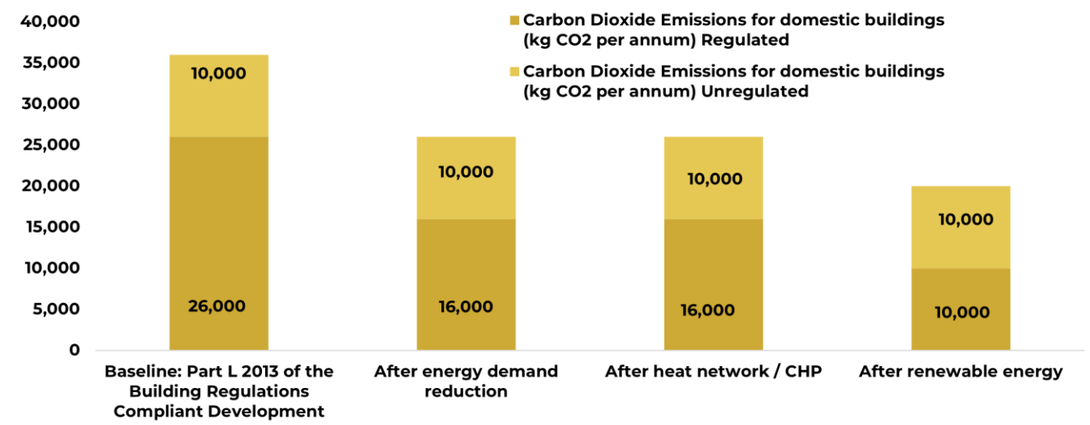


Figure 6 Total site-wide savings at each stage of the energy hierarchy

	Regulated domestic carbon dioxide savings	
	(tCO_2 per annum)	(%)
Savings from energy demand reduction	10	38%
Savings from heat network / CHP	0	0%
Savings from renewable energy	6	23%
Cumulative on-site savings	**16**	**62%**

Table 10 Total site-wide savings at each stage of the energy hierarchy

Emissions within this report are based on the following CO_2 emission rates:

- Natural Gas 0.210 kgCO2/kWh
- Grid electricity 0.233 kgCO2/kWh

These represent the SAP 10 carbon factor figures. For the assessment of demand reduction measures (Be Lean stage) space heating and domestic hot water is assumed to be from gas boilers at this stage with an 89.5% efficient gas boiler, to standardize a benchmark target. However, the Be Green stage of the energy hierarchy results considers air-source heat pumps as an alternative method for space heating and hot water

APPENDIX A – DER/TER WORKSHEETS

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

Design SAP
elmhurst energy

Property Reference	S462_House 61_Existing	**Issued on Date**	15/03/2022
Assessment Reference	Be Lean_MEV	**Prop Type Ref**	House 61
Property	Reddington Road, House 61, London, NW3 7RP		

SAP Rating	61 D	**DER**	42.86	**TER**	15.17
Environmental	48 E	**% DER<TER**	-182.56		
CO_2 Emissions (t/year)	23.82	**DFEE**	168.58	**TFEE**	70.81
General Requirements Compliance	Fail	**% DFEE<TFEE**	-138.07		

Assessor Details	Mr. Andy Love, Love Design Studio Ltd, Tel: 07563755762, Mail@lovedesignstudio.co.uk	**Assessor ID**	U860-0001
Client			

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DWELLING AS DESIGNED

Detached House, total floor area 644 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.17 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 42.86 kgCO□/m²Fail
Excess emissions =27.69 kgCO□/m² (183.0%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)70.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)168.6 kWh/m²/yrFail
Excess energy =97.8 kWh/m²/yr (138.0%)
---
2 Fabric U-values

Element	Average	Highest	
External wall	1.38 (max. 0.30)	1.50 (max. 0.70)	Fail
Party wall	0.00 (max. 0.20)	-	OK
Floor	1.20 (max. 0.25)	1.20 (max. 0.70)	Fail
Roof	0.62 (max. 0.20)	0.68 (max. 0.35)	Fail
Openings	2.85 (max. 2.00)	3.00 (max. 3.30)	Fail

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
---
3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

Efficiency: 88.0% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: Nominal cylinder loss: 11.04 kWh/day
Permitted by DBSCG 1.96 Fail
Primary pipework insulated: No Fail
---
6 Controls
Space heating controls: Programmer, room thermostat and TRVs Fail (TFA > 150)

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:75%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 3.63 m², No overhang
Windows facing North East: 23.88 m², No overhang
Windows facing East: 3.89 m², No overhang
Windows facing South East: 17.95 m², No overhang
Windows facing South West: 30.33 m², No overhang
Windows facing West: 1.99 m², No overhang
Windows facing North West: 13.93 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	180.0000	(1a)	x 2.9000	(2a) =	522.0000	(1a) - (3a)
Ground floor	205.0000	(1b)	x 3.3000	(2b) =	676.5000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	105.0000	(1d)	x 5.3000	(2d) =	556.5000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	644.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2244.7200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							9 * 10	=	90.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	90.0000	/ (5) =	0.0401	(8)
Pressure test			No	
Measured/design AP50			15.0000	
Infiltration rate			0.7901	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.6716	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8563	0.8395	0.8227	0.7387	0.7219	0.6380	0.6380	0.6212	0.6716	0.7219	0.7555	0.7891	(22b)
Effective ac	0.8666	0.8524	0.8384	0.7729	0.7606	0.7035	0.7035	0.6930	0.7255	0.7606	0.7854	0.8113	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 2.80)			95.6000	2.5180	240.7194			(27)
Glazed Door			28.5800	3.0000	85.7400			(26a)
Roof Window (Uw = 3.00)			5.8500	2.6786	15.6696			(27a)
Heat Loss Floor 2			220.0000	1.2000	264.0000			(28)
Heat Loss Floor 1			39.0000	1.2000	46.8000			(28a)
External Wall 1	632.0000	124.1800	507.8200	1.5000	761.7300			(29a)
Stud wall	16.0000		16.0000	0.1735	2.7763			(29a)
wall to garage	61.3500		61.3500	0.7426	45.5569			(29a)
Pitched	97.0000		97.0000	0.5075	49.2239			(30)
flat roof	175.0000	5.8500	169.1500	0.6800	115.0220			(30)
Total net area of external elements Aum(A, m2)			1240.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		1627.2381			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	186.0525	(36)
Total fabric heat loss (33) + (36) =	1813.2906	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	641.9364	631.3915	621.0554	572.5070	563.4238	521.1397	521.1397	513.3093	537.4269	563.4238	581.7991	601.0096	(38)
Heat transfer coeff	2455.2270	2444.6821	2434.3460	2385.7977	2376.7144	2334.4304	2334.4304	2326.6000	2350.7176	2376.7144	2395.0897	2414.3002	(39)
Average = Sum(39)m / 12 =												2385.7542	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.8125	3.7961	3.7800	3.7047	3.6906	3.6249	3.6249	3.6127	3.6502	3.6906	3.7191	3.7489	(40)
HLP (average)												3.7046	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.5791 (42)
Average daily hot water use (litres/day)	119.2043 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	131.1248	126.3566	121.5884	116.8203	112.0521	107.2839	107.2839	112.0521	116.8203	121.5884	126.3566	131.1248	(44)
Energy conte	194.4542	170.0709	175.4980	153.0034	146.8104	126.6862	117.3934	134.7106	136.3195	158.8672	173.4160	188.3186	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1875.5484	(45)
Distribution loss (46)m = 0.15 x (45)m													
	29.1681	25.5106	26.3247	22.9505	22.0216	19.0029	17.6090	20.2066	20.4479	23.8301	26.0124	28.2478	(46)
Water storage loss:													
Store volume												160.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0760	(51)
Volume factor from Table 2a												0.9086	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												5.9634	(55)
Total storage loss													
	184.8666	166.9763	184.8666	178.9031	184.8666	178.9031	184.8666	184.8666	178.9031	184.8666	178.9031	184.8666	(56)
If cylinder contains dedicated solar storage													
	184.8666	166.9763	184.8666	178.9031	184.8666	178.9031	184.8666	184.8666	178.9031	184.8666	178.9031	184.8666	(57)
Primary loss	43.3132	39.1216	43.3132	41.9160	43.3132	41.9160	43.3132	43.3132	41.9160	43.3132	41.9160	43.3132	(59)
Total heat required for water heating calculated for each month													
	422.6340	376.1688	403.6777	373.8225	374.9902	347.5053	345.5732	362.8904	357.1386	387.0470	394.2351	416.4983	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	422.6340	376.1688	403.6777	373.8225	374.9902	347.5053	345.5732	362.8904	357.1386	387.0470	394.2351	416.4983	(64)
											Total per year (kWh/year) = Sum(64)m =	4562.1813	(64)
Heat gains from water heating, kWh/month													
	247.1999	221.4269	240.8969	227.5289	231.3583	218.7785	221.5771	227.3351	221.9815	235.3672	234.3161	245.1597	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	81.3950	72.2943	58.7937	44.5106	33.2722	28.0898	30.3520	39.4527	52.9533	67.2364	78.4748	83.6572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	699.5761	706.8355	688.5420	649.5974	600.4368	554.2327	523.3655	516.1061	534.3996	573.3443	622.5049	668.7090	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	(71)
Water heating gains (Table 5)													
	332.2579	329.5043	323.7862	316.0124	310.9654	303.8590	297.8187	305.5579	308.3077	316.3537	325.4391	329.5158	(72)
Total internal gains													
	1192.9160	1188.3211	1150.8089	1089.8074	1024.3613	965.8684	931.2232	940.8037	975.3476	1036.6214	1106.1058	1161.5689	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.7600	0.7000	0.7700	14.2306	(74)
Northeast	23.8800	11.2829	0.7600	0.7000	0.7700	99.3348	(75)
East	3.8900	19.6403	0.7600	0.7000	0.7700	28.1671	(76)
Southeast	17.9500	36.7938	0.7600	0.7000	0.7700	243.4918	(77)
Southwest	30.3300	36.7938	0.7600	0.7000	0.7700	411.4265	(79)
West	1.9900	19.6403	0.7600	0.7000	0.7700	14.4094	(80)
Northwest	13.9300	11.2829	0.7600	0.7000	0.7700	57.9453	(81)
Horizontal	5.8500	26.0000	0.7600	0.7000	1.0000	72.8255	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	941.8310	1697.4534	2555.4446	3532.9463	4274.6265	4378.7474	4165.7239	3594.7927	2892.7833	1940.2533	1145.4158	794.6132	(83)
Total gains	2134.7470	2885.7745	3706.2535	4622.7537	5298.9878	5344.6159	5096.9472	4535.5964	3868.1309	2976.8747	2251.5216	1956.1822	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	18.2151	18.2937	18.3713	18.7452	18.8168	19.1577	19.1577	19.2221	19.0249	18.8168	18.6725	18.5239	
alpha	2.2143	2.2196	2.2248	2.2497	2.2545	2.2772	2.2772	2.2815	2.2683	2.2545	2.2448	2.2349	
util living area													
	0.9986	0.9972	0.9941	0.9863	0.9693	0.9360	0.8864	0.9136	0.9702	0.9925	0.9978	0.9989	(86)
MIT	17.1826	17.4100	17.8829	18.5807	19.3084	20.0010	20.4217	20.3397	19.7508	18.8303	17.9158	17.1788	(87)
Th 2	18.3988	18.4048	18.4107	18.4391	18.4445	18.4701	18.4701	18.4749	18.4601	18.4445	18.4335	18.4223	(88)
util rest of house													
	0.9980	0.9959	0.9910	0.9778	0.9433	0.8495	0.6395	0.7166	0.9288	0.9865	0.9966	0.9984	(89)
MIT 2	15.2085	15.4388	15.9140	16.6239	17.3447	18.0183	18.3589	18.3161	17.7931	16.8785	15.9597	15.2170	(90)
Living area fraction										fLA = Living area / (4) =		0.0839	(91)
MIT	15.3740	15.6040	16.0791	16.7880	17.5093	18.1846	18.5319	18.4858	17.9573	17.0421	16.1238	15.3815	(92)
Temperature adjustment												-0.1500	
adjusted MIT	15.2240	15.4540	15.9291	16.6380	17.3593	18.0346	18.3819	18.3358	17.8073	16.8921	15.9738	15.2315	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9931	0.9854	0.9664	0.9220	0.8199	0.6218	0.6928	0.9052	0.9788	0.9942	0.9973	(94)
Useful gains	2127.5091	2865.9380	3652.3210	4467.2608	4885.8151	4382.2705	3169.2383	3142.3345	3501.5310	2913.8904	2238.4738	1950.8864	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Heat loss rate W
          26820.9657 25801.2848 22953.6044 18461.3136 13450.5845  8017.7809  4159.6897  4503.8823  8714.7311 14954.6056 21253.4537 26633.2915 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
          18371.9317 15412.5531 14360.1549 10075.7180  6372.1884     0.0000     0.0000     0.0000     0.0000  8958.2921 13690.7856 18363.7094 (98)
Space heating                                                                                                                    105605.3332 (98)
Space heating per m2                                                                                                 (98) / (4) =    163.9834 (99)


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8c. Space cooling requirement
-------------------------------------------------------------------------------------------------------
Not applicable


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9a. Energy requirements - Individual heating systems, including micro-CHP
-------------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                            0.0000 (201)
Fraction of space heat from main system(s)                                                                                       1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                88.9000 (206)
Efficiency of secondary/supplementary heating system, %                                                                          0.0000 (208)
Space heating requirement                                                                                                   118791.1509 (211)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
          18371.9317 15412.5531 14360.1549 10075.7180  6372.1884     0.0000     0.0000     0.0000     0.0000  8958.2921 13690.7856 18363.7094 (98)
Space heating efficiency (main heating system 1)
             88.9000    88.9000    88.9000    88.9000    88.9000     0.0000     0.0000     0.0000     0.0000    88.9000    88.9000    88.9000 (210)
Space heating fuel (main heating system)
          20665.8399 17336.9551 16153.1551 11333.7661  7167.8160     0.0000     0.0000     0.0000     0.0000 10076.8190 15400.2087 20656.5910 (211)
Water heating requirement
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
            422.6340   376.1688   403.6777   373.8225   374.9902   347.5053   345.5732   362.8904   357.1386   387.0470   394.2351   416.4983 (64)
Efficiency of water heater                                                                                                       78.8000 (216)
(217)m       88.6445    88.6293    88.5895    88.4942    88.2712    78.8000    78.8000    78.8000    78.8000    88.4306    88.5822    88.6480 (217)
Fuel for water heating, kWh/month
            476.7741   424.4291   455.6720   422.4259   424.8160   440.9966   438.5446   460.5208   453.2216   437.6846   445.0500   469.8338 (219)
Water heating fuel used                                                                                                         5349.9692 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                            118791.1509 (211)
Space heating fuel - secondary                                                                                                   0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                         30.0000 (230c)
   main heating flue fan                                                                                                        45.0000 (230e)
Total electricity for the above, kWh/year                                                                                       75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                           1437.4616 (232)
Total delivered energy for all uses                                                                                         125653.5818 (238)


-------------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-------------------------------------------------------------------------------------------------------
                                                                  Energy       Emission factor            Emissions
                                                                 kWh/year           kg CO2/kWh          kg CO2/year
Space heating - main system 1                                118791.1509                0.2160          25658.8886 (261)
Space heating - secondary                                         0.0000                0.0000              0.0000 (263)
Water heating (other fuel)                                     5349.9692                0.2160           1155.5934 (264)
Space and water heating                                                                                 26814.4820 (265)
Pumps and fans                                                   75.0000                0.5190             38.9250 (267)
Energy for lighting                                            1437.4616                0.5190            746.0426 (268)
Total CO2, kg/year                                                                                      27599.4495 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                42.8600 (273)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                        42.8600 ZC1
Total Floor Area                                                                                TFA     644.0000
Assumed number of occupants                                                                       N       3.5791
CO2 emission factor in Table 12 for electricity displaced from grid                              EF       0.5190
CO2 emissions from appliances, equation (L14)                                                              6.4372 ZC2
CO2 emissions from cooking, equation (L16)                                                                 0.3182 ZC3
Total CO2 emissions                                                                                       49.6153 ZC4
Residual CO2 emissions offset from biofuel CHP                                                             0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                   0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                            0.0000 ZC7
Net CO2 emissions                                                                                         49.6153 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	180.0000	(1a)	x 2.9000	(2a) =	522.0000	(1a) - (3a)
Ground floor	205.0000	(1b)	x 3.3000	(2b) =	676.5000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	105.0000	(1d)	x 5.3000	(2d) =	556.5000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	644.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2244.7200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0178	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2678	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2276	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2902	0.2846	0.2789	0.2504	0.2447	0.2163	0.2163	0.2106	0.2276	0.2447	0.2561	0.2675	(22b)
Effective ac	0.5421	0.5405	0.5389	0.5314	0.5299	0.5234	0.5234	0.5222	0.5259	0.5299	0.5328	0.5358	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			28.5800	1.2000	34.2960			(26a)
TER Opening Type (Uw = 1.40)			95.6000	1.3258	126.7424			(27)
TER Room Window (Uw = 1.70)			5.8500	1.5918	9.3118			(27a)
Heat Loss Floor 2			220.0000	0.1300	28.6000			(28)
Heat Loss Floor 1			39.0000	0.1300	5.0700			(28a)
External Wall 1	632.0000	124.1800	507.8200	0.1800	91.4076			(29a)
Stud wall	16.0000		16.0000	0.1800	2.8800			(29a)
wall to garage	61.3500		61.3500	0.1800	11.0430			(29a)
Pitched	97.0000		97.0000	0.1300	12.6100			(30)
flat roof	175.0000	5.8500	169.1500	0.1300	21.9895			(30)
Total net area of external elements Aum(A, m2)			1240.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		343.9503			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	62.0175	(36)
Total fabric heat loss (33) + (36) =	405.9678	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	401.5813	400.3696	399.1820	393.6037	392.5600	387.7015	387.7015	386.8018	389.5729	392.5600	394.6714	396.8787	(38)
Heat transfer coeff	807.5491	806.3375	805.1498	799.5715	798.5279	793.6693	793.6693	792.7696	795.5408	798.5279	800.6392	802.8465	(39)
Average = Sum(39)m / 12 =												799.5665	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2540	1.2521	1.2502	1.2416	1.2400	1.2324	1.2324	1.2310	1.2353	1.2400	1.2432	1.2467	(40)
HLP (average)												1.2416	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.5791 (42)
Average daily hot water use (litres/day)	119.2043 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	131.1248	126.3566	121.5884	116.8203	112.0521	107.2839	107.2839	112.0521	116.8203	121.5884	126.3566	131.1248	(44)
Energy conte	194.4542	170.0709	175.4980	153.0034	146.8104	126.6862	117.3934	134.7106	136.3195	158.8672	173.4160	188.3186	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1875.5484	(45)
Distribution loss (46)m = 0.15 x (45)m													
	29.1681	25.5106	26.3247	22.9505	22.0216	19.0029	17.6090	20.2066	20.4479	23.8301	26.0124	28.2478	(46)
Water storage loss:													
Store volume												160.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4476	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7817	(55)
Total storage loss													
	24.2332	21.8880	24.2332	23.4515	24.2332	23.4515	24.2332	24.2332	23.4515	24.2332	23.4515	24.2332	(56)
If cylinder contains dedicated solar storage													
	24.2332	21.8880	24.2332	23.4515	24.2332	23.4515	24.2332	24.2332	23.4515	24.2332	23.4515	24.2332	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	241.9498	212.9702	222.9936	198.9669	194.3060	172.6497	164.8890	182.2062	182.2830	206.3628	219.3795	235.8141	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	241.9498	212.9702	222.9936	198.9669	194.3060	172.6497	164.8890	182.2062	182.2830	206.3628	219.3795	235.8141	(64)
											Total per year (kWh/year) = Sum(64)m =	2434.7707	(64)
Heat gains from water heating, kWh/month													
	102.6525	90.8680	96.3495	87.6444	86.8109	78.8939	77.0298	82.7878	82.0970	90.8198	94.4316	100.6124	(65)

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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	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.1160	57.8355	47.0350	35.6085	26.6178	22.4718	24.2816	31.5622	42.3627	53.7891	62.7799	66.9258	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	699.5761	706.8355	688.5420	649.5974	600.4368	554.2327	523.3655	516.1061	534.3996	573.3443	622.5049	668.7090	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	(71)
Water heating gains (Table 5)													
	137.9738	135.2202	129.5021	121.7283	116.6814	109.5749	103.5346	111.2739	114.0236	122.0697	131.1550	135.2317	(72)
Total internal gains													
	982.3529	979.5782	944.7660	886.6212	823.4228	765.9664	730.8687	738.6291	770.4729	828.8900	896.1267	950.5534	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1763.0812	2386.6777	3063.0951	3815.2477	4366.8632	4395.7176	4184.0346	3718.5230	3168.4379	2437.2579	1845.6161	1609.2460	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.3802	55.4634	55.5452	55.9327	56.0058	56.3487	56.3487	56.4126	56.2161	56.0058	55.8581	55.7046	
alpha	4.6920	4.6976	4.7030	4.7288	4.7337	4.7566	4.7566	4.7608	4.7477	4.7337	4.7239	4.7136	
util living area													
	0.9999	0.9997	0.9986	0.9925	0.9650	0.8802	0.7443	0.8183	0.9675	0.9979	0.9998	1.0000	(86)
MIT	19.3222	19.4830	19.7661	20.1554	20.5391	20.8261	20.9457	20.9132	20.6519	20.1574	19.6688	19.2977	(87)
Th 2	19.8771	19.8786	19.8800	19.8869	19.8882	19.8942	19.8942	19.8953	19.8919	19.8882	19.8856	19.8829	(88)
util rest of house													
	0.9999	0.9996	0.9981	0.9889	0.9455	0.8071	0.5980	0.6878	0.9403	0.9965	0.9997	0.9999	(89)
MIT 2	17.6097	17.8462	18.2615	18.8340	19.3818	19.7566	19.8705	19.8504	19.5494	18.8399	18.1231	17.5778	(90)
Living area fraction											fLA = Living area / (4) =	0.0839	(91)
MIT	17.7533	17.9834	18.3877	18.9448	19.4788	19.8462	19.9607	19.9395	19.6418	18.9504	18.2527	17.7220	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7533	17.9834	18.3877	18.9448	19.4788	19.8462	19.9607	19.9395	19.6418	18.9504	18.2527	17.7220	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9993	0.9968	0.9842	0.9354	0.8032	0.6081	0.6942	0.9311	0.9946	0.9995	0.9999	(94)
Useful gains	1762.7902	2384.9619	3053.2734	3755.1187	4084.8542	3530.4585	2544.4905	2581.4443	2949.9837	2424.0270	1844.7624	1609.0765	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	10864.2082	10549.6713	9571.3787	8031.5242	6211.5939	4163.7861	2667.2789	2806.0138	4408.7319	6668.0301	8929.3229	10856.1093	(97)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	6771.4550	5486.6848	4849.4704	3079.0119	1582.2943	0.0000	0.0000	0.0000	0.0000	3157.5383	5100.8836	6879.7924	(98)
Space heating												36907.1306	(98)
Space heating per m2											(98) / (4) =	57.3092	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												39472.8669	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	6771.4550	5486.6848	4849.4704	3079.0119	1582.2943	0.0000	0.0000	0.0000	0.0000	3157.5383	5100.8836	6879.7924	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	7242.1979	5868.1120	5186.5993	3293.0609	1692.2933	0.0000	0.0000	0.0000	0.0000	3377.0463	5455.4904	7358.0668	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	241.9498	212.9702	222.9936	198.9669	194.3060	172.6497	164.8890	182.2062	182.2830	206.3628	219.3795	235.8141	(64)
Efficiency of water heater												79.8000	(216)
(217)m	90.0833	90.0488	89.9697	89.7694	89.1920	79.8000	79.8000	79.8000	79.8000	89.7617	90.0024	90.0996	(217)
Fuel for water heating, kWh/month													
	268.5846	236.5052	247.8542	221.6422	217.8513	216.3530	206.6278	228.3286	228.4248	229.9009	243.7485	261.7260	(219)
Water heating fuel used												2807.5470	(219)
Annual totals kWh/year													
Space heating fuel - main system												39472.8669	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												1149.9693	(232)
Total delivered energy for all uses												43505.3832	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	39472.8669	0.2160	8526.1393	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2807.5470	0.2160	606.4301	(264)
Space and water heating			9132.5694	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	1149.9693	0.5190	596.8341	(268)
Total CO2, kg/m2/year			9768.3285	(272)
Emissions per m2 for space and water heating			14.1810	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			0.9268	(272b)
Emissions per m2 for pumps and fans			0.0604	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1810 * 1.00) + 0.9268 + 0.0604, rounded to 2 d.p.			15.1700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	180.0000	(1a)	x 2.9000	(2a) =	522.0000	(1a) - (3a)
Ground floor	205.0000	(1b)	x 3.3000	(2b) =	676.5000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	105.0000	(1d)	x 5.3000	(2d) =	556.5000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	644.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2244.7200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0178	(8)
Pressure test			No	
Measured/design AP50			15.0000	
Infiltration rate			0.7678	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.6526	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8321	0.8158	0.7995	0.7179	0.7016	0.6200	0.6200	0.6037	0.6526	0.7016	0.7342	0.7669	(22b)
Effective ac	0.8462	0.8328	0.8196	0.7577	0.7461	0.6922	0.6922	0.6822	0.7130	0.7461	0.7695	0.7940	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 2.80)			95.6000	2.5180	240.7194			(27)
Glazed Door			28.5800	3.0000	85.7400			(26a)
Roof Window (Uw = 3.00)			5.8500	2.6786	15.6696			(27a)
Heat Loss Floor 2			220.0000	1.2000	264.0000			(28)
Heat Loss Floor 1			39.0000	1.2000	46.8000			(28a)
External Wall 1	632.0000	124.1800	507.8200	1.5000	761.7300			(29a)
Stud wall	16.0000		16.0000	0.1735	2.7763			(29a)
wall to garage	61.3500		61.3500	0.7426	45.5569			(29a)
Pitched	97.0000		97.0000	0.5075	49.2239			(30)
flat roof	175.0000	5.8500	169.1500	0.6800	115.0220			(30)
Total net area of external elements Aum(A, m2)			1240.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		1627.2381			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		186.0525	(36)
Total fabric heat loss	(33) + (36) =	1813.2906	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	626.8406	616.8819	607.1204	561.2708	552.6925	512.7590	512.7590	505.3639	528.1408	552.6925	570.0463	588.1889	(38)
Heat transfer coeff	2440.1313	2430.1725	2420.4110	2374.5614	2365.9831	2326.0496	2326.0496	2318.6545	2341.4314	2365.9831	2383.3369	2401.4796	(39)
Average = Sum(39)m / 12 =												2374.5203	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.7890	3.7736	3.7584	3.6872	3.6739	3.6119	3.6119	3.6004	3.6358	3.6739	3.7008	3.7290	(40)
HLP (average)												3.6871	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.5791	(42)
Average daily hot water use (litres/day)	119.2043	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	131.1248	126.3566	121.5884	116.8203	112.0521	107.2839	107.2839	112.0521	116.8203	121.5884	126.3566	131.1248	(44)
Energy conte	194.4542	170.0709	175.4980	153.0034	146.8104	126.6862	117.3934	134.7106	136.3195	158.8672	173.4160	188.3186	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1875.5484 (45)

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

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

41.3215	36.1401	37.2933	32.5132	31.1972	26.9208	24.9461	28.6260	28.9679	33.7593	36.8509	40.0177	(65)

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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	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	(66)

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

65.1160	57.8355	47.0350	35.6085	26.6178	22.4718	24.2816	31.5622	42.3627	53.7891	62.7799	66.9258	(67)

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

699.5761	706.8355	688.5420	649.5974	600.4368	554.2327	523.3655	516.1061	534.3996	573.3443	622.5049	668.7090	(68)

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

40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	(71)

Water heating gains (Table 5)

55.5397	53.7799	50.1254	45.1572	41.9317	37.3900	33.5297	38.4758	40.2332	45.3754	51.1818	53.7872	(72)

Total internal gains

896.9188	895.1378	862.3894	807.0501	745.6732	690.7815	657.8638	662.8311	693.6824	749.1957	813.1535	866.1089	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.7600	0.7000	0.7700	14.2306	(74)
Northeast	23.8800	11.2829	0.7600	0.7000	0.7700	99.3348	(75)
East	3.8900	19.6403	0.7600	0.7000	0.7700	28.1671	(76)
Southeast	17.9500	36.7938	0.7600	0.7000	0.7700	243.4918	(77)
Southwest	30.3300	36.7938	0.7600	0.7000	0.7700	411.4265	(79)
West	1.9900	19.6403	0.7600	0.7000	0.7700	14.4094	(80)
Northwest	13.9300	11.2829	0.7600	0.7000	0.7700	57.9453	(81)
Horizontal	5.8500	26.0000	0.7600	0.7000	1.0000	72.8255	(82)

Solar gains	941.8310	1697.4534	2555.4446	3532.9463	4274.6265	4378.7474	4165.7239	3594.7927	2892.7833	1940.2533	1145.4158	794.6132	(83)
Total gains	1838.7498	2592.5912	3417.8340	4339.9964	5020.2997	5069.5289	4823.5877	4257.6237	3586.4657	2689.4490	1958.5693	1660.7222	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	18.3278	18.4029	18.4771	18.8339	18.9022	19.2267	19.2267	19.2880	19.1004	18.9022	18.7645	18.6228	
alpha	2.2219	2.2269	2.2318	2.2556	2.2601	2.2818	2.2818	2.2859	2.2734	2.2601	2.2510	2.2415	
util living area													
	0.9990	0.9978	0.9950	0.9880	0.9724	0.9419	0.8962	0.9226	0.9744	0.9940	0.9984	0.9992	(86)
MIT	17.1674	17.3944	17.8665	18.5619	19.2894	19.9819	20.4048	20.3206	19.7290	18.8088	17.8961	17.1615	(87)
Th 2	18.4074	18.4131	18.4187	18.4458	18.4509	18.4753	18.4753	18.4798	18.4658	18.4509	18.4405	18.4298	(88)
util rest of house													
	0.9986	0.9968	0.9924	0.9805	0.9487	0.8613	0.6596	0.7377	0.9380	0.9891	0.9975	0.9989	(89)
MIT 2	15.1978	15.4276	15.9021	16.6094	17.3310	18.0073	18.3564	18.3103	17.7774	16.8609	15.9438	15.2037	(90)
Living area fraction									fLA = Living area / (4) =			0.0839	(91)
MIT	15.3629	15.5925	16.0668	16.7731	17.4952	18.1729	18.5282	18.4789	17.9410	17.0242	16.1075	15.3678	(92)
Temperature adjustment												0.0000	
adjusted MIT	15.3629	15.5925	16.0668	16.7731	17.4952	18.1729	18.5282	18.4789	17.9410	17.0242	16.1075	15.3678	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9947	0.9881	0.9713	0.9320	0.8427	0.6696	0.7376	0.9218	0.9835	0.9959	0.9982	(94)
Useful gains	1834.3686	2578.8098	3377.0140	4215.2756	4678.9188	4272.0157	3229.9916	3140.2628	3305.9196	2645.1274	1950.4429	1657.6708	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	26995.0322	25984.6244	23155.5264	18695.1555	13711.3397	8310.7395	4485.0720	4820.1632	8993.4448	15199.6582	21467.9359	26819.3558	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	18719.5337	15728.7074	14715.2132	10425.5136	6720.1211	0.0000	0.0000	0.0000	0.0000	9340.5709	14052.5949	18720.2937	(98)
Space heating												108422.5485	(98)
Space heating per m2											(98) / (4) =	168.3580	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	21864.8665	17212.7672	17621.7744	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.2669	0.3171	0.2794	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5836.0986	5458.1603	4924.2621	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	6075.8570	5786.6641	5146.7869	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	172.6261	244.4068	165.5585	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												582.5914	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	43.1565	61.1017	41.3896	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												145.6478	(107)
Space cooling per m2												0.2262	(108)
Energy for space heating												168.3580	(99)
Energy for space cooling												0.2262	(108)
Total												168.5842	(109)
Dwelling Fabric Energy Efficiency (DFEE)												168.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	180.0000	(1a)	x 2.9000	(2a) =	522.0000	(1a) - (3a)
Ground floor	205.0000	(1b)	x 3.3000	(2b) =	676.5000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	105.0000	(1d)	x 5.3000	(2d) =	556.5000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	644.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2244.7200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0178	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2678	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2276	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2902	0.2846	0.2789	0.2504	0.2447	0.2163	0.2163	0.2106	0.2276	0.2447	0.2561	0.2675	(22b)
Effective ac	0.5421	0.5405	0.5389	0.5314	0.5299	0.5234	0.5234	0.5222	0.5259	0.5299	0.5328	0.5358	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			28.5800	1.2000	34.2960			(26a)
TER Opening Type (Uw = 1.40)			95.6000	1.3258	126.7424			(27)
TER Room Window (Uw = 1.70)			5.8500	1.5918	9.3118			(27a)
Heat Loss Floor 2			220.0000	0.1300	28.6000			(28)
Heat Loss Floor 1			39.0000	0.1300	5.0700			(28a)
External Wall 1	632.0000	124.1800	507.8200	0.1800	91.4076			(29a)
Stud wall	16.0000		16.0000	0.1800	2.8800			(29a)
wall to garage	61.3500		61.3500	0.1800	11.0430			(29a)
Pitched	97.0000		97.0000	0.1300	12.6100			(30)
flat roof	175.0000	5.8500	169.1500	0.1300	21.9895			(30)
Total net area of external elements Aum(A, m2)			1240.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		343.9503			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	62.0175	(36)
Total fabric heat loss (33) + (36) =	405.9678	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	401.5813	400.3696	399.1820	393.6037	392.5600	387.7015	387.7015	386.8018	389.5729	392.5600	394.6714	396.8787	(38)
Heat transfer coeff	807.5491	806.3375	805.1498	799.5715	798.5279	793.6693	793.6693	792.7696	795.5408	798.5279	800.6392	802.8465	(39)
Average = Sum(39)m / 12 =												799.5665	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2540	1.2521	1.2502	1.2416	1.2400	1.2324	1.2324	1.2310	1.2353	1.2400	1.2432	1.2467	(40)
HLP (average)												1.2416	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.5791	(42)
Average daily hot water use (litres/day)	119.2043	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	131.1248	126.3566	121.5884	116.8203	112.0521	107.2839	107.2839	112.0521	116.8203	121.5884	126.3566	131.1248	(44)
Energy conte	194.4542	170.0709	175.4980	153.0034	146.8104	126.6862	117.3934	134.7106	136.3195	158.8672	173.4160	188.3186	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1875.5484	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
41.3215	36.1401	37.2933	32.5132	31.1972	26.9208	24.9461	28.6260	28.9679	33.7593	36.8509	40.0177	(65)	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	178.9565	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
65.1160	57.8355	47.0350	35.6085	26.6178	22.4718	24.2816	31.5622	42.3627	53.7891	62.7799	66.9258	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
699.5761	706.8355	688.5420	649.5974	600.4368	554.2327	523.3655	516.1061	534.3996	573.3443	622.5049	668.7090	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	40.8957	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	-143.1652	(71)	
Water heating gains (Table 5)													
55.5397	53.7799	50.1254	45.1572	41.9317	37.3900	33.5297	38.4758	40.2332	45.3754	51.1818	53.7872	(72)	
Total internal gains													
896.9188	895.1378	862.3894	807.0501	745.6732	690.7815	657.8638	662.8311	693.6824	749.1957	813.1535	866.1089	(73)	

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1677.6471	2302.2374	2980.7185	3735.6766	4289.1136	4320.5327	4111.0297	3642.7250	3091.6475	2357.5636	1762.6429	1524.8015	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.3802	55.4634	55.5452	55.9327	56.0058	56.3487	56.3487	56.4126	56.2161	56.0058	55.8581	55.7046	
alpha	4.6920	4.6976	4.7030	4.7288	4.7337	4.7566	4.7566	4.7608	4.7477	4.7337	4.7239	4.7136	
util living area													
1.0000	0.9998	0.9988	0.9932	0.9672	0.8858	0.7528	0.8269	0.9703	0.9982	0.9999	1.0000	(86)	
MIT	19.3099	19.4709	19.7544	20.1444	20.5297	20.8201	20.9429	20.9088	20.6425	20.1461	19.6569	19.2856	(87)
Th 2	19.8771	19.8786	19.8800	19.8869	19.8882	19.8942	19.8942	19.8953	19.8919	19.8882	19.8856	19.8829	(88)
util rest of house													
0.9999	0.9997	0.9983	0.9898	0.9487	0.8146	0.6069	0.6983	0.9450	0.9970	0.9998	1.0000	(89)	
MIT 2	18.3168	18.4789	18.7633	19.1572	19.5338	19.7961	19.8770	19.8626	19.6497	19.1612	18.6704	18.2970	(90)
Living area fraction									fLA = Living area / (4) =			0.0839	(91)
MIT	18.4001	18.5621	18.8464	19.2400	19.6173	19.8820	19.9664	19.9503	19.7330	19.2438	18.7531	18.3799	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4001	18.5621	18.8464	19.2400	19.6173	19.8820	19.9664	19.9503	19.7330	19.2438	18.7531	18.3799	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9995	0.9976	0.9871	0.9425	0.8136	0.6179	0.7062	0.9396	0.9959	0.9997	0.9999	(94)
Useful gains	1677.4680	2301.0716	2973.4769	3687.3274	4042.6778	3515.1506	2540.3503	2572.3426	2904.9936	2347.9372	1762.0978	1524.7002	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
11386.5009	11016.2353	9940.7090	8267.5535	6322.2191	4192.1440	2671.8014	2814.5908	4481.2533	6902.3295	9329.9229	11384.2547	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
7223.5205	5856.5900	5183.6207	3297.7628	1695.9788	0.0000	0.0000	0.0000	0.0000	3388.4679	5448.8341	7335.5085	(98)	
Space heating												39430.2832	(98)
Space heating per m2											(98) / (4) =	61.2271	(99)

8c. Space cooling requirement

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	7460.4917	5873.1531	6025.0490	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6553	0.7509	0.6823	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	4888.6563	4410.1839	4110.6198	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5216.5848	4969.0922	4440.7738	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	236.1085	415.8278	245.6346	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												897.5708	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	59.0271	103.9569	61.4086	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												224.3927	(107)
Space cooling per m2												0.3484	(108)
Energy for space heating												61.2271	(99)
Energy for space cooling												0.3484	(108)
Total												61.5756	(109)
Target Fabric Energy Efficiency (TFEE)												70.8	(109)

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

Design SAP
elmhurst energy

Property Reference	S462_House 61	**Issued on Date**	15/03/2022
Assessment Reference	Be Lean_MEV	**Prop Type Ref**	House 61
Property	Reddington Road, House 61, London, NW3 7RP		

SAP Rating	78 C	**DER**	24.34	**TER**	15.21
Environmental	70 C	**% DER<TER**	-60.01		
CO_2 Emissions (t/year)	14.34	**DFEE**	98.22	**TFEE**	71.35
General Requirements Compliance	Fail	**% DFEE<TFEE**	-37.66		

Assessor Details	Mr. Andy Love, Love Design Studio Ltd, Tel: 07563755762, Mail@lovedesignstudio.co.uk	**Assessor ID**	U860-0001
Client			

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

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

Detached House, total floor area 703 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.21 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 24.34 kgCO□/m²Fail
Excess emissions =9.13 kgCO□/m² (60.0%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)71.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)98.2 kWh/m²/yrFail
Excess energy =26.9 kWh/m²/yr (37.7%)

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.29 (max. 0.30)	0.30 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.25 (max. 0.25)	0.25 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.64 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

---
3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

Efficiency: 89.5% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Nominal cylinder loss: 1.82 kWh/day
Permitted by DBSCG 2.10 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 3.63 m², No overhang
Windows facing North East: 23.88 m², No overhang
Windows facing East: 3.89 m², No overhang
Windows facing South East: 17.95 m², No overhang
Windows facing South West: 30.33 m², No overhang
Windows facing West: 1.99 m², No overhang
Windows facing North West: 13.93 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							9 * 10 =	90.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.0368	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.7868	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6688	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8527	0.8360	0.8193	0.7357	0.7189	0.6353	0.6353	0.6186	0.6688	0.7189	0.7524	0.7858	(22b)
Effective ac	0.8635	0.8494	0.8356	0.7706	0.7584	0.7018	0.7018	0.6913	0.7236	0.7584	0.7830	0.8088	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.60)			95.6000	1.5038	143.7594			(27)
Glazed Door			28.5800	1.8000	51.4440			(26a)
Roof Window (Uw = 1.60)			5.8500	1.5038	8.7970			(27a)
Heat Loss Floor 2			220.0000	0.2500	55.0000			(28)
Heat Loss Floor 1			39.0000	0.2500	9.7500			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.3000	190.1460			(29a)
Stud wall	16.0000		16.0000	0.1735	2.7763			(29a)
wall to garage	61.3500		61.3500	0.2492	15.2865			(29a)
Pitched	97.0000		97.0000	0.1481	14.3704			(30)
flat roof	175.0000	5.8500	169.1500	0.1600	27.0640			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		518.3936			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	204.9525	(36)
Total fabric heat loss (33) + (36) =	723.3461	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	696.8727	685.4805	674.3138	621.8644	612.0513	566.3695	566.3695	557.9099	583.9655	612.0513	631.9031	652.6573	(38)
Heat transfer coeff	1420.2188	1408.8266	1397.6599	1345.2105	1335.3973	1289.7156	1289.7156	1281.2560	1307.3115	1335.3973	1355.2492	1376.0034	(39)
Average = Sum(39)m / 12 =												1345.1635	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0202	2.0040	1.9881	1.9135	1.8996	1.8346	1.8346	1.8226	1.8596	1.8996	1.9278	1.9573	(40)
HLP (average)												1.9135	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558 (42)
Average daily hot water use (litres/day)	121.0260 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1904.2097	(45)
Distribution loss (46)m = 0.15 x (45)m													
	29.6139	25.9005	26.7270	23.3012	22.3581	19.2933	17.8781	20.5154	20.7604	24.1942	26.4099	28.6795	(46)
Water storage loss:													
Store volume												180.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8736	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9805	(55)
Total storage loss													
	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(56)
If cylinder contains dedicated solar storage													
	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	251.0847	221.1360	231.8387	207.2695	202.7128	180.5501	172.8462	190.4281	190.3306	214.9538	227.9940	244.8552	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	251.0847	221.1360	231.8387	207.2695	202.7128	180.5501	172.8462	190.4281	190.3306	214.9538	227.9940	244.8552	(64)
										Total per year (kWh/year) = Sum(64)m =		2535.9997	(64)
Heat gains from water heating, kWh/month													
	108.5712	96.1856	102.1719	93.1934	92.4875	84.3092	82.5569	88.4029	87.5612	96.5577	100.0843	106.4999	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	(71)
Water heating gains (Table 5)													
	145.9290	143.1333	137.3278	129.4353	124.3112	117.0961	110.9636	118.8211	121.6128	129.7818	139.0060	143.1450	(72)
Total internal gains													
	1032.9767	1030.0188	993.3797	932.2440	865.7336	805.4376	768.7524	776.7721	810.3975	871.8096	942.4201	999.6401	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1813.7050	2437.1184	3111.7088	3860.8705	4409.1740	4435.1888	4221.9183	3756.6660	3208.3625	2480.1775	1891.9095	1658.3326	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3746	34.6526	34.9294	36.2913	36.5580	37.8529	37.8529	38.1028	37.3434	36.5580	36.0225	35.4792	
alpha	3.2916	3.3102	3.3286	3.4194	3.4372	3.5235	3.5235	3.5402	3.4896	3.4372	3.4015	3.3653	
util living area													
	0.9998	0.9994	0.9983	0.9944	0.9815	0.9448	0.8776	0.9154	0.9824	0.9978	0.9996	0.9999	(86)
MIT	19.0237	19.1631	19.4274	19.8271	20.2082	20.5614	20.7479	20.7046	20.4020	19.9153	19.4334	19.0454	(87)
Th 2	19.3199	19.3307	19.3413	19.3916	19.4011	19.4459	19.4459	19.4543	19.4286	19.4011	19.3819	19.3619	(88)
util rest of house													
	0.9997	0.9992	0.9976	0.9913	0.9682	0.8900	0.7215	0.7954	0.9628	0.9962	0.9995	0.9998	(89)
MIT 2	16.7275	16.9388	17.3328	17.9509	18.5095	19.0333	19.2523	19.2216	18.8115	18.0876	17.3693	16.7876	(90)
Living area fraction										fLA = Living area / (4) =		0.0768	(91)
MIT	16.9039	17.1096	17.4937	18.0950	18.6400	19.1506	19.3672	19.3355	18.9336	18.2280	17.5278	16.9610	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.7539	16.9596	17.3437	17.9450	18.4900	19.0006	19.2172	19.1855	18.7836	18.0780	17.3778	16.8110	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9986	0.9959	0.9864	0.9551	0.8636	0.6850	0.7593	0.9472	0.9937	0.9990	0.9997	(94)
Useful gains	1812.8017	2433.7438	3098.9751	3808.5094	4211.0568	3830.4505	2892.1645	2852.6080	3038.9301	2464.6115	1890.0713	1657.7773	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Heat loss rate W													
	17687.2607	16989.9314	15155.8344	12167.4329	9067.2935	5675.5646	3375.3859	3568.9814	6122.9689	9986.1545	13929.0076	17352.7672	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	11810.5975	9781.7581	8970.3033	6018.4249	3613.0401	0.0000	0.0000	0.0000	0.0000	5596.0280	8668.0341	11677.0725	(98)
Space heating												66135.2585	(98)
Space heating per m2											(98) / (4) =	94.0758	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												73158.4718	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	11810.5975	9781.7581	8970.3033	6018.4249	3613.0401	0.0000	0.0000	0.0000	0.0000	5596.0280	8668.0341	11677.0725	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	13064.8203	10820.5288	9922.9019	6657.5497	3996.7257	0.0000	0.0000	0.0000	0.0000	6190.2965	9588.5333	12917.1156	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	251.0847	221.1360	231.8387	207.2695	202.7128	180.5501	172.8462	190.4281	190.3306	214.9538	227.9940	244.8552	(64)
Efficiency of water heater												80.3000	(216)
(217)m	90.1639	90.1493	90.1144	90.0230	89.8000	80.3000	80.3000	80.3000	80.3000	89.9813	90.1095	90.1671	(217)
Fuel for water heating, kWh/month													
	278.4758	245.2996	257.2714	230.2405	225.7381	224.8445	215.2506	237.1458	237.0244	238.8871	253.0188	271.5573	(219)
Water heating fuel used												2914.7539	(219)
Annual totals kWh/year													
Space heating fuel - main system												73158.4718	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												1232.6303	(232)
Total delivered energy for all uses												77380.8559	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	73158.4718	0.2160	15802.2299	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2914.7539	0.2160	629.5868	(264)
Space and water heating			16431.8167	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	1232.6303	0.5190	639.7351	(268)
Total CO2, kg/year			17110.4769	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			24.3400	(273)

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

DER		24.3400	ZC1
Total Floor Area	TFA	703.0000	
Assumed number of occupants	N	3.6558	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		6.2074	ZC2
CO2 emissions from cooking, equation (L16)		0.2941	ZC3
Total CO2 emissions		30.8415	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.8415	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0164	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2664	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2264	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2887	0.2830	0.2773	0.2490	0.2434	0.2151	0.2151	0.2094	0.2264	0.2434	0.2547	0.2660	(22b)
Effective ac	0.5417	0.5400	0.5385	0.5310	0.5296	0.5231	0.5231	0.5219	0.5256	0.5296	0.5324	0.5354	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			28.5800	1.2000	34.2960			(26a)
TER Opening Type (Uw = 1.40)			95.6000	1.3258	126.7424			(27)
TER Room Window (Uw = 1.70)			5.8500	1.5918	9.3118			(27a)
Heat Loss Floor 2			220.0000	0.1300	28.6000			(28)
Heat Loss Floor 1			39.0000	0.1300	5.0700			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.1800	114.0876			(29a)
Stud wall	16.0000		16.0000	0.1800	2.8800			(29a)
wall to garage	61.3500		61.3500	0.1800	11.0430			(29a)
Pitched	97.0000		97.0000	0.1300	12.6100			(30)
flat roof	175.0000	5.8500	169.1500	0.1300	21.9895			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		366.6303			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	68.3175	(36)
Total fabric heat loss (33) + (36) =	434.9478	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	437.1164	435.8108	434.5310	428.5202	427.3956	422.1603	422.1603	421.1908	424.1768	427.3956	429.6706	432.0491	(38)
Heat transfer coeff	872.0642	870.7586	869.4789	863.4680	862.3434	857.1081	857.1081	856.1386	859.1247	862.3434	864.6185	866.9970	(39)
Average = Sum(39)m / 12 =												863.4626	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2405	1.2386	1.2368	1.2283	1.2267	1.2192	1.2192	1.2178	1.2221	1.2267	1.2299	1.2333	(40)
HLP (average)												1.2283	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558 (42)
Average daily hot water use (litres/day)	121.0260 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1904.2097 (45)

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

29.6139	25.9005	26.7270	23.3012	22.3581	19.2933	17.8781	20.5154	20.7604	24.1942	26.4099	28.6795 (46)

Water storage loss:

Store volume 180.0000 (47)

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

Temperature factor from Table 2b 0.5400 (49)

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

Total storage loss

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (56)

If cylinder contains dedicated solar storage

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (57)
23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Primary loss

Total heat required for water heating calculated for each month

246.6685	217.1471	227.4225	202.9957	198.2965	176.2764	168.4300	186.0119	186.0569	210.5376	223.7203	240.4390 (62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

246.6685	217.1471	227.4225	202.9957	198.2965	176.2764	168.4300	186.0119	186.0569	210.5376	223.7203	240.4390 (64)

Total per year (kWh/year) = Sum(64)m = 2484.0024 (64)

Heat gains from water heating, kWh/month

105.0382	92.9945	98.6389	89.7744	88.9545	80.8902	79.0239	84.8699	84.1422	93.0247	96.6653	102.9669 (65)

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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	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)

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

69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365 (67)

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

736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211 (68)

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

41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792 (69)
3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Pumps, fans

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

-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332 (71)

Water heating gains (Table 5)

141.1804	138.3847	132.5792	124.6867	119.5626	112.3475	106.2150	114.0724	116.8642	125.0332	134.2574	138.3964 (72)

Total internal gains

1028.2281	1025.2702	988.6311	927.4954	860.9850	800.6890	764.0037	772.0234	805.6489	867.0610	937.6715	994.8914 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1808.9564	2432.3698	3106.9602	3856.1219	4404.4253	4430.4402	4217.1696	3751.9174	3203.6139	2475.4289	1887.1609	1653.5840	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9815	56.0654	56.1479	56.5388	56.6125	56.9583	56.9583	57.0228	56.8246	56.6125	56.4636	56.3087	
alpha	4.7321	4.7377	4.7432	4.7693	4.7742	4.7972	4.7972	4.8015	4.7883	4.7742	4.7642	4.7539	

util living area

1.0000	0.9998	0.9990	0.9945	0.9734	0.9028	0.7783	0.8471	0.9752	0.9984	0.9999	1.0000 (86)

MIT	19.3237	19.4766	19.7502	20.1290	20.5082	20.8040	20.9355	20.8997	20.6303	20.1440	19.6659	19.3008	(87)
Th 2	19.8877	19.8892	19.8907	19.8975	19.8987	19.9047	19.9047	19.9058	19.9024	19.8987	19.8962	19.8935	(88)

util rest of house

0.9999	0.9997	0.9986	0.9919	0.9579	0.8380	0.6354	0.7245	0.9534	0.9975	0.9998	1.0000 (89)

MIT 2	17.6193	17.8442	18.2456	18.8034	19.3485	19.7435	19.8751	19.8510	19.5295	18.8278	18.1263	17.5897	(90)

Living area fraction fLA = Living area / (4) = 0.0768 (91)

MIT	17.7502	17.9696	18.3612	18.9052	19.4376	19.8250	19.9565	19.9316	19.6140	18.9289	18.2446	17.7211	(92)

Temperature adjustment 0.0000

adjusted MIT	17.7502	17.9696	18.3612	18.9052	19.4376	19.8250	19.9565	19.9316	19.6140	18.9289	18.2446	17.7211	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9995	0.9976	0.9881	0.9485	0.8319	0.6433	0.7281	0.9445	0.9959	0.9997	0.9999	(94)
Useful gains	1808.7362	2431.0910	3099.6211	3810.1211	4177.7673	3685.8035	2713.0884	2731.9436	3025.7801	2465.3728	1886.5186	1653.4555	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

11729.4279	11380.4504	10313.0590	8639.1888	6672.4836	4478.3924	2876.9166	3023.5193	4737.2551	7182.3942	9635.7838	11722.7629	(97)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	7380.9947	6013.9695	5366.7978	3476.9288	1856.0689	0.0000	0.0000	0.0000	0.0000	3509.4639	5579.4709	7491.5647	(98)
Space heating												40675.2593	(98)
Space heating per m2											(98) / (4) =	57.8595	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												43502.9511	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	7380.9947	6013.9695	5366.7978	3476.9288	1856.0689	0.0000	0.0000	0.0000	0.0000	3509.4639	5579.4709	7491.5647	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	7894.1119	6432.0530	5739.8907	3718.6404	1985.1005	0.0000	0.0000	0.0000	0.0000	3753.4374	5967.3486	8012.3687	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	246.6685	217.1471	227.4225	202.9957	198.2965	176.2764	168.4300	186.0119	186.0569	210.5376	223.7203	240.4390	(64)
Efficiency of water heater												79.8000	(216)
(217)m	90.1093	90.0791	90.0094	89.8355	89.3437	79.8000	79.8000	79.8000	79.8000	89.8184	90.0346	90.1242	(217)
Fuel for water heating, kWh/month													
	273.7437	241.0627	252.6654	225.9637	221.9481	220.8977	211.0652	233.0976	233.1540	234.4037	248.4826	266.7862	(219)
Water heating fuel used												2863.2706	(219)
Annual totals kWh/year													
Space heating fuel - main system												43502.9511	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												1232.6303	(232)
Total delivered energy for all uses												47673.8519	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	43502.9511	0.2160	9396.6374	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2863.2706	0.2160	618.4664	(264)
Space and water heating			10015.1039	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	1232.6303	0.5190	639.7351	(268)
Total CO2, kg/m2/year			10693.7640	(272)
Emissions per m2 for space and water heating			14.2462	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			0.9100	(272b)
Emissions per m2 for pumps and fans			0.0554	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2462 * 1.00) + 0.9100 + 0.0554, rounded to 2 d.p.			15.2100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0164	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.7664	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6514	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8305	0.8143	0.7980	0.7165	0.7003	0.6188	0.6188	0.6025	0.6514	0.7003	0.7328	0.7654	(22b)
Effective ac	0.8449	0.8315	0.8184	0.7567	0.7452	0.6915	0.6915	0.6815	0.7122	0.7452	0.7685	0.7929	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.60)			95.6000	1.5038	143.7594			(27)
Glazed Door			28.5800	1.8000	51.4440			(26a)
Roof Window (Uw = 1.60)			5.8500	1.5038	8.7970			(27a)
Heat Loss Floor 2			220.0000	0.2500	55.0000			(28)
Heat Loss Floor 1			39.0000	0.2500	9.7500			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.3000	190.1460			(29a)
Stud wall	16.0000		16.0000	0.1735	2.7763			(29a)
wall to garage	61.3500		61.3500	0.2492	15.2865			(29a)
Pitched	97.0000		97.0000	0.1481	14.3704			(30)
flat roof	175.0000	5.8500	169.1500	0.1600	27.0640			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		518.3936			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	204.9525	(36)
Total fabric heat loss (33) + (36) =	723.3461	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	681.8230	671.0152	660.4213	610.6625	601.3527	558.0144	558.0144	549.9887	574.7077	601.3527	620.1862	639.8757	(38)
Heat transfer coeff	1405.1691	1394.3612	1383.7674	1334.0085	1324.6988	1281.3604	1281.3604	1273.3348	1298.0537	1324.6988	1343.5323	1363.2218	(39)
Average = Sum(39)m / 12 =												1333.9639	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.9988	1.9834	1.9684	1.8976	1.8844	1.8227	1.8227	1.8113	1.8464	1.8844	1.9111	1.9391	(40)
HLP (average)												1.8975	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558	(42)
Average daily hot water use (litres/day)	121.0260	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1904.2097 (45)

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

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

41.9530	36.6923	37.8632	33.0101	31.6739	27.3322	25.3273	29.0635	29.4106	34.2752	37.4140	40.6292	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)

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

69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365	(67)

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

736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211	(68)

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

41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	(69)

Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	(71)

Water heating gains (Table 5)

56.3884	54.6017	50.8914	45.8473	42.5725	37.9614	34.0421	39.0638	40.8480	46.0688	51.9639	54.6092	(72)

Total internal gains

940.4361	938.4872	903.9433	845.6560	780.9949	723.3028	688.8309	694.0148	726.6326	785.0966	852.3780	908.1042	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1721.1645	2345.5867	3022.2724	3774.2825	4324.4353	4353.0540	4141.9968	3673.9087	3124.5977	2393.4645	1801.8674	1566.7967	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7428	35.0120	35.2801	36.5961	36.8532	38.0997	38.0997	38.3398	37.6097	36.8532	36.3366	35.8118	
alpha	3.3162	3.3341	3.3520	3.4397	3.4569	3.5400	3.5400	3.5560	3.5073	3.4569	3.4224	3.3875	

util living area

0.9998	0.9995	0.9985	0.9948	0.9824	0.9472	0.8818	0.9194	0.9837	0.9981	0.9997	0.9999	(86)

MIT	18.4839	18.6681	19.0181	19.5435	20.0489	20.5147	20.7637	20.7044	20.3025	19.6581	19.0202	18.5079	(87)
Th 2	19.3341	19.3444	19.3545	19.4025	19.4115	19.4542	19.4542	19.4621	19.4377	19.4115	19.3932	19.3742	(88)

util rest of house

0.9998	0.9993	0.9978	0.9920	0.9698	0.8942	0.7289	0.8031	0.9654	0.9967	0.9995	0.9999	(89)

MIT 2	17.0889	17.2802	17.6371	18.1953	18.7020	19.1772	19.3782	19.3490	18.9739	18.3172	17.6667	17.1410	(90)

Living area fraction fLA = Living area / (4) = 0.0768 (91)

MIT	17.1961	17.3868	17.7431	18.2989	18.8055	19.2799	19.4846	19.4531	19.0759	18.4202	17.7707	17.2460	(92)

Temperature adjustment 0.0000

adjusted MIT	17.1961	17.3868	17.7431	18.2989	18.8055	19.2799	19.4846	19.4531	19.0759	18.4202	17.7707	17.2460	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9989	0.9967	0.9887	0.9621	0.8849	0.7334	0.8020	0.9580	0.9951	0.9993	0.9998	(94)
Useful gains	1720.5304	2343.0466	3012.2371	3731.6319	4160.4170	3852.1603	3037.6902	2946.5678	2993.2842	2381.8254	1800.5649	1566.4156	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

18121.1484	17411.1554	15557.8991	12538.1882	9412.6070	5996.6557	3696.2470	3887.6484	6459.0357	10359.4346	14336.4149	17784.5892	(97)

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh

12202.0598	10125.7691	9333.9726	6340.7206	3907.6293	0.0000	0.0000	0.0000	0.0000	5935.3413	9025.8120	12066.3212	(98)

Space heating 68937.6259 (98)

Space heating per m2 (98) / (4) = 98.0621 (99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	12044.7879	9482.0671	9677.3444	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4238	0.5014	0.4472	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5104.4977	4754.3884	4327.9745	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5266.8238	5017.1715	4489.6665	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	116.8747	195.5106	120.2988	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												432.6842	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	29.2187	48.8777	30.0747	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												108.1710	(107)
Space cooling per m2												0.1539	(108)
Energy for space heating												98.0621	(99)
Energy for space cooling												0.1539	(108)
Total												98.2159	(109)
Dwelling Fabric Energy Efficiency (DFEE)												98.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0164	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2664	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2264	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2887	0.2830	0.2773	0.2490	0.2434	0.2151	0.2151	0.2094	0.2264	0.2434	0.2547	0.2660	(22b)
Effective ac	0.5417	0.5400	0.5385	0.5310	0.5296	0.5231	0.5231	0.5219	0.5256	0.5296	0.5324	0.5354	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			28.5800	1.2000	34.2960			(26a)
TER Opening Type (Uw = 1.40)			95.6000	1.3258	126.7424			(27)
TER Room Window (Uw = 1.70)			5.8500	1.5918	9.3118			(27a)
Heat Loss Floor 2			220.0000	0.1300	28.6000			(28)
Heat Loss Floor 1			39.0000	0.1300	5.0700			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.1800	114.0876			(29a)
Stud wall	16.0000		16.0000	0.1800	2.8800			(29a)
wall to garage	61.3500		61.3500	0.1800	11.0430			(29a)
Pitched	97.0000		97.0000	0.1300	12.6100			(30)
flat roof	175.0000	5.8500	169.1500	0.1300	21.9895			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		366.6303			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	68.3175	(36)
Total fabric heat loss (33) + (36) =	434.9478	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	437.1164	435.8108	434.5310	428.5202	427.3956	422.1603	422.1603	421.1908	424.1768	427.3956	429.6706	432.0491	(38)
Heat transfer coeff	872.0642	870.7586	869.4789	863.4680	862.3434	857.1081	857.1081	856.1386	859.1247	862.3434	864.6185	866.9970	(39)
Average = Sum(39)m / 12 =												863.4626	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2405	1.2386	1.2368	1.2283	1.2267	1.2192	1.2192	1.2178	1.2221	1.2267	1.2299	1.2333	(40)
HLP (average)												1.2283	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558 (42)
Average daily hot water use (litres/day)	121.0260 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1904.2097	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
41.9530	36.6923	37.8632	33.0101	31.6739	27.3322	25.3273	29.0635	29.4106	34.2752	37.4140	40.6292	(65)	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	(71)	
Water heating gains (Table 5)													
56.3884	54.6017	50.8914	45.8473	42.5725	37.9614	34.0421	39.0638	40.8480	46.0688	51.9639	54.6092	(72)	
Total internal gains													
940.4361	938.4872	903.9433	845.6560	780.9949	723.3028	688.8309	694.0148	726.6326	785.0966	852.3780	908.1042	(73)	

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1721.1645	2345.5867	3022.2724	3774.2825	4324.4353	4353.0540	4141.9968	3673.9087	3124.5977	2393.4645	1801.8674	1566.7967	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9815	56.0654	56.1479	56.5388	56.6125	56.9583	56.9583	57.0228	56.8246	56.6125	56.4636	56.3087	
alpha	4.7321	4.7377	4.7432	4.7693	4.7742	4.7972	4.7972	4.8015	4.7883	4.7742	4.7642	4.7539	
util living area													
1.0000	0.9998	0.9991	0.9950	0.9751	0.9078	0.7866	0.8551	0.9774	0.9987	0.9999	1.0000	(86)	
MIT	19.3122	19.4652	19.7391	20.1185	20.4990	20.7976	20.9323	20.8949	20.6210	20.1333	19.6547	19.2894	(87)
Th 2	19.8877	19.8892	19.8907	19.8975	19.8987	19.9047	19.9047	19.9058	19.9024	19.8987	19.8962	19.8935	(88)
util rest of house													
1.0000	0.9998	0.9988	0.9926	0.9605	0.8450	0.6446	0.7349	0.9573	0.9978	0.9999	1.0000	(89)	
MIT 2	18.3274	18.4816	18.7564	19.1401	19.5145	19.7901	19.8832	19.8660	19.6395	19.1569	18.6765	18.3091	(90)
Living area fraction									fLA = Living area / (4) =			0.0768	(91)
MIT	18.4030	18.5571	18.8319	19.2153	19.5901	19.8675	19.9638	19.9450	19.7149	19.2319	18.7517	18.3844	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4030	18.5571	18.8319	19.2153	19.5901	19.8675	19.9638	19.9450	19.7149	19.2319	18.7517	18.3844	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9996	0.9982	0.9903	0.9548	0.8422	0.6537	0.7404	0.9521	0.9970	0.9998	1.0000	(94)
Useful gains	1721.0299	2344.7262	3016.9232	3737.7985	4129.1140	3666.3304	2707.5310	2720.1825	2974.8877	2386.2425	1801.4610	1566.7206	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
12298.7477	11892.0560	10722.3452	8906.9153	6803.9886	4514.8099	2883.1307	3035.0265	4823.8642	7443.6603	10074.2548	12297.8422	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
7869.8220	6415.8056	5732.8340	3721.7641	1990.1067	0.0000	0.0000	0.0000	0.0000	3762.7188	5956.4115	7983.9545	(98)	
Space heating												43433.4173	(98)
Space heating per m2											(98) / (4) =	61.7830	(99)

8c. Space cooling requirement

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	8056.8163	6342.6000	6506.6535	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6215	0.7188	0.6493	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5007.4295	4558.9096	4224.5358	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5266.8238	5017.1715	4489.6665	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	186.7638	340.9468	197.2572	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												724.9678	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	46.6910	85.2367	49.3143	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												181.2420	(107)
Space cooling per m2												0.2578	(108)
Energy for space heating												61.7830	(99)
Energy for space cooling												0.2578	(108)
Total												62.0408	(109)
Target Fabric Energy Efficiency (TFEE)												71.3	(109)

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

Design SAP
elmhurst energy

Property Reference	S462_House 61	**Issued on Date**	07/03/2022
Assessment Reference	Be Green_ASHP	**Prop Type Ref**	House 61
Property	Reddington Road, House 61, London, NW3 7RP		

SAP Rating	59 D	**DER**	30.39	**TER**	23.05
Environmental	63 D	**% DER<TER**	-31.86		
CO_2 Emissions (t/year)	17.91	**DFEE**	98.22	**TFEE**	71.35
General Requirements Compliance	Fail	**% DFEE<TFEE**	-37.66		

Assessor Details	Mr. Andy Love, Love Design Studio Ltd, Tel: 07563755762, Mail@lovedesignstudio.co.uk	**Assessor ID**	U860-0001
Client			

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

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

DWELLING AS DESIGNED

Detached House, total floor area 703 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 23.05 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 30.39 kgCO□/m²Fail
Excess emissions =7.34 kgCO□/m² (31.8%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)71.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)98.2 kWh/m²/yrFail
Excess energy =26.9 kWh/m²/yr (37.7%)

2 Fabric U-values

Element	Average	Highest	
External wall	0.29 (max. 0.30)	0.30 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.25 (max. 0.25)	0.25 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.64 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK

4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Nominal cylinder loss: 1.82 kWh/day
Permitted by DBSCG 2.10: OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 3.63 m², No overhang
Windows facing North East: 23.88 m², No overhang
Windows facing East: 3.89 m², No overhang
Windows facing South East: 17.95 m², No overhang
Windows facing South West: 30.33 m², No overhang
Windows facing West: 1.99 m², No overhang
Windows facing North West: 13.93 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							9 * 10 =	90.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.0368	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.7868	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6688	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8527	0.8360	0.8193	0.7357	0.7189	0.6353	0.6353	0.6186	0.6688	0.7189	0.7524	0.7858	(22b)
Effective ac	0.8635	0.8494	0.8356	0.7706	0.7584	0.7018	0.7018	0.6913	0.7236	0.7584	0.7830	0.8088	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.60)			95.6000	1.5038	143.7594			(27)
Glazed Door			28.5800	1.8000	51.4440			(26a)
Roof Window (Uw = 1.60)			5.8500	1.5038	8.7970			(27a)
Heat Loss Floor 2			220.0000	0.2500	55.0000			(28)
Heat Loss Floor 1			39.0000	0.2500	9.7500			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.3000	190.1460			(29a)
Stud wall	16.0000		16.0000	0.1735	2.7763			(29a)
wall to garage	61.3500		61.3500	0.2492	15.2865			(29a)
Pitched	97.0000		97.0000	0.1481	14.3704			(30)
flat roof	175.0000	5.8500	169.1500	0.1600	27.0640			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		518.3936			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	204.9525	(36)
Total fabric heat loss (33) + (36) =	723.3461	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	696.8727	685.4805	674.3138	621.8644	612.0513	566.3695	566.3695	557.9099	583.9655	612.0513	631.9031	652.6573	(38)
Heat transfer coeff	1420.2188	1408.8266	1397.6599	1345.2105	1335.3973	1289.7156	1289.7156	1281.2560	1307.3115	1335.3973	1355.2492	1376.0034	(39)
Average = Sum(39)m / 12 =												1345.1635	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0202	2.0040	1.9881	1.9135	1.8996	1.8346	1.8346	1.8226	1.8596	1.8996	1.9278	1.9573	(40)
HLP (average)												1.9135	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558 (42)
Average daily hot water use (litres/day)	121.0260 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1904.2097	(45)
Distribution loss (46)m = 0.15 x (45)m													
	29.6139	25.9005	26.7270	23.3012	22.3581	19.2933	17.8781	20.5154	20.7604	24.1942	26.4099	28.6795	(46)
Water storage loss:													
Store volume												180.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8736	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9805	(55)
Total storage loss													
	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(56)
If cylinder contains dedicated solar storage													
	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	251.0847	221.1360	231.8387	207.2695	202.7128	180.5501	172.8462	190.4281	190.3306	214.9538	227.9940	244.8552	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	251.0847	221.1360	231.8387	207.2695	202.7128	180.5501	172.8462	190.4281	190.3306	214.9538	227.9940	244.8552	(64)
										Total per year (kWh/year) = Sum(64)m =		2535.9997	(64)
Heat gains from water heating, kWh/month													
	108.5712	96.1856	102.1719	93.1934	92.4875	84.3092	82.5569	88.4029	87.5612	96.5577	100.0843	106.4999	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	(71)
Water heating gains (Table 5)													
	145.9290	143.1333	137.3278	129.4353	124.3112	117.0961	110.9636	118.8211	121.6128	129.7818	139.0060	143.1450	(72)
Total internal gains													
	1032.9767	1030.0188	993.3797	932.2440	865.7336	805.4376	768.7524	776.7721	810.3975	871.8096	942.4201	999.6401	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1813.7050	2437.1184	3111.7088	3860.8705	4409.1740	4435.1888	4221.9183	3756.6660	3208.3625	2480.1775	1891.9095	1658.3326	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3746	34.6526	34.9294	36.2913	36.5580	37.8529	37.8529	38.1028	37.3434	36.5580	36.0225	35.4792	
alpha	3.2916	3.3102	3.3286	3.4194	3.4372	3.5235	3.5235	3.5402	3.4896	3.4372	3.4015	3.3653	
util living area													
	0.9998	0.9994	0.9983	0.9944	0.9815	0.9448	0.8776	0.9154	0.9824	0.9978	0.9996	0.9999	(86)
MIT	19.0237	19.1631	19.4274	19.8271	20.2082	20.5614	20.7479	20.7046	20.4020	19.9153	19.4334	19.0454	(87)
Th 2	19.3199	19.3307	19.3413	19.3916	19.4011	19.4459	19.4459	19.4543	19.4286	19.4011	19.3819	19.3619	(88)
util rest of house													
	0.9997	0.9992	0.9976	0.9913	0.9682	0.8900	0.7215	0.7954	0.9628	0.9962	0.9995	0.9998	(89)
MIT 2	16.7275	16.9388	17.3328	17.9509	18.5095	19.0333	19.2523	19.2216	18.8115	18.0876	17.3693	16.7876	(90)
Living area fraction										fLA = Living area / (4) =		0.0768	(91)
MIT	16.9039	17.1096	17.4937	18.0950	18.6400	19.1506	19.3672	19.3355	18.9336	18.2280	17.5278	16.9610	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.9039	17.1096	17.4937	18.0950	18.6400	19.1506	19.3672	19.3355	18.9336	18.2280	17.5278	16.9610	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9987	0.9961	0.9871	0.9576	0.8733	0.7095	0.7802	0.9514	0.9941	0.9991	0.9997	(94)
Useful gains	1812.8354	2433.8725	3099.5022	3811.0198	4222.3658	3873.0362	2995.2856	2930.9945	3052.5902	2465.5467	1890.1557	1657.7983	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Heat loss rate W
17900.2936 17201.2554 15365.4834 12369.2145 9267.6031 5869.0219 3568.8432 3761.1698 6319.0656 10186.4641 14132.2949 17559.1677 (97)
Month fracti 1.0000 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 (97a)
Space heating kWh
11969.0689 9923.6813 9125.8900 6161.9002 3753.6565 0.0000 0.0000 0.0000 0.0000 5744.3625 8814.3402 11830.6188 (98)
Space heating 67323.5185 (98)
Space heating per m2 (98) / (4) = 95.7660 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 175.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 38448.6114 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	11969.0689	9923.6813	9125.8900	6161.9002	3753.6565	0.0000	0.0000	0.0000	0.0000	5744.3625	8814.3402	11830.6188	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	6835.5619	5667.4365	5211.8161	3519.0749	2143.7216	0.0000	0.0000	0.0000	0.0000	3280.6182	5033.8893	6756.4928	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement
251.0847 221.1360 231.8387 207.2695 202.7128 180.5501 172.8462 190.4281 190.3306 214.9538 227.9940 244.8552 (64)
Efficiency of water heater 175.1000 (216)
(217)m 175.1000 175.1000 175.1000 175.1000 175.1000 175.1000 175.1000 175.1000 175.1000 175.1000 175.1000 175.1000 (217)
Fuel for water heating, kWh/month
143.3950 126.2912 132.4036 118.3720 115.7697 103.1126 98.7129 108.7539 108.6982 122.7606 130.2079 139.8374 (219)
Water heating fuel used 1448.3151 (219)
Annual totals kWh/year
Space heating fuel - main system 38448.6114 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 30.0000 (231)
Electricity for lighting (calculated in Appendix L) 1232.6303 (232)
Total delivered energy for all uses 41159.5567 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	38448.6114	0.5190	19954.8293	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1448.3151	0.5190	751.6755	(264)
Space and water heating			20706.5048	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	1232.6303	0.5190	639.7351	(268)
Total CO2, kg/year			21361.8099	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			30.3900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER 30.3900 ZC1
Total Floor Area TFA 703.0000
Assumed number of occupants N 3.6558
CO2 emission factor in Table 12 for electricity displaced from grid EF 0.5190
CO2 emissions from appliances, equation (L14) 6.2074 ZC2
CO2 emissions from cooking, equation (L16) 0.2941 ZC3
Total CO2 emissions 36.8915 ZC4
Residual CO2 emissions offset from biofuel CHP 0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year 0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation 0.0000 ZC7
Net CO2 emissions 36.8915 ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0164	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2664	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2264	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2887	0.2830	0.2773	0.2490	0.2434	0.2151	0.2151	0.2094	0.2264	0.2434	0.2547	0.2660	(22b)
Effective ac	0.5417	0.5400	0.5385	0.5310	0.5296	0.5231	0.5231	0.5219	0.5256	0.5296	0.5324	0.5354	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			28.5800	1.2000	34.2960			(26a)
TER Opening Type (Uw = 1.40)			95.6000	1.3258	126.7424			(27)
TER Room Window (Uw = 1.70)			5.8500	1.5918	9.3118			(27a)
Heat Loss Floor 2			220.0000	0.1300	28.6000			(28)
Heat Loss Floor 1			39.0000	0.1300	5.0700			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.1800	114.0876			(29a)
Stud wall	16.0000		16.0000	0.1800	2.8800			(29a)
wall to garage	61.3500		61.3500	0.1800	11.0430			(29a)
Pitched	97.0000		97.0000	0.1300	12.6100			(30)
flat roof	175.0000	5.8500	169.1500	0.1300	21.9895			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		366.6303			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	68.3175	(36)
Total fabric heat loss (33) + (36) =	434.9478	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	437.1164	435.8108	434.5310	428.5202	427.3956	422.1603	422.1603	421.1908	424.1768	427.3956	429.6706	432.0491	(38)
Heat transfer coeff	872.0642	870.7586	869.4789	863.4680	862.3434	857.1081	857.1081	856.1386	859.1247	862.3434	864.6185	866.9970	(39)
Average = Sum(39)m / 12 =												863.4626	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2405	1.2386	1.2368	1.2283	1.2267	1.2192	1.2192	1.2178	1.2221	1.2267	1.2299	1.2333	(40)
HLP (average)												1.2283	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558 (42)
Average daily hot water use (litres/day)	121.0260 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1904.2097 (45)

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

29.6139	25.9005	26.7270	23.3012	22.3581	19.2933	17.8781	20.5154	20.7604	24.1942	26.4099	28.6795 (46)

Water storage loss:

Store volume 180.0000 (47)

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

Temperature factor from Table 2b 0.5400 (49)

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

Total storage loss

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (56)

If cylinder contains dedicated solar storage

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (57)
23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Primary loss

Total heat required for water heating calculated for each month

246.6685	217.1471	227.4225	202.9957	198.2965	176.2764	168.4300	186.0119	186.0569	210.5376	223.7203	240.4390 (62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

246.6685	217.1471	227.4225	202.9957	198.2965	176.2764	168.4300	186.0119	186.0569	210.5376	223.7203	240.4390 (64)

Total per year (kWh/year) = Sum(64)m = 2484.0024 (64)

Heat gains from water heating, kWh/month

105.0382	92.9945	98.6389	89.7744	88.9545	80.8902	79.0239	84.8699	84.1422	93.0247	96.6653	102.9669 (65)

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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	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)

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

69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365 (67)

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

736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211 (68)

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

41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792 (69)
3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Pumps, fans

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

-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332 (71)

Water heating gains (Table 5)

141.1804	138.3847	132.5792	124.6867	119.5626	112.3475	106.2150	114.0724	116.8642	125.0332	134.2574	138.3964 (72)

Total internal gains

1028.2281	1025.2702	988.6311	927.4954	860.9850	800.6890	764.0037	772.0234	805.6489	867.0610	937.6715	994.8914 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1808.9564	2432.3698	3106.9602	3856.1219	4404.4253	4430.4402	4217.1696	3751.9174	3203.6139	2475.4289	1887.1609	1653.5840	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9815	56.0654	56.1479	56.5388	56.6125	56.9583	56.9583	57.0228	56.8246	56.6125	56.4636	56.3087	
alpha	4.7321	4.7377	4.7432	4.7693	4.7742	4.7972	4.7972	4.8015	4.7883	4.7742	4.7642	4.7539	

util living area

1.0000	0.9998	0.9990	0.9945	0.9734	0.9028	0.7783	0.8471	0.9752	0.9984	0.9999	1.0000 (86)

MIT	19.3237	19.4766	19.7502	20.1290	20.5082	20.8040	20.9355	20.8997	20.6303	20.1440	19.6659	19.3008	(87)
Th 2	19.8877	19.8892	19.8907	19.8975	19.8987	19.9047	19.9047	19.9058	19.9024	19.8987	19.8962	19.8935	(88)

util rest of house

0.9999	0.9997	0.9986	0.9919	0.9579	0.8380	0.6354	0.7245	0.9534	0.9975	0.9998	1.0000 (89)

MIT 2	17.6193	17.8442	18.2456	18.8034	19.3485	19.7435	19.8751	19.8510	19.5295	18.8278	18.1263	17.5897	(90)

Living area fraction fLA = Living area / (4) = 0.0768 (91)

MIT	17.7502	17.9696	18.3612	18.9052	19.4376	19.8250	19.9565	19.9316	19.6140	18.9289	18.2446	17.7211	(92)

Temperature adjustment 0.0000

adjusted MIT	17.7502	17.9696	18.3612	18.9052	19.4376	19.8250	19.9565	19.9316	19.6140	18.9289	18.2446	17.7211	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9995	0.9976	0.9881	0.9485	0.8319	0.6433	0.7281	0.9445	0.9959	0.9997	0.9999	(94)
Useful gains	1808.7362	2431.0910	3099.6211	3810.1211	4177.7673	3685.8035	2713.0884	2731.9436	3025.7801	2465.3728	1886.5186	1653.4555	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

11729.4279	11380.4504	10313.0590	8639.1888	6672.4836	4478.3924	2876.9166	3023.5193	4737.2551	7182.3942	9635.7838	11722.7629	(97)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	7380.9947	6013.9695	5366.7978	3476.9288	1856.0689	0.0000	0.0000	0.0000	0.0000	3509.4639	5579.4709	7491.5647	(98)
Space heating												40675.2593	(98)
Space heating per m2											(98) / (4) =	57.8595	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												43502.9511	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	7380.9947	6013.9695	5366.7978	3476.9288	1856.0689	0.0000	0.0000	0.0000	0.0000	3509.4639	5579.4709	7491.5647	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	7894.1119	6432.0530	5739.8907	3718.6404	1985.1005	0.0000	0.0000	0.0000	0.0000	3753.4374	5967.3486	8012.3687	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	246.6685	217.1471	227.4225	202.9957	198.2965	176.2764	168.4300	186.0119	186.0569	210.5376	223.7203	240.4390	(64)
Efficiency of water heater												79.8000	(216)
(217)m	90.1093	90.0791	90.0094	89.8355	89.3437	79.8000	79.8000	79.8000	79.8000	89.8184	90.0346	90.1242	(217)
Fuel for water heating, kWh/month													
	273.7437	241.0627	252.6654	225.9637	221.9481	220.8977	211.0652	233.0976	233.1540	234.4037	248.4826	266.7862	(219)
Water heating fuel used												2863.2706	(219)
Annual totals kWh/year													
Space heating fuel - main system												43502.9511	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												1232.6303	(232)
Total delivered energy for all uses												47673.8519	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	43502.9511	0.2160	9396.6374	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2863.2706	0.2160	618.4664	(264)
Space and water heating			10015.1039	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	1232.6303	0.5190	639.7351	(268)
Total CO2, kg/m2/year			10693.7640	(272)
Emissions per m2 for space and water heating			14.2462	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			0.9100	(272b)
Emissions per m2 for pumps and fans			0.0554	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2462 * 1.55) + 0.9100 + 0.0554, rounded to 2 d.p.			23.0500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0164	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.7664	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6514	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8305	0.8143	0.7980	0.7165	0.7003	0.6188	0.6188	0.6025	0.6514	0.7003	0.7328	0.7654	(22b)
Effective ac	0.8449	0.8315	0.8184	0.7567	0.7452	0.6915	0.6915	0.6815	0.7122	0.7452	0.7685	0.7929	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.60)			95.6000	1.5038	143.7594			(27)
Glazed Door			28.5800	1.8000	51.4440			(26a)
Roof Window (Uw = 1.60)			5.8500	1.5038	8.7970			(27a)
Heat Loss Floor 2			220.0000	0.2500	55.0000			(28)
Heat Loss Floor 1			39.0000	0.2500	9.7500			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.3000	190.1460			(29a)
Stud wall	16.0000		16.0000	0.1735	2.7763			(29a)
wall to garage	61.3500		61.3500	0.2492	15.2865			(29a)
Pitched	97.0000		97.0000	0.1481	14.3704			(30)
flat roof	175.0000	5.8500	169.1500	0.1600	27.0640			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		518.3936			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	204.9525	(36)
Total fabric heat loss (33) + (36) =	723.3461	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	681.8230	671.0152	660.4213	610.6625	601.3527	558.0144	558.0144	549.9887	574.7077	601.3527	620.1862	639.8757	(38)
Heat transfer coeff	1405.1691	1394.3612	1383.7674	1334.0085	1324.6988	1281.3604	1281.3604	1273.3348	1298.0537	1324.6988	1343.5323	1363.2218	(39)
Average = Sum(39)m / 12 =												1333.9639	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.9988	1.9834	1.9684	1.8976	1.8844	1.8227	1.8227	1.8113	1.8464	1.8844	1.9111	1.9391	(40)
HLP (average)												1.8975	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558	(42)
Average daily hot water use (litres/day)	121.0260	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1904.2097 (45)

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

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

41.9530	36.6923	37.8632	33.0101	31.6739	27.3322	25.3273	29.0635	29.4106	34.2752	37.4140	40.6292	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)

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

69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365	(67)

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

736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211	(68)

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

41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	(69)

Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	(71)

Water heating gains (Table 5)

56.3884	54.6017	50.8914	45.8473	42.5725	37.9614	34.0421	39.0638	40.8480	46.0688	51.9639	54.6092	(72)

Total internal gains

940.4361	938.4872	903.9433	845.6560	780.9949	723.3028	688.8309	694.0148	726.6326	785.0966	852.3780	908.1042	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1721.1645	2345.5867	3022.2724	3774.2825	4324.4353	4353.0540	4141.9968	3673.9087	3124.5977	2393.4645	1801.8674	1566.7967	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7428	35.0120	35.2801	36.5961	36.8532	38.0997	38.0997	38.3398	37.6097	36.8532	36.3366	35.8118	
alpha	3.3162	3.3341	3.3520	3.4397	3.4569	3.5400	3.5400	3.5560	3.5073	3.4569	3.4224	3.3875	

util living area

0.9998	0.9995	0.9985	0.9948	0.9824	0.9472	0.8818	0.9194	0.9837	0.9981	0.9997	0.9999	(86)

MIT	18.4839	18.6681	19.0181	19.5435	20.0489	20.5147	20.7637	20.7044	20.3025	19.6581	19.0202	18.5079	(87)
Th 2	19.3341	19.3444	19.3545	19.4025	19.4115	19.4542	19.4542	19.4621	19.4377	19.4115	19.3932	19.3742	(88)

util rest of house

0.9998	0.9993	0.9978	0.9920	0.9698	0.8942	0.7289	0.8031	0.9654	0.9967	0.9995	0.9999	(89)

MIT 2	17.0889	17.2802	17.6371	18.1953	18.7020	19.1772	19.3782	19.3490	18.9739	18.3172	17.6667	17.1410	(90)

Living area fraction fLA = Living area / (4) = 0.0768 (91)

MIT	17.1961	17.3868	17.7431	18.2989	18.8055	19.2799	19.4846	19.4531	19.0759	18.4202	17.7707	17.2460	(92)

Temperature adjustment 0.0000

adjusted MIT	17.1961	17.3868	17.7431	18.2989	18.8055	19.2799	19.4846	19.4531	19.0759	18.4202	17.7707	17.2460	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9989	0.9967	0.9887	0.9621	0.8849	0.7334	0.8020	0.9580	0.9951	0.9993	0.9998	(94)
Useful gains	1720.5304	2343.0466	3012.2371	3731.6319	4160.4170	3852.1603	3037.6902	2946.5678	2993.2842	2381.8254	1800.5649	1566.4156	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

18121.1484	17411.1554	15557.8991	12538.1882	9412.6070	5996.6557	3696.2470	3887.6484	6459.0357	10359.4346	14336.4149	17784.5892	(97)

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh

12202.0598	10125.7691	9333.9726	6340.7206	3907.6293	0.0000	0.0000	0.0000	0.0000	5935.3413	9025.8120	12066.3212	(98)

Space heating 68937.6259 (98)

Space heating per m2 (98) / (4) = 98.0621 (99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	12044.7879	9482.0671	9677.3444	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4238	0.5014	0.4472	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5104.4977	4754.3884	4327.9745	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5266.8238	5017.1715	4489.6665	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	116.8747	195.5106	120.2988	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												432.6842	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	29.2187	48.8777	30.0747	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												108.1710	(107)
Space cooling per m2												0.1539	(108)
Energy for space heating												98.0621	(99)
Energy for space cooling												0.1539	(108)
Total												98.2159	(109)
Dwelling Fabric Energy Efficiency (DFEE)												98.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	220.0000	(1a)	x 2.9000	(2a) =	638.0000	(1a) - (3a)
Ground floor	213.0000	(1b)	x 3.3000	(2b) =	702.9000	(1b) - (3b)
First floor	154.0000	(1c)	x 3.1800	(2c) =	489.7200	(1c) - (3c)
Second floor	116.0000	(1d)	x 5.3000	(2d) =	614.8000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	703.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2445.4200	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0164	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2664	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2264	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2887	0.2830	0.2773	0.2490	0.2434	0.2151	0.2151	0.2094	0.2264	0.2434	0.2547	0.2660	(22b)
Effective ac	0.5417	0.5400	0.5385	0.5310	0.5296	0.5231	0.5231	0.5219	0.5256	0.5296	0.5324	0.5354	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			28.5800	1.2000	34.2960			(26a)
TER Opening Type (Uw = 1.40)			95.6000	1.3258	126.7424			(27)
TER Room Window (Uw = 1.70)			5.8500	1.5918	9.3118			(27a)
Heat Loss Floor 2			220.0000	0.1300	28.6000			(28)
Heat Loss Floor 1			39.0000	0.1300	5.0700			(28a)
External Wall 1	758.0000	124.1800	633.8200	0.1800	114.0876			(29a)
Stud wall	16.0000		16.0000	0.1800	2.8800			(29a)
wall to garage	61.3500		61.3500	0.1800	11.0430			(29a)
Pitched	97.0000		97.0000	0.1300	12.6100			(30)
flat roof	175.0000	5.8500	169.1500	0.1300	21.9895			(30)
Total net area of external elements Aum(A, m2)			1366.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		366.6303			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	68.3175	(36)
Total fabric heat loss (33) + (36) =	434.9478	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	437.1164	435.8108	434.5310	428.5202	427.3956	422.1603	422.1603	421.1908	424.1768	427.3956	429.6706	432.0491	(38)
Heat transfer coeff	872.0642	870.7586	869.4789	863.4680	862.3434	857.1081	857.1081	856.1386	859.1247	862.3434	864.6185	866.9970	(39)
Average = Sum(39)m / 12 =												863.4626	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2405	1.2386	1.2368	1.2283	1.2267	1.2192	1.2192	1.2178	1.2221	1.2267	1.2299	1.2333	(40)
HLP (average)												1.2283	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.6558 (42)
Average daily hot water use (litres/day)	121.0260 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.1286	128.2875	123.4465	118.6054	113.7644	108.9234	108.9234	113.7644	118.6054	123.4465	128.2875	133.1286	(44)
Energy conte	197.4258	172.6699	178.1798	155.3415	149.0539	128.6222	119.1873	136.7692	138.4027	161.2950	176.0661	191.1964	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1904.2097	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
41.9530	36.6923	37.8632	33.0101	31.6739	27.3322	25.3273	29.0635	29.4106	34.2752	37.4140	40.6292	(65)	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	182.7915	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
69.7966	61.9927	50.4159	38.1681	28.5311	24.0871	26.0270	33.8309	45.4077	57.6556	67.2926	71.7365	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
736.4136	744.0553	724.7985	683.8032	632.0539	583.4169	550.9243	543.2827	562.5394	603.5348	655.2841	703.9211	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	41.2792	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	-146.2332	(71)	
Water heating gains (Table 5)													
56.3884	54.6017	50.8914	45.8473	42.5725	37.9614	34.0421	39.0638	40.8480	46.0688	51.9639	54.6092	(72)	
Total internal gains													
940.4361	938.4872	903.9433	845.6560	780.9949	723.3028	688.8309	694.0148	726.6326	785.0966	852.3780	908.1042	(73)	

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6300	10.6334	0.6300	0.7000	0.7700	11.7964	(74)
Northeast	23.8800	11.2829	0.6300	0.7000	0.7700	82.3433	(75)
East	3.8900	19.6403	0.6300	0.7000	0.7700	23.3490	(76)
Southeast	17.9500	36.7938	0.6300	0.7000	0.7700	201.8419	(77)
Southwest	30.3300	36.7938	0.6300	0.7000	0.7700	341.0509	(79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)
Northwest	13.9300	11.2829	0.6300	0.7000	0.7700	48.0336	(81)
Horizontal	5.8500	26.0000	0.6300	0.7000	1.0000	60.3685	(82)

Solar gains	780.7283	1407.0996	2118.3291	2928.6265	3543.4404	3629.7512	3453.1659	2979.8939	2397.9651	1608.3679	949.4894	658.6925	(83)
Total gains	1721.1645	2345.5867	3022.2724	3774.2825	4324.4353	4353.0540	4141.9968	3673.9087	3124.5977	2393.4645	1801.8674	1566.7967	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9815	56.0654	56.1479	56.5388	56.6125	56.9583	56.9583	57.0228	56.8246	56.6125	56.4636	56.3087	
alpha	4.7321	4.7377	4.7432	4.7693	4.7742	4.7972	4.7972	4.8015	4.7883	4.7742	4.7642	4.7539	
util living area													
1.0000	0.9998	0.9991	0.9950	0.9751	0.9078	0.7866	0.8551	0.9774	0.9987	0.9999	1.0000	(86)	
MIT	19.3122	19.4652	19.7391	20.1185	20.4990	20.7976	20.9323	20.8949	20.6210	20.1333	19.6547	19.2894	(87)
Th 2	19.8877	19.8892	19.8907	19.8975	19.8987	19.9047	19.9047	19.9058	19.9024	19.8987	19.8962	19.8935	(88)
util rest of house													
1.0000	0.9998	0.9988	0.9926	0.9605	0.8450	0.6446	0.7349	0.9573	0.9978	0.9999	1.0000	(89)	
MIT 2	18.3274	18.4816	18.7564	19.1401	19.5145	19.7901	19.8832	19.8660	19.6395	19.1569	18.6765	18.3091	(90)
Living area fraction									fLA = Living area / (4) =			0.0768	(91)
MIT	18.4030	18.5571	18.8319	19.2153	19.5901	19.8675	19.9638	19.9450	19.7149	19.2319	18.7517	18.3844	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4030	18.5571	18.8319	19.2153	19.5901	19.8675	19.9638	19.9450	19.7149	19.2319	18.7517	18.3844	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9996	0.9982	0.9903	0.9548	0.8422	0.6537	0.7404	0.9521	0.9970	0.9998	1.0000	(94)
Useful gains	1721.0299	2344.7262	3016.9232	3737.7985	4129.1140	3666.3304	2707.5310	2720.1825	2974.8877	2386.2425	1801.4610	1566.7206	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
12298.7477	11892.0560	10722.3452	8906.9153	6803.9886	4514.8099	2883.1307	3035.0265	4823.8642	7443.6603	10074.2548	12297.8422	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
7869.8220	6415.8056	5732.8340	3721.7641	1990.1067	0.0000	0.0000	0.0000	0.0000	3762.7188	5956.4115	7983.9545	(98)	
Space heating												43433.4173	(98)
Space heating per m2											(98) / (4) =	61.7830	(99)

8c. Space cooling requirement

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	8056.8163	6342.6000	6506.6535	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6215	0.7188	0.6493	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5007.4295	4558.9096	4224.5358	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5266.8238	5017.1715	4489.6665	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	186.7638	340.9468	197.2572	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												724.9678	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	46.6910	85.2367	49.3143	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												181.2420	(107)
Space cooling per m2												0.2578	(108)
Energy for space heating												61.7830	(99)
Energy for space cooling												0.2578	(108)
Total												62.0408	(109)
Target Fabric Energy Efficiency (TFEE)												71.3	(109)

APPENDIX B – CIBSE TM59 OVERHEATING ASSESSMENT

A Dynamic Software Model (DSM) using IES- Virtual Environment software (IES VE). has been used to assess the scheme's likelihood of overheating against the CIBSE TM59 'Design methodology for the assessment of overheating risk in homes (2017)' criteria and targets.

The modelling incorporates windows, window reveals, balcony doors and external shading from balcony structure and includes all rooms as stipulated within TM59 methodology requirements.

As per the TM59 guidance, and considering the scheme's primary ventilation strategy is to use window openings, the following two criteria must be met:

1) For living rooms, kitchens and bedrooms:

The number of hours during which ΔT (the difference between operative and threshold comfort temperatures) is greater than or equal to one degree (K), during the period of May to September inclusive, shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).

2) For bedrooms only:

To evaluate comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

Criteria for Homes Predominantly Mechanically Ventilated

For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Communal Corridors

Corridor ventilation should be included in the analysis as designed. Whilst there is no mandatory target to meet, if an operative temperature of 28 °C is exceeded for more than 3% of the total annual hours, then this should be identified as a significant risk within the report.

The following was considered as part of the assessment:

- The assessment has been produced using the following weather files:
  - London Heathrow DSY1: 2020_50_High emissions scenario.
  - London Heathrow DSY1: 2050_50_High emissions scenario.
  - London Heathrow DSY1: 2080_50_High emissions scenario.
  - London Heathrow DSY2: 2020_50_High emissions scenario.
  - London Heathrow DSY3: 2020_50_High emissions scenario.
- Blinds have not been included in the assessment as they would clash with opening windows.
- The site is within a conservation area and there are strict regulations on what can be incorporated to the external façade; therefore, external shutters and louvres have not been modelled as part of the scheme.
- The windows have only been modelled as open when the internal temperature is greater than or equal to 22 degC during occupied hours.
- Bathrooms and corridors have been included in the model but are not required to pass.
- Internal doors have been modelled as open, but bedroom doors have been modelled as shut during sleeping hours.
- Profiles for occupancy periods, and internal gains (people, lighting, equipment) are standardised and include the following:
  - 1 person is assumed present in bedrooms during the daytime
  - 2 people in the night in a double bedroom.
  - Living spaces occupied from 9am to 10pm

Natural ventilation paths are modelled by algorithms that control the window and balcony door openings where applicable. Cross-ventilation is possible. Bedroom doors are modelled as open during the day and closed in the evening.

The software incorporates VistaPro, which permits range testing of variables. Such as Operative Temperatures more than 26°C between the hours of 10pm to 7am as per Chapter 4.3 of TM:59. This methodology has been applied for all Living/Dining/Kitchens and for Bedrooms. This is the Fixed Temperature method.

The following images are taken from the thermal models which provide a visual indication of how the building is exposed to solar gain. Blue areas are the apartments, Magenta areas and green areas are local shading such as balconies:

MODELLING IMAGES

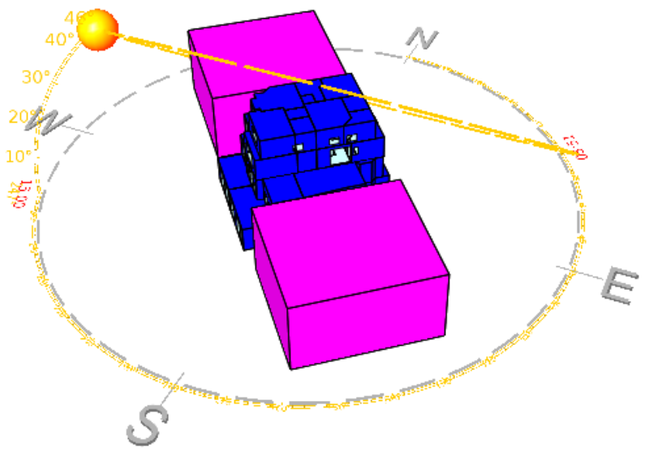

Figure 7: Modelling image from IES VE DSM software.

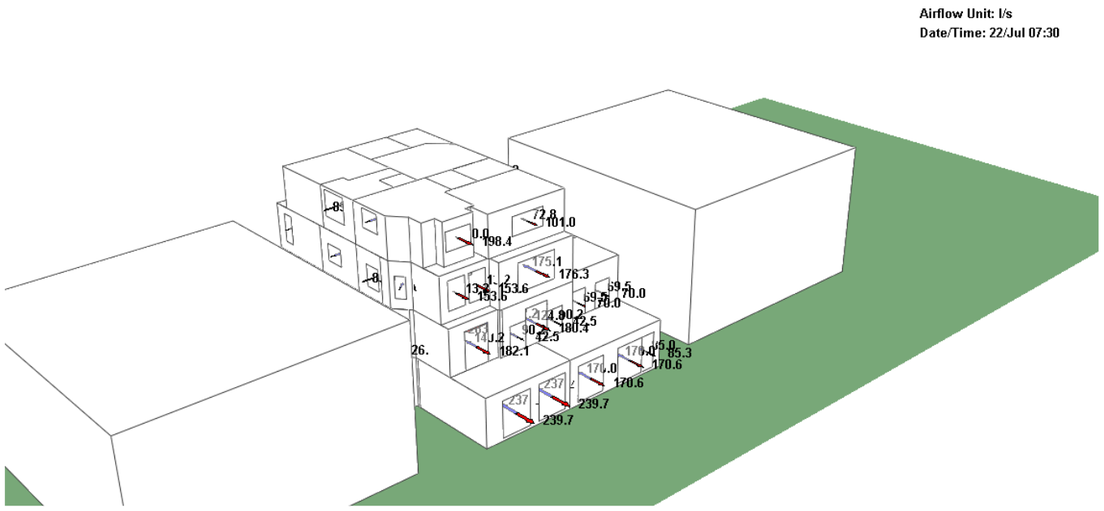

Figure 8: Modelling image from the MacroFlo module from the IES VE software indicating bulk-air flow.

BUILDING CLASSIFICATION

The following building classifications are stipulated with Table 2 CIBSE TM:52. These classifications determine the benchmark values within each criterion that the building must be seen to meet or better. Depending on the classification a greater or lesser benchmark is set with corresponding level of expectation.

Category	Description	Acceptable Range (degK)
Category I	High level of expectation only used for spaces occupied by very sensitive fragile persons	2
Category II	Normal expectation (for new buildings and renovations)	3
Category III	A moderate expectation (used for existing buildings)	4

Building Fabric

(See Energy Statement).

Glazing Specification

Glazing Type	Double Glazing, Low-E Soft Coat
g-value	0.4
Frame Factor	0.85
Blinds	Not modelled as would interfere with the window openings.

RESULTS SUMMARY

The results indicate that the Gym and Sauna uses require some form of active cooling under its current design based on CIBSE TM52 Criterion 1 targets.

All five bedrooms exceed 26degC for more than 32 hours of the year in accordance with TM59 Criterion 2 under the 2080 and DSY03 2020 weather files.

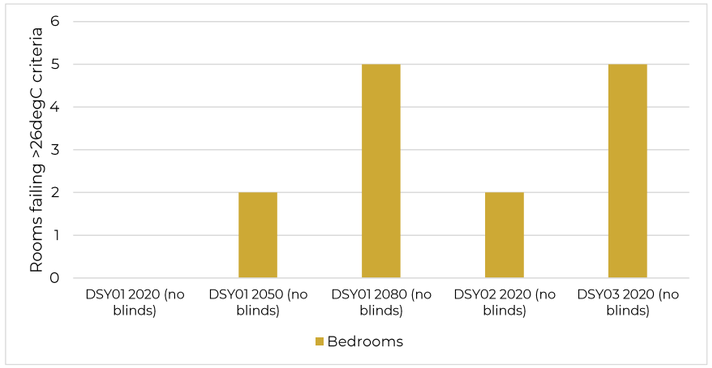

Figure 9: Criterion 2 results for individual bedrooms.

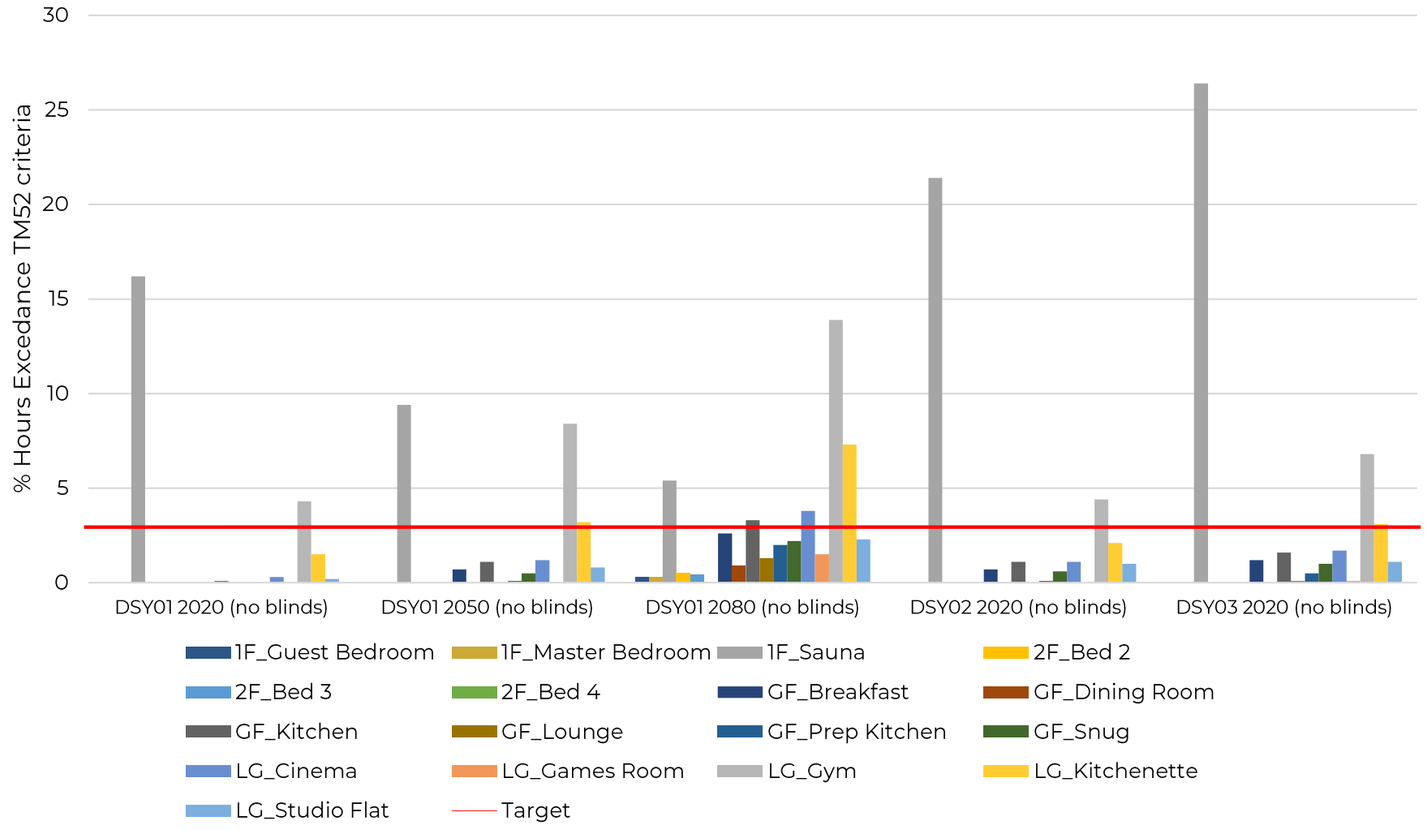

Figure 10: Criterion 1 results for the individual rooms.

CRITERION 1 - HOURS OF EXCEEDANCE – DETAILED RESULTS

Weather file	1F_Guest Bedroom	1F_Master	1F_Sauna	2F_Bed 2	2F_Bed 3	2F_Bed 4	GF_Breakfast	GF_Dining Room	GF_Kitchen	GF_Lounge	GF_Prep Kitchen	GF_Snug	LG_Cinema	LG_Games Room	LG_Gym	LG_Kitchenette	LG_Studio Flat
DSY01 2020 (no blinds)	0	0	16.2	0	0	0	0	0	0.1	0	0	0	0.3	0	4.3	1.5	0.2
DSY01 2020 (no blinds)	0	0	9.4	0	0	0	0.7	0	1.1	0	0.1	0.5	1.2	0	8.4	3.2	0.8
DSY01 2020 (no blinds)	0.3	0.3	5.4	0.5	0.4	0	2.6	0.9	3.3	1.3	2	2.2	3.8	1.5	13.9	7.3	2.3
DSY01 2020 (no blinds)	0	0	21.4	0	0	0	0.7	0	1.1	0	0.1	0.6	1.1	0	4.4	2.1	1
DSY01 2020 (no blinds)	0	0	26.4	0	0	0	1.2	0	1.6	0.1	0.5	1	1.7	0.1	6.8	3.1	1.1

CRITERION 2 - HOURS OF EXCEEDANCE ABOVE 26°C – DETAILED RESULTS

Weather file	1F_Master Bedroom	1F_Guest	2F_Bed 2	2F_Bed 3	2F_Bed 4
DSY01 2020 (no blinds)	11	9	13	10	12
DSY01 2020 (no blinds)	28	22	36	29	42
DSY01 2020 (no blinds)	108	94	133	103	142
DSY01 2020 (no blinds)	27	21	34	24	35
DSY01 2020 (no blinds)	38	33	43	39	52

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