COVE HOMES

LISS FOREST NURSERY - GREATHAM

Energy & Sustainability Statement

16th September 2021

SEC/cs/ESS- 3693/-

Southern Energy Consultants
Energy & Sustainability Solutions

About Southern Energy Consultants Ltd

Southern Energy Consultants Ltd are a construction consultancy specialising in sustainability, energy conservation, the application of renewable technologies and statutory utilities infrastructure design and management. As a consultancy we do not sell or have financial interest in any products so are able to take an objective view of developments to assist developers with incorporating cost effective and practical solutions.

Our services include Planning Energy Statements, energy calculations for Building Regulation compliance, Code for Sustainable Homes assessments and utilities design and management. Our team of consultants include registered SAP, SBEM and Code for Sustainable Homes assessors, Planning Specialists, Renewable Energy Specialists, CAD Specialist, Utilities Specialists and Civil Engineers.

Within SEC Ltd we have over 25 years experience working with and for National Developers, Construction and Design and Build Contractors we apply our expertise not only to assist with developers understanding of new energy and sustainability obligations but also in a way that ensures that the needs and responsibilities of all stakeholders are wholly respected.

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1.0 Introduction and Planning Policy Requirements

Site and proposals

1.1 This Energy and Sustainability Statement has been prepared by Southern Energy Consultants on behalf of Cove Construction Ltd., Peter Catt, Vincent Catt and Neill Catt (hereafter referred to as the Applicant). The Statement reviews and reports on the sustainable design and construction measures proposed for development of 37 dwellings of mixed type and tenure on a site of 2.35 hectares at Liss Forest Nursery, Greatham. The proposals also include hard and soft landscaping, drainage and associated infrastructure works.

1.2 The village of Greatham is located within the South Downs National Park and currently constitutes a horticultural nursery and residential dwelling. Nearby are Deal Farm, Greatham Village Hall, Greatham Primary School and the Greatham Conservation Area. The site's close proximity to the A3 trunk road facilitates easy connections to larger settlements close to Greatham, including Petersfield, Haslemere and Portsmouth. The railway station in Liss, located approximately 3 miles from the site, provides a connecting service to Guildford and London Waterloo every 20-40 minutes during the working week, and Portsmouth approximately every half an hour. Bus route 38 from Alton to Petersfield runs three times a day from Monday to Saturday and stops less than two minutes' walk from the site in the village centre of Greatham. Walking opportunities are available via Shipwrights Way, a trail of approximately 31 miles from Alice Holt Forest to Portsmouth.

Planning policies of relevance

1.3 At a **national level**, The National Planning Policy Framework (NPPF, 2021) places considerable emphasis on a *"presumption in favour of sustainable development"*. As such, developments which do not cause demonstrable harm to existing communities, the environment and countryside will be likely to be approved, with their contribution to sustainable economic growth recognised. In order to be considered 'sustainable', a development must also adhere to the policy contents described within local plans.

1.4 The policy agenda within the NPPF recognises that sustainable development comprises:

- Social progress which recognises the needs of everyone
- Effective protection of the environment

- Prudent use of natural resources
- Maintenance of high and stable levels of economic growth

Developments must be stable and in keeping with these objectives. They should ensure the provision of high quality accommodation in suitable locations. Locations which reduce the need for travel should be targeted. As a consequence, developments should only be located in areas where it is possible to provide a high level of infrastructure and support services.

1.5 The Government will require all new development to meet prescribed and staged carbon emissions reduction targets outlined within Building Regulations. The NPPF places emphasis on the use of renewable energy and/or energy efficiency measures as a tool for meeting the four overarching elements of the Government's Strategy for Sustainable Development. The wider environmental and economic benefits of all proposals for renewable energy and/or energy efficiency ventures, irrespective of their scale, are material planning considerations that are given significant weight when determining the success of planning applications. In terms of energy generation, the NPPF asserts that to support the move to a low carbon future, local planning authorities should plan for new development in locations and ways which reduce greenhouse gas emissions and, when setting any local requirement for a building's sustainability, do so in a way consistent with nationally described standards.

1.6 Developments where the principal objective is to conserve or enhance biodiversity will be favoured. Proposals for development are to be permitted where they do not cause harm to biodiversity and where mitigation measures are put in place for the loss of any features of ecological value.

1.7 Local Planning Authorities should ensure that new developments make sufficient provision for waste management and promotes designs and layouts that secure the integration of waste management facilities without adverse impact on the street scene or, in less developed areas, the local landscape. The issue of flood risk should be taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is, exceptionally, necessary in such areas, development proposals should deliver safe schemes, without increasing flood risk elsewhere and, where possible, reducing flood risk overall.

1.8 **Local policies** for sustainable design and construction are set out in the South Downs Local Plan (adopted July 2019). The most relevant policies with regards to this planning application are SD1 (Sustainable development), SD2 (Ecosystem services), SD9 (Biodiversity and geodiversity), SD17 (Protection of the water environment), SD19 (Transport and accessibility), SD20 (Walking, cycling and pedestrian routes), SD45 (Green infrastructure), SD48 (Climate change and sustainable use of resources), SD49 (Flood risk management), SD51 (Renewable energy) and SD54 (Pollution and air quality).

1.9 Policy SD1 affirms that the NPPF's 'presumption in favour of sustainable development' will apply. The National Park purposes are i) to conserve and enhance the natural beauty, wildlife and cultural heritage of the area; and ii) to promote opportunities for the understanding and enjoyment of the special qualities of the National Park by the public. Where it appears that there is a conflict between the National Park purposes, greater weight will be attached to the first of those purposes. Planning permission will be refused where development proposals fail to conserve the landscape, natural beauty, wildlife and cultural heritage of the National Park unless, exceptionally: a) the benefits of the proposals demonstrably outweigh the great weight to be attached to those interests; and b) there is substantial compliance with other relevant policies in the development plan.

1.10 Policy SD2 states that development proposals will be permitted where they have an overall positive impact on the ability of the natural environment to contribute goods and services. This will be achieved through the use of high quality design, and by delivering all opportunities to: a) sustainably manage land and water environments; b) protect and provide more, better and joined up natural habitats; c) conserve water resources and improve water quality; d) manage and mitigate the risk of flooding; e) improve the National Park's resilience to, and mitigation of, climate change; f) increase the ability to store carbon through new planting or other means; g) conserve and enhance soils, use soils sustainably and protect the best and most versatile agricultural land; h) support the sustainable production and use of food, forestry and raw materials; i) reduce levels of pollution; j) improve opportunities for peoples' health and wellbeing; and k) provide opportunities for access to the natural and cultural resources which contribute to the special qualities.

1.11 Policy SD9 articulates that proposals for development must conserve and enhance biodiversity and geodiversity, giving particular regard to ecological networks and areas with high potential for

priority habitat restoration or creation. In particular, proposals should a) retain, protect and enhance features of biodiversity and geological interest (including supporting habitat and commuting routes through the site and taking due account of any use by migratory species) and ensure appropriate and long-term management of those features; b) identify and incorporate opportunities for net gains in biodiversity; c) contribute to the restoration and enhancement of existing habitats, the creation of wildlife habitats and the creation of linkages between sites to create and enhance local and regional ecological networks; d) protect and support recovery of rare, notable and priority species; e) seek to eradicate or control any invasive non-native species present on site; f) contribute to the protection, management and enhancement of biodiversity and geodiversity; and g) comply with the mitigation hierarchy as set out in national policy.

1.12 Policy SD17 demands that development proposals do not affect groundwater, surface water features, and watercourse corridors. This is unless they enhance the following: a) water quality and quantity, and help achieve requirements of the European Water Framework Directive, or its replacement; b) ability of groundwater, surface water features and watercourse corridors to function by natural processes throughout seasonal variations, within the immediate vicinity, and both upstream and downstream of the site of the proposal; and c) specifically for surface water features and watercourse corridors i. biodiversity; ii. historic significance; iii. character, appearance, and setting; iv. public access to and along the waterway for recreational opportunities; and v. ability for maintenance of the watercourse, including for flood risk management purposes.

1.13 Policies SD19 and SD20 articulate that development proposals will be permitted provided that they are located and designed to minimise the need to travel and promote the use of sustainable modes of transport. Development proposals that are likely to generate a significant number of journeys must be located near existing town and village centres, public transport routes, main roads and, where relevant, the cycle network. The following improvements to transport infrastructure will be supported: a) public transport waiting facilities, particularly those with reliable and accessible information; b) infrastructure supporting the transfer of freight from road to rail and water; c) improvements to walking, cycling and bus connectivity at all transport interchanges; and d) improvements to the quality and provision of cycle parking at railway stations and key bus stops. In village centres such as Greatham, development will be permitted which appropriately provides for improved footways, cycle routes and cycle parking.

1.14 Policy SD45 requires new development proposals to maintain or enhance green infrastructure (GI) assets, links and the overall GI network. GI proposals must contribute to multifunctional landscapes which: a) strengthen connectivity and resilience of ecological networks; b) incorporate GI measures that are appropriate to the type and context of the development proposal as part of an overall landscape design; c) maximise opportunities to mitigate, adapt and improve resilience to climate change; d) maximise opportunities for cycling and walking, including multi-user routes and, where possible, facilitate circular routes; and e) support health and wellbeing and improve opportunities for understanding and enjoyment of the National Park and its special qualities.

1.15 Policy SD48 outlines that all new development proposals are required to incorporate sustainable design features that will reduce and mitigate the anticipated impacts of impact change. Unless demonstrated to be technically unfeasible or unviable, all new residential developments must deliver at least a 19% reduction in carbon dioxide emissions against Part L of Building Regulations (2013) through energy efficiency measures and achieve total mains water consumption of not more than 110 litres per person per day.

1.16 Policy SD49 requires development proposals, wherever possible, to be located in Flood Zone 1. Development in areas of flood risk will, where relevant, be required to meet the national Sequential and Exception Tests, not increasing the risk of flooding elsewhere and, wherever possible, reducing overall flood risk. Flood protection, mitigation and adaptation measures should be adopted and the integrity of coastal and river flood defences should not be undermined.

1.17 Policy SD51 affirms that proposals for renewable energy schemes that contribute towards reducing greenhouse gas emissions and moving towards a carbon neutral National Park will be permitted where it is demonstrated through suitable site specific analysis that the proposal: a) makes provision for the removal of the facilities and reinstatement of the site, should it cease to be operational; b) ensures existing public access is not impeded; and c) does not result in the loss in use of Grades 1, 2 or 3a agricultural land. Development proposals for small-scale individual wind turbines and freestanding solar arrays serving individual properties or small groups of properties will be permitted where: a) they are suitably sited and screened and clearly associated with the buildings or properties that they are intended to serve; b) they are appropriate in scale to the property being served; and c) there is no unacceptable adverse impact on local amenity or conflict with public safety.

1.18 Policy SD54 states that development proposals will be permitted provided that levels of air, noise, vibration, light, water, odour or other pollutants do not have a significant negative affect on people and the natural environment now or in the foreseeable future, taking into account cumulative impacts and any mitigation measures that are proposed.

1.19 In addition, the East Hampshire District Council's Local Plan: Joint Core Strategy (2014) sets out a number of relevant policies that largely repeat the content expressed in the South Downs National Park's Local Plan. These include Policies CP1 (Presumption in favour of sustainable development), CP21 (Biodiversity), CP24 (Sustainable construction), CP25 (Flood risk), CP26 (Water resources/water quality), CP27 (Pollution), CP28 (Green infrastructure), CP29 (Design) and CP31 (Transport). Key targets, such as the 10% renewable energy generation required by Policy CP24, have been superseded by more stringent requirements in the South Downs National Park's more recently adopted Local Plan.

Aims and structure

1.20 This Statement provides a comprehensive summary of the Applicant's sustainability proposals, with particular emphasis on the energy/emissions, biodiversity and water management measures that will be integrated in order to satisfy the policy requirements of the NPPF and the South Downs National Park's Local Plan. The Applicant's response to these requirements is provided in Sections 2 to 7 of this Statement.

2.0 Building Design and Carbon Dioxide Emissions

Baseline emissions

2.1 All 37 dwellings at Liss Forest Nursery will be designed and built to meet or better the current emissions standard set by Part L1a of Building Regulations (2013. The estimated regulated carbon dioxide emissions for the dwellings have been calculated using SAP (2012) methodology and the most up-to-date Elmhurst software. SAP calculates the regulated carbon dioxide emissions associated with space heating, hot water and fixed electrical items. The estimated regulated carbon dioxide emissions for the 37 dwellings are calculated per dwelling type and aggregated in Table 1 below.

Table 1: Baseline Carbon Dioxide Emissions – Liss Forest Nursery

Dwelling Type	Baseline Carbon Dioxide Emissions ($KgCO_2/yr$)	Number of Dwellings	Total Carbon Dioxide Emissions ($KgCO_2/yr$)
Private dwellings			
Vyne A/C	1,481	6	8,886
Pemberley	1,438	3	4,314
Longstock	1,672	4	6,688
Houghton	1,836	1	1,836
Dean	1,782	4	7,128
Hyde	1,818	1	1,818
Oakleigh	2,454	1	2,454
Alverstoke	2,712	2	5,424
Avington	2,724	2	5,448
Hillier	2,733	2	5,466
Omerley	3,012	2	6,024
Omerley - DG	3,111	1	3,111
Sub-total		**29**	**58,597**
Affordable dwellings			
Romsey (average)	1,127	2	2,254
Vyne B	1,481	4	5,924
Longstock	1,672	2	3,344
Sub-total		**8**	**11,522**
TOTAL		**37**	**70,119**

2.2 Baseline emissions for the development are **70,119 $kgCO_2$/year.** Given the current 'climate emergency', the Applicant has determined that the development will target at least a 31% reduction (**21,737 $kgCO_2$/year)** in carbon dioxide emissions rather than the 19% reduction that is required by Policy SD48. A 31% reduction is the reduction in emissions that will be required under forthcoming revisions to Building Regulations as a step change in the pathway to zero carbon homes articulated via the Future Homes Standard. The 31% reduction target will be achieved via a combination of energy efficiency measures and feasible renewable energy technologies. This Statement first sets out the Applicant's energy efficiency measures which will deliver lower emissions than the baseline

in Table 1. A feasibility study is then conducted to determine technically suitable renewable energy technologies for the Liss Forest Nursery site, before further calculations are conducted to demonstrate the site-wide reductions in emissions following installation.

Energy efficiency measures

2.3 As a first energy efficiency measure, the proposed dwellings will incorporate sufficient insulation in the building envelope (walls, roofs, floors and glazing) to achieve average U-values considerably better than the limiting standards demanded by Part L1a of 2013 Building Regulations. Table 2 overleaf illustrates the proposed U-values and the limiting area-weighted values set by Part L1a of 2013 Building Regulations.

Table 2: Insulation Enhancement Proposals

Thermal Element	Maximum Area-Weighted U-value (W/m^2K) Allowable Under 2013 Building Regulations	Proposed U-value (W/m^2K) Required to Meet 2013 Building Regulations Baseline	% Improvement on 2013 Allowable U-Value Standard
Main external walls	0.30	0.29	3.33
Roof (joists)	0.20	0.11	45.00
Roof (rafters)	0.20	0.15	25.00
Ground floor	0.25	0.11-.012	52.00-60.00
Windows	2.00	1.40	30.00

2.4 The Applicant intends to meet the U-value performance standards detailed in Table 2 through the following construction specification for the main thermal elements (Table 3).

Table 3: Fabric Enhancement Construction Specification

Construction Element	Delivered U-Value	Insulation Specification
Main external walls	0.29	300mm construction, including 100mm bricks, 50mm cavity fully filled with mineral wool batts (thermal

		conductivity of 0.037 W/m^{2}K or better), medium density blocks (thermal conductivity of 0.28 W/m^{2}K), and plasterboard (taped and jointed).
Party walls	0.00	Fully filled and sealed.
Roof (joists)	0.11	One layer of 100mm mineral wool insulation (thermal conductivity of 0.044 W/m^{2}K) laid between ceiling joists and one layer of 300mm mineral wool insulation (thermal conductivity of 0.044 W/m^{2}K) laid over to provide a total thickness of 400mm.
Roof (rafters)	0.15	Layer of 130mm XR4000 insulation between rafters and 30mm XR4000 (thermal conductivity of 0.022 W/m^{2}K) insulation underneath.
Ground floor	0.11-0.12	Beam and block construction (175mm beam) to include 150mm insulation (thermal conductivity maximum of 0.022 W/m^{2}K) with screed topping.
Windows	1.40	PVCu double-glazed windows with low 'e' soft coat glazing to specialist BFRC approved manufacturers design and specification.

2.5 In accordance with the objectives of Policy SD54, all insulating materials that will be specified will have an Ozone Depleting Potential of Zero and a Global Warming Potential of less than 5.

2.6 The performance standards and fabric measures detailed in Tables 2 and 3 will result in a reduced space heating requirement for the dwellings. The dwellings will also benefit from advanced Time and Temperature Zone controls. As such, it will be possible for future occupants to minimise the energy demand associated with the heating operation of their home in two defined localities.

2.7 The specified boiler for all dwellings at Liss Forest Nursery will have a SEDBUK (2009) energy efficiency of at least 88.9%. Combi boilers will be provided to dwellings with one or two bedrooms; system boilers to all other dwelling types. The installation of weather compensators will further improve the efficiency of the whole heating system, reducing demand and associated carbon dioxide emissions. All hot water cylinders will be insulated and have very low heat loss of not more than 1.80 kWh/day.

2.8 Air tightness standards will be improved by the Applicant adopting a mixture of LABC and Accredited Construction Details for non-repeating thermal bridges. These details incorporate an improvement over Building Regulations (2013) requirements by reducing air leakage loss and convective bypass of insulation. The Applicant will reduce the dwelling's design air permeability from $10m^3/hm^2$ to $5m^3/hm^2$ to further reduce space heating requirements.

2.9 It is not proposed to provide any mechanical cooling to the proposed dwellings. Instead it is the intention of the Applicant to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical measures such as good thermal insulation and an air tight build.

2.10 Ventilation to the dwellings will be facilitated via the installation of highly efficient decentralised extract fans. In addition, the development will adopt a range of passive ventilation measures. Openable windows will be installed as a necessary fixture to facilitate natural ventilation. These will help facilitate cross-ventilation, convective-ventilation and night purging.

2.11 All of the internal lighting throughout the development will be of the dedicated low energy type. External lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices.

Emissions Summary After Energy Efficiency Measures

2.12 SAP calculations have demonstrated that the adoption of the robust design measures set out in Paragraphs 2.3 to 2.11 of this Statement results in annual carbon dioxide emissions for the 37 proposed dwellings of **60,173 $kgCO_2$/year**, with the outcomes for each dwelling type and in aggregate summarised in Table 4 overleaf. This is a reduction of **9,946 $kgCO_2$/year** from the baseline of **70,119 $kgCO_2$/year**, equal to **14.18%**. Detailed examples of the SAP Calculations are provided in the Appendix to this Statement, with the modelled outputs for other dwelling types available upon request.

Table 4: As-Designed Carbon Dioxide Emissions – Liss Forest Nursery

Dwelling Type	Baseline Carbon Dioxide Emissions ($KgCO_2/yr$)	Number of Dwellings	Total Carbon Dioxide Emissions ($KgCO_2/yr$)
Private dwellings			
Vyne A/C	1,292	6	1,292
Pemberley	1,245	3	3,735
Longstock	1,588	4	6,352
Houghton	1,595	1	1,595
Dean	1,958	4	7,832
Hyde	1,733	1	1,733
Oakleigh	2,390	1	2,390
Alverstoke	2,641	2	5,282
Avington	2,653	2	5,306
Hillier	2,662	2	5,324
Omerley	2,934	2	5,868
Omerley - DG	3,030	1	3,030
Sub-total		**29**	**49,739**
Affordable dwellings			
Romsey (average)	1,045	2	2,090
Vyne B	1,292	4	5,168
Longstock	1,588	2	3,176
Sub-total		**8**	**10,434**
TOTAL		**37**	**60,173**

Renewable energy objective and feasibility

2.13 Energy efficiency measures have reduced site-wide emissions from the baseline scenario by 9,946 $kgCO_2$/year, however, the Applicant must now deliver at least a further **11,791 $kgCO_2$/year** reduction in carbon dioxide emissions through technically feasible renewable energy installations.

2.14 Renewable energy is defined as *"those energy flows that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of oceans, from the sun and also from biomass"* (London Plan, 2015). The technologies to be evaluated in this Statement are as follows:

- District Heating / CHP
- Biomass
- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

2.15 The Applicant has conducted a detailed review of the feasibility of installing Combined Heat and Power infrastructure (CHP) to serve the Liss Forest Nursery development. CHP is a form of district heating that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high carbon dioxide emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. While CHP would enable reductions in carbon dioxide emissions beyond the baseline case, the following reasons make it unsuited to this development:

- **Diversity and extent of heat demand** – CHP is best suited to developments where there is a diversity of energy demand. A mixed-use scheme built out in a single phase, or a very large residential scheme (>1,000 homes) will have extended periods of the day in which there is a continuous demand for heat. In these circumstances, the district heating network and CHP engine can operate consistently to generate electricity, with heat as a by-product. On a small-sized residential scheme such as this, heat demand would be low and not continuous, especially during the working day, leading to an over-generation and subsequent dumping of heat.
- **Distributional heat losses** – thermal stores are a source of standing heat losses, as are even the best insulated distribution networks. When communal systems satisfy only a small and intermittent demand, these standing losses will represent a large part (>30%) of total demand. Carbon dioxide emissions savings gained within the dwellings through association

with CHP may be considerably reduced by the additional heat losses associated with the network.

- **Plant room size and location** – to incorporate a central plant room would require a considerable amount of space. The most suitable location in terms of space would be one of the proposed perimeter areas of public open space, but the installation of such infrastructure would be in conflict with the Applicant's objective to deliver a vibrant and ecologically prosperous development with land uses suitable for people of all ages, including children and young families. The noise emissions generated from plant infrastructure would also be high and in conflict with the objectives of Policy SD54.
- **Minimised heat demands** – the Applicant's proposed energy strategy is based on the adoption of best practice standards for energy efficiency, an approach resulting in reduced space heating demands, which reduces the suitability of any district heating scheme.
- **Installed costs** – the installed cost of any CHP / district heating network benefit from economies of scale. However, pipe run costs remain approximately £1,000 per metre, and total costs for CHP infrastructure across the site – predominantly from the plant room, CHP engine and pipe runs – would likely extend beyond £3 million for a scheme of this scale.
- **Running costs** – the fixed costs associated with the management and operation of a communal plant room would need to be shared by future occupants as part of an energy standing charge. The smaller the scheme, the greater the cost for the individual occupant, a particularly unfair situation in the light of the Applicant's commitment to provide significant levels of affordable housing. In addition, CHP engines impose additional running costs as contracts for maintenance and replacement costs are typically handled by specialist companies.
- **Absence of other local infrastructure** – there are no other CHP / district heating networks in the vicinity of the development with which to forge a connection to serve the development.

2.16 Biomass community heating is an alternative to conventional fossil fuel heating but, as per the reasons used against the installation of gas-fuelled CHP or district heating, should be discounted as an option at Liss Forest Nursery for the proposed dwellings. Biomass boilers within individual dwellings are usually installed with a standard gas boiler as back-up in case the occupier runs out of fuel. Although they are reducing in size, they are still large enough to require a dedicated room with additional space for the fuel – there is insufficient space available for such infrastructure in the

majority of proposed dwelling types, especially the two bedroom houses and two apartments. The management of fuel deliveries and ash dispersal is also complex, necessitating a dedicated operative as opposed to residents of the future dwellings at Liss Forest Nursery. Furthermore, the emissions of Nitrous Oxide and particulate matter that are associated with biomass installations would have the capacity to worsen air pollution in the National Park.

Ground and Air Source Heat Pumps (GSHPs and ASHPs)

2.17 Although GSHPs require considerable land area for deployment, ASHPs can be affixed to a property, providing heating and cooling, and space and hot water heating. In addition, ASHPs provide an efficient form of heating during summer and winter months due to a very high seasonal coefficient of performance, which is typically around 3.2. This means that a heat pump provides heating which is 320% efficient, as compared to a gas boiler which typically has a SEDBUK (2009) efficiency of around 90%. Maintenance requirements are low and there is no requirement on the part of the future homeowner to store fuel, as would be the case with a biomass boiler. Although ASHPs have traditionally been thought of as a 'noisy technology' technological advancements in recent years mean that modern systems rarely emit any more sound than a domestic fridge-freezer. The potential for the technology to present a visual blight to surroundings is relatively low in the case of houses, and therefore the technology has been deemed suitable for the proposed dwellings at Liss Forest Nursery.

Hydroelectric power

2.18 Hydroelectric power plants generate electricity using the gravitational force of flowing or falling water. However, there are no rivers of sufficient scale in the vicinity of the Liss Forest Nursery development to facilitate a hydroelectric power installation.

Wind Turbines

2.19 Wind turbines are a modern, high-technology descendant of the windmills that have been around for centuries. In modern windmills the kinetic energy of the wind is used to turn a turbine to generate electricity as opposed to moving water or turning a grist mill wheel. A site with an average wind speed of 5m/s or more is generally considered to be suitable for installing a wind turbine. The average wind speed at the Liss Forest Nursery development is moderate, around 4.3m/s at 10m AOD and is below the level required to generate significant carbon dioxide reductions or commercial

take-up. The installation of a single, large wind turbine to serve the development would also be controversial due to the nature of the locality. Even if space could be found within the development to accommodate a very high (15-20m) turbine, their installation would then present a significant visual blight to neighbours in Greatham Village and likely be visible from the Greatham Conservation Area located just 100 metres to the south of the site. Furthermore, this technology could only generate significant reductions in carbon dioxide emissions for a small proportion of the 37 dwellings associated with the development.

Solar thermal and photovoltaic panels

2.20 Solar thermal heating panels contribute to the hot water demand of a dwelling. Water or glycol (heat transfer liquid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store where heat is exchanged with water from the conventional system. The proposed dwellings generally contain suitable attributes (orientation, available roof-space and limited shadowing) for solar photovoltaic installations to be designed-in, although solar thermal installations are unsuitable in some cases. This is because the smaller dwelling types, such as the two bedroom houses, have very little space to accommodate a large hot water cylinder incorporating dedicated solar storage. Most importantly, due to the seasonal availability of solar radiation, at best solar thermal panels can satisfy around 60% of a dwelling's annual hot water demand, which equates to a reduction in per annum carbon dioxide emissions of 15%, and is thus insufficient to satisfy the Applicant's sought-after 31% reduction in site-wide emissions.

2.21 There are few constraints on the capacity of solar photovoltaic panels to deliver reductions in emissions. For nearly all of the dwellings on the site, roof-space is available at no worse than a west-east orientation and there is sufficient roof-space available to accommodate up to 4-6 panels. However, in some cases, the presence of dormers will constrain opportunities to install solar photovoltaic panels, and the Applicant has also considered the potential for large-scale installations to present a visual blight to the surrounds. A potential solar photovoltaic layout is include in the Appendix to this Statement, demonstrating that panels will only be included on roof-space on a single elevation per dwelling, with no panels visible from outside the northern perimeter of the site.

Impacts of feasible options

2.22 The feasibility study confirms that two technologies are technical suitable for deployment at Liss Forest Nursery. These are ASHPs and solar photovoltaic panels. It is unlikely that ASHPs will be able to deliver the 31% reduction in site-wide emissions alone. Therefore, three options present themselves for the Applicant, which can be given greater attention at the detailed design stage: (1) provision of a combination of ASHPs and relatively limited allocation of solar photovoltaic output, or (2) provision of gas boilers (no ASHPs) and a larger allocation of solar photovoltaic output, or (3) provision of a combination of gas boilers and ASHPs and moderate allocation of solar photovoltaic output. Further illustrative SAP calculations have been undertaken to demonstrate the impact of Option 2, which would require a total of 28.50 kWp of solar photovoltaic output (likely an average of 3-4 panels per dwelling) across the site. In the Appendix, further SAP calculations demonstrate the impact of introducing 1.25 kWp and 0.75 kWp installations of solar photovoltaic output to the Houghton (Plot 24) and Vyne (Plot 35) types, respectively. These demonstrate 31% and 35% betterments of their respective baseline emissions standards. If either Option 1 or 3 is specified at the detailed design stage, then a smaller allocation of solar photovoltaic output will be required across the site, however, the focus on Option 2 enables the largest scenario to be communicated, which is important given the sensitive location of the site.

2.23 Table 5 below summarises the impacts of the Applicant's best practice energy efficiency measures and introduction of a total of 28.5 kWp of solar photovoltaic output across the site (Option 2), comparing the eventual projected carbon dioxide emissions with the regulatory baseline standard.

Table 5: Emissions Reduction from Energy Efficiency Measures, ASHPs and Solar PV Installations – Liss Forest Nursery

	Emissions ($kgCO_2$/year)
Baseline	70,119
Reduction from energy efficiency measures	(9,946)
Reduction from 28.5 kWp solar PV output	(11,970)
Total reduction	**(21,916)**
Emissions after reductions	**48,203**
Overall percentage reduction from baseline	**31.26**

3.0 Layout, Permeability and Landscaping

3.1 The form and boundary of the development has been heavily shaped by the existing hedgerows to the perimeter and within the site, and careful consideration has been given to the design and location of the dwellings to prevent over-shading and the subsequent desire for lopping and felling of trees. Buildings are massed to enable them to be articulated in a sensitive manner with respect to the street scene, whilst enabling the economic potential of the land to be maximised with respect to its capacity to provide a variety of much needed housing in the National Park, especially affordable accommodation. Lower density housing is provided towards the perimeter of the development.

3.2 The Applicant's commitment to inclusivity will be demonstrated through their attitude towards movement and equality. The Applicant will ensure that the development is scaled appropriately so as to respond to the needs of all of its users. They will incorporate the requirements of the Equality Act (2010) into their design, making reasonable adjustments to enable disabled access, regularly reviewing whether the buildings are accessible and effective, and providing necessary design adjustments where it is practicable to do so.

3.3 It is important that future residents feel secure and free from the fear of crime. The Applicant and their design team will integrate AD Part Q of the Building Regulations into the design of the dwellings. The design proposals also integrate sound urban design principles in locating circulation routes so that they are overlooked by ground floor active windows from habitable rooms, maximising the surveillance of the public realm.

3.4 The site will be provided with vehicle parking in line with the South Downs National Park Authority's 'Guidance on Parking for Residential and Non-Residential Development' Supplementary Planning Document (April 2021). The Transport Assessment (July 2021) prepared in support of this planning application by Paul Basham Associates confirms that this equates to provision of 93 parking spaces for the Liss Forest Nursery development, equal to 2.51 spaces per dwelling. Of the 93 spaces, 81 would relate to the proposed dwellings and 12 would be for visitors. An electric vehicle charging point (1 x 32 amp) will be provided, wherever feasible.

3.5 Cycle storage facilities will be provided within either garden sheds or garages. The provision of such infrastructure will help to promote sustainable modes of travel to employment and amenity sites in Greatham and other conurbations nearby. In addition, the site is well located in relation to formal cycle routes, with National Cycle Network (NCN) Route 22 located approximately 320 metres north of the site.

3.6 All homes will be provided with home office infrastructure, enabling working from home, an issue that has become all the more important in recent months due to the COVID-19 crisis. Future residents will benefit from high speed broadband. All dwellings will have the ability to 'house' home office facilities, with sufficient space for a desk, office chair and filing cabinet, as well as the necessary electrical infrastructure located in a suitable position within the property (2 double power sockets, telephone / CAT5 cabling point, etc.).

3.7 All houses will be provided with fully accessible private spaces in the form of rear gardens. Access to all private spaces will be facilitated in accordance with the principles of inclusive design. The following measures will be introduced to ensure that those with mobility difficulties can access all areas of the development:

- A pedestrian friendly environment
- Step free entrance access from all dwellings to bin store areas and private gardens
- Pavements with tactile surfacing
- Carefully designed landscaping

3.8 The Liss Forest Nursery site has been the subject of an extensive Ecological Impact Assessment (July 2021) by Ecological Planning and Research (EPR), which includes outcomes from preceding scoping and baseline studies on birds, bats, badgers, invertebrates, mammals and herptile species. Given the potential for disturbance, as determined in initial studies conducted in 2018, detailed mitigation proposals for bats, mature trees and hedgerows are set out in the EPR assessment. In satisfying Policies SD1, SD2, SD9 and SD45, the Applicant will adopt all ecological mitigation measures set out in EPR's report, which include:

- A lighting strategy specifically in relation to bats to be implemented at the construction and operational phase.

- A Construction Environmental Management Plan containing measures to prevent impacts occurring during site clearance and construction.
- A Landscape and Ecology Management Plan to guide habitat creation and long-term management.
- Retention and protection of existing hedgerows and trees.

3.9 Dwellings have been afforded generous set-backs from the road and are open and largely laid to lawn with shrub planting. Extensive soft landscaping will be used to provide 'defensible' areas to the front and flanks of dwellings, and this approach, combined with the use of permeable paving and SUDS (swales, attenuation basin and green roofs) on the site, will contribute to the sustainable management of surface water runoff on site. The site will include large areas of landscape and planting that will help towards the facilitation of a healthy and habitable microclimate whilst providing amenity open space and a pleasant place in which to live and work.

3.10 The layout integrates GI fingers throughout the site, which will contribute to the connectivity of the site and enhancement of biodiversity. This endeavour will be further enhanced through the retention of mature trees to the south-western perimeter of the site and establishment of a landscape buffer to the rural edge, which will include the retention and enhancement of existing hedgerow and planting and the establishment of semi-natural public open space. Pedestrian and cycle routes will be integrated, well maintained and safe. These will connect the Liss Forest Nursery site to existing public footpaths to the south and village amenities to the north.

3.11 In addition to the ecological mitigation and compensatory measures described in paragraph 3.8, the Applicant will undertake further initiatives to encourage a net gain in the overall biodiversity of the site. These will include:

- Species rich planting of wildflowers in areas of grassland, which will encourage floral diversity and the flourishing of invertebrate populations.
- Installation of at least four bat boxes within the new buildings to provide new roosting opportunities for pipistrelle bats.
- Creation of a new habitat pile for hibernating reptiles and amphibians, formed from the remains of vegetation clearance.

- Incorporation of 'hedgehog gates' in the gravel board of fences separating residential dwellings.

4.0 Materials

4.1 Given the rural character of the development, a major consideration in materials selection is maintaining a locally-influenced architectural style that is common to the South Downs e.g. including ornamental ridge tiles, tile hanging, stone and brick facades, and ironstone galleting. However, from a sustainability perspective, the Applicant is equally committed to minimising the environmental impact of the materials used over the lifetime of the building – from manufacture, to eventual demolition, to disposal. For building materials, the Applicant will, in the main, seek to specify 'A+' or 'A' rated materials using the online BRE Green Guide to Housing Specification, with all materials rated at least 'E'.

4.2 The Applicant will avoid the specification of peat and natural weathered limestone in buildings or landscaping.

4.3 Timber used in the development for both basic and finishing elements will be sourced from sustainable European sources (e.g. PEFC or FSC accredited).

4.4 Wherever feasible, the Applicants will commit to using materials that are locally sourced, from renewable sources and recycled e.g. secondary aggregates.

5.0 Noise and Dust Pollution

5.1 Mitigation measures will be adopted during the design and construction phase in accordance with the recommendations in the Environmental Noise Impact Assessment by Sound Advice Acoustics (SAA) (June 2021) to ensure that the baseline ambient noise levels are not overtly increased by the proposed development. Given the development's proximity to a major trunk road, the report by SAA determines that the development should be designed with 4mm glass / 16mm air gap / 4mm

glass double glazed windows and an acoustic through frame slot vent to all rooms with daytime noise levels above LAeq 16 HOUR 60 dB Daytime and LAeq 8 HOUR 52 dB Night Time. The remaining development will be designed with a 4mm glass / 16mm air gap / 4mm glass double glazed windows and a standard through frame slot vent to all other rooms to ensure that internal noise levels are compliant with the requirements of British Standard 8233: 2014.

5.2 In order to best mitigate the development's contribution to local air pollution, best practice mitigation procedures will be included in a Construction Environmental Management Plan and adopted on-site during the construction phase, which will include the following measures:

- Dampening and sweeping roadways;
- Covering vehicles and skips when loaded with material;
- Locating stock piles to take into account the prevailing wind;
- Sealing and replanting completed earthworks as early as practicable.

5.3 Air intakes and outlets within the proposed dwellings will all avoid any sources of external pollution in order to avoid internal air pollution.

6.0 Recycling and Waste Management

6.1 The Applicant's proposals have allocated sufficient and accessible space within external storage areas in rear gardens for East Hampshire District Council's waste and recycling service. For all houses, this includes space for a 240 litre green bin for non-recyclable waste, a 240 litre black bin for recyclable waste, and an optional brown bin for the fortnightly collection of garden waste. All bin storage areas, including communal bins, will be sited on hard, level surfaces fully accessible to any resident in a wheelchair. The street scene incorporates sufficient space to enable vehicular access for refuse collections.

6.2 The Applicants will adhere to the waste hierarchy in order to ensure that the generation of waste is reduced, while re-use is increased. They will:

- Ensure the accurate specification of materials and volumes.
- Recycle and re-use waste generated on site.
- Arrange take back schemes with suppliers.
- Instruct a licensed waste contractor to segregate site waste for recycling.

7.0 Avoiding Flooding and Minimising Water Use

7.1 The proposed development has a very low risk of flooding from fluvial, tidal, groundwater, surface runoff and artificial sources, according to the Flood Risk Assessment prepared by PFA Consulting in July 2021. Although the proposed development is already located in Flood Zone 1, the Applicants will implement a drainage strategy that seeks to utilise the natural drainage features of the site and incorporates Sustainable Urban Drainage Systems (SUDS) in order to reduce the risk of flooding to the site and surrounding area. These will constitute a detention basin, swales, green roofs to carports, rain gardens and large diameter pipes in order to attenuate surface water runoff rates to Greenfield runoff rates with discharges to local watercourses. Microdrainage calculations by PFA Consulting confirm that Greenfield runoff rates will not be exceeded for all storm events up to the 1 in 100 year flood, including an additional 40% allowance for the anticipated impacts of climate change.

7.2 During the construction phase, the Applicant will adopt best practice procedures on site in relation to the potential for water pollution. Detailed procedural guidance will be disseminated to site operatives having been prepared in accordance with Environment Agency advice.

7.3 In terms of internal potable water consumption, The Applicant is committed to complying with Policy SD48 by delivering performance of not more than 110 litres per person per day in all dwellings (see calculation in Appendix), which is a 15 litres per person per day betterment of the standard set by Part G of Building Regulations. In order to meet these targets, a combination of reduced-flow taps and showers, dual-flush toilets and moderately sized baths will be installed. Flow rates and volumes will not exceed the following:

- Toilets = 6/4 litre dual flush
- Kitchen taps = 12 litres per minute

- Wash hand basin taps = 5 litres per minute
- Showers = 6 litres per minutes
- Baths = 181 litres

8.0 Conclusion

8.1 This Statement has set out the Applicant's comprehensive response to the various sustainability policies set by the NPPF (2021), the South Downs National Park Authority's Local Plan (2019) and East Hampshire District Council's Local Plan: Joint Core Strategy (2014). The Applicant's proposals will enable the delivery of a sustainable and prosperous development at Liss Forest Nursery, reflecting and enhancing the existing characteristics and qualities of the locality. Via the provision of both affordable and private forms of housing, the Applicant is responding to a pressing need for local housing suitable for families in an area with an ageing population.

8.2 The Applicant will specify a range of best practice energy efficiency measures to enable all proposed dwellings to better the carbon dioxide emissions standard set by Part L1a of Building Regulations (2013). A combination of highly efficient fabric, ventilation and heating systems will lead to this performance, together with the specification of low energy lighting and delivery of an air-tight build. The installation of either solar photovoltaic panels or Air Source Heat Pumps, or a combination of both technologies, will enable the site to reduce its carbon dioxide emissions by at least 31% compared to the standard set by Part L1a of Building Regulations (2013).

8.3 In addition, the following sustainable design measures will be adopted:

- Water efficient sanitary devices will be installed to meet a target for internal potable water; consumption of not more than 110 litres per person per day;
- Sustainable Urban Drainage Systems will be specified in the form of attenuation basins, swales, rain gardens and green roofs to carports;
- Priority will be given to the selection of materials with very low lifecycle impacts according to the BRE's Green Guide;
- All timber products will be sourced responsibly from either PEFC or FSC sources;

- Waste streams will be identified, reduced and re-used wherever practicable;
- Various ecological enhancement measures will be introduced to ensure the provision of suitable environments for local flora and fauna, leading to a net gain in biodiversity;
- Security in dwellings will be incorporated under Part Q of the Building Regulations, helping to reduce the fear and incidence of crime in the new community.
- Cycle storage facilities and links to existing cycle/pedestrian networks will be provided to encourage the use of sustainable forms of transportation over the private car.
- Electric car charging points installed for every dwelling, wherever feasible.
- An array of formal and informal open spaces will be provided for the recreational benefit of future residents.

APPENDIX

Indicative solar photovoltaic panel layout
Example SAP Calculations:
Type Houghton (Plot 24) with 1.25 kWp solar PV (35% betterment)
Type Vyne (Plot 35) with 0.75 kWp solar PV (31% betterment)
Part G Water Efficiency Calculation

Rev	Date	Drawn	Checked
A	27/07/21	LD	

ISSUED FOR PLANNING.

Legend

Potential position of solar panels. Dependant on final technical design. (illustrative only)

Project:
LISS FOREST NURSERY
PETERSFIELD ROAD
GREATHAM

Drawing Title:
SITE LAYOUT (37 UNITS)
POTENTIAL SOLAR PANEL POSITIONS

COVE HOMES

carlton design partnership
Selborne House, 58a Castle Way, Southampton, SO14 2AW
023 8011 8866 www.carltondesignpartnership.com

1:500 @ A1 | 0 5 10 15 20 25m

Drg No: 150715/SL37/11/SP | Rev: A

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

Property Reference	SECLISHOU	**Issued on Date**	12/09/2021
Assessment Reference	001	**Prop Type Ref**	Houghton
Property	Plot 24, Greatham, Hampshire, GU22		

SAP Rating	88 B	**DER**	12.52	**TER**	18.33
Environmental	90 B	**% DER<TER**	31.68		
CO_2 Emissions (t/year)	0.88	**DFEE**	53.50	**TFEE**	59.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.49		

Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: 01635261582, info@southernenergyconsultants.co.uk	**Assessor ID**	d168-0001
Client	Cove Homes, COV001		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r16

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 100 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) 18.33 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.52 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.5 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.29 (max. 0.30)	0.29 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.36 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal Logic + System 30

Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: Room heaters - Wood Logs

Closed room heater
Efficiency: 65%
Minimum: 65% OK

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.80 kWh/day
Permitted by DBSCG 2.30 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
Continuous extract system (decentralised)
Specific fan power: 0.1600 0.1600
Maximum: 0.7 OK

---
9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North East: 10.32 m², No overhang
Windows facing South East: 4.95 m², No overhang
Windows facing South West: 0.66 m², No overhang
Windows facing North West: 4.50 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value: 0.00 W/m²K
Roof U-value: 0.11 W/m²K
Floor U-value: 0.11 W/m²K
Door U-value: 1.00 W/m²K
Thermal bridging y-value: 0.019 W/m²K
Secondary heating (wood logs)
Secondary heating fuel: wood logs
Photovoltaic array: 1.25 kW

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)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	1	=	1 * 40 =	40.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(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	0.4442	0.4355	0.4268	0.3832	0.3745	0.3310	0.3310	0.3223	0.3484	0.3745	0.3919	0.4093	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6942	0.6855	0.6768	0.6332	0.6245	0.5810	0.5810	0.5723	0.5984	0.6245	0.6419	0.6593	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1100	5.5638			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2900	36.3747			(29a)
External Roof 1	50.5800		50.5800	0.1100	5.5638			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.7075			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.7021	(36)
Total fabric heat loss (33) + (36) =	81.4096	(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	57.3213	56.6021	55.8829	52.2871	51.5679	47.9720	47.9720	47.2528	49.4104	51.5679	53.0062	54.4446	(38)
Heat transfer coeff	138.7309	138.0117	137.2926	133.6967	132.9775	129.3817	129.3817	128.6625	130.8200	132.9775	134.4159	135.8542	(39)
Average = Sum(39)m / 12 =												133.5169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3852	1.3781	1.3709	1.3350	1.3278	1.2919	1.2919	1.2847	1.3062	1.3278	1.3421	1.3565	(40)
HLP (average)												1.3332	(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	2.7409 (42)
Average daily hot water use (litres/day)	99.2966 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2969	21.2502	21.9283	19.1177	18.3438	15.8293	14.6682	16.8320	17.0330	19.8503	21.6682	23.5303	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(64)
Total per year (kWh/year) = Sum(64)m =												2190.9984	(64)
Heat gains from water heating, kWh/month													
	96.5737	85.6864	91.3233	83.7151	83.3777	76.4260	75.2301	80.0264	79.0941	86.7171	89.3688	94.8743	(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	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.9900	20.4195	16.6063	12.5720	9.3977	7.9340	8.5729	11.1434	14.9567	18.9909	22.1652	23.6290	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	256.5700	259.2324	252.5233	238.2403	220.2106	203.2652	191.9447	189.2823	195.9914	210.2744	228.3041	245.2495	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	129.8033	127.5096	122.7464	116.2709	112.0668	106.1472	101.1157	107.5624	109.8530	116.5553	124.1233	127.5192	(72)
Total internal gains													
	476.4770	474.2752	458.9896	434.1969	408.7888	384.4600	368.7469	375.1018	387.9147	412.9342	441.7063	463.5113	(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	
Northeast	10.3200	11.2829	0.6300	0.0000	0.7700	56.4850	(75)
Southeast	4.9500	36.7938	0.6300	0.0000	0.7700	88.3510	(77)
Southwest	0.6600	36.7938	0.6300	0.0000	0.7700	11.7801	(79)
Northwest	4.5000	11.2829	0.6300	0.0000	0.7700	24.6301	(81)

Solar gains	181.2463	335.6726	530.8478	777.7014	980.5801	1021.6499	964.9372	806.2177	615.1719	390.2857	221.9978	151.9341	(83)
Total gains	657.7233	809.9478	989.8374	1211.8983	1389.3689	1406.1099	1333.6841	1181.3194	1003.0866	803.2200	663.7041	615.4454	(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	50.1320	50.3933	50.6572	52.0197	52.3010	53.7546	53.7546	54.0551	53.1636	52.3010	51.7414	51.1936	
alpha	4.3421	4.3596	4.3771	4.4680	4.4867	4.5836	4.5836	4.6037	4.5442	4.4867	4.4494	4.4129	
util living area													
	0.9970	0.9922	0.9758	0.9131	0.7672	0.5663	0.4219	0.4904	0.7739	0.9614	0.9935	0.9978	(86)
MIT	19.5063	19.7229	20.0761	20.5363	20.8449	20.9710	20.9939	20.9885	20.8848	20.4453	19.9046	19.4923	(87)
Th 2	19.7747	19.7802	19.7857	19.8135	19.8191	19.8472	19.8472	19.8528	19.8359	19.8191	19.8080	19.7968	(88)
util rest of house													
	0.9959	0.9894	0.9673	0.8841	0.7025	0.4738	0.3139	0.3735	0.6851	0.9426	0.9908	0.9970	(89)
MIT 2	17.8099	18.1289	18.6415	19.2984	19.6813	19.8302	19.8453	19.8487	19.7516	19.1955	18.4139	17.8043	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	18.1152	18.4157	18.8997	19.5211	19.8907	20.0355	20.0519	20.0538	19.9555	19.4203	18.6821	18.1080	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9652	18.2657	18.7497	19.3711	19.7407	19.8855	19.9019	19.9038	19.8055	19.2703	18.5321	17.9580	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9934	0.9843	0.9571	0.8708	0.6978	0.4770	0.3191	0.3788	0.6824	0.9305	0.9863	0.9950	(94)
Useful gains	653.3757	797.2322	947.3670	1055.2734	969.4425	670.7064	425.6350	447.4869	684.5204	747.4060	654.6130	612.3704	(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													
	1895.7803	1844.6214	1681.7878	1399.9548	1069.2302	683.8434	427.2108	450.8070	746.3884	1152.9596	1536.6564	1869.0803	(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													
	924.3490	703.8455	546.4090	248.1706	74.2421	0.0000	0.0000	0.0000	0.0000	301.7319	635.0712	934.9922	(98)
Space heating												4368.8114	(98)
Space heating per m2											(98) / (4) =	43.6227	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	4339.8789	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	924.3490	703.8455	546.4090	248.1706	74.2421	0.0000	0.0000	0.0000	0.0000	301.7319	635.0712	934.9922	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	918.2274	699.1843	542.7904	246.5270	73.7504	0.0000	0.0000	0.0000	0.0000	299.7337	630.8655	928.8002	(211)
Water heating requirement													
	142.2075	108.2839	84.0629	38.1801	11.4219	0.0000	0.0000	0.0000	0.0000	46.4203	97.7033	143.8449	(215)
Water heating													
Water heating requirement													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.1718	87.8856	87.2278	85.5039	82.5875	79.9000	79.9000	79.9000	79.9000	85.9264	87.6029	88.2377	(217)
Fuel for water heating, kWh/month													
	244.2662	216.0713	228.8071	209.4910	212.7281	196.7471	189.2146	207.2687	206.7903	216.1502	223.8816	238.2914	(219)
Water heating fuel used												2589.7076	(219)
Annual totals kWh/year													
Space heating fuel - main system												4339.8789	(211)
Space heating fuel - secondary												672.1248	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.8080, total flow = 37.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												56.1702	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												131.1702	(231)
Electricity for lighting (calculated in Appendix L)												406.0108	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.25 * 1029 * 1.00) =										-1029.1867		-1029.1867	(233)
Total delivered energy for all uses												7109.7056	(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	4339.8789	0.2160	937.4138	(261)
Space heating - secondary	672.1248	0.0190	12.7704	(263)
Water heating (other fuel)	2589.7076	0.2160	559.3768	(264)
Space and water heating			1509.5611	(265)
Pumps and fans	131.1702	0.5190	68.0773	(267)
Energy for lighting	406.0108	0.5190	210.7196	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total CO2, kg/year			1254.2101	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.5200	(273)

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

DER		12.5200	ZC1
Total Floor Area	TFA	100.1500	
Assumed number of occupants	N	2.7409	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1810	ZC2
CO2 emissions from cooking, equation (L16)		1.8451	ZC3
Total CO2 emissions		29.5461	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		29.5461	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)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(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	0.4442	0.4355	0.4268	0.3832	0.3745	0.3310	0.3310	0.3223	0.3484	0.3745	0.3919	0.4093	(22b)
Effective ac	0.5986	0.5948	0.5911	0.5734	0.5701	0.5548	0.5548	0.5519	0.5607	0.5701	0.5768	0.5838	(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 Opaque door			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1300	6.5754			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.1800	22.5774			(29a)
External Roof 1	50.5800		50.5800	0.1300	6.5754			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.9334			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.7899	(36)
Total fabric heat loss					(33) + (36) =		76.7233	(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	49.4327	49.1164	48.8063	47.3501	47.0776	45.8092	45.8092	45.5743	46.2978	47.0776	47.6288	48.2050	(38)
Heat transfer coeff	126.1560	125.8397	125.5297	124.0734	123.8009	122.5325	122.5325	122.2976	123.0211	123.8009	124.3521	124.9284	(39)
Average = Sum(39)m / 12 =												124.0721	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2597	1.2565	1.2534	1.2389	1.2362	1.2235	1.2235	1.2211	1.2284	1.2362	1.2417	1.2474	(40)
HLP (average)												1.2389	(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												2.7409	(42)
Average daily hot water use (litres/day)												99.2966	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2969	21.2502	21.9283	19.1177	18.3438	15.8293	14.6682	16.8320	17.0330	19.8503	21.6682	23.5303	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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													
	213.7260	188.4071	197.9355	177.5284	174.0389	155.6063	149.5347	163.9599	163.6308	184.0822	194.5320	208.6150	(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													
	213.7260	188.4071	197.9355	177.5284	174.0389	155.6063	149.5347	163.9599	163.6308	184.0822	194.5320	208.6150	(64)
								Total per year (kWh/year) = Sum(64)m =				2171.5968	(64)
Heat gains from water heating, kWh/month													
	95.2554	84.4958	90.0051	82.4393	82.0595	75.1503	73.9118	78.7082	77.8184	85.3989	88.0931	93.5560	(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	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.9900	20.4195	16.6063	12.5720	9.3977	7.9340	8.5729	11.1434	14.9567	18.9909	22.1652	23.6290	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	256.5700	259.2324	252.5233	238.2403	220.2106	203.2652	191.9447	189.2823	195.9914	210.2744	228.3041	245.2495	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	128.0315	125.7378	120.9746	114.4991	110.2950	104.3754	99.3438	105.7906	108.0811	114.7834	122.3515	125.7473	(72)
Total internal gains													
	474.7052	472.5034	457.2178	432.4251	407.0170	382.6882	366.9751	373.3299	386.1429	411.1624	439.9344	461.7395	(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	
Northeast	10.3200	11.2829	0.6300	0.7000	0.7700	35.5856	(75)
Southeast	4.9500	36.7938	0.6300	0.7000	0.7700	55.6611	(77)
Southwest	0.6600	36.7938	0.6300	0.7000	0.7700	7.4215	(79)
Northwest	4.5000	11.2829	0.6300	0.7000	0.7700	15.5170	(81)

Solar gains	114.1851	211.4737	334.4341	489.9519	617.7655	643.6394	607.9104	507.9171	387.5583	245.8800	139.8586	95.7185	(83)
Total gains	588.8903	683.9771	791.6519	922.3770	1024.7824	1026.3276	974.8855	881.2470	773.7012	657.0424	579.7931	557.4579	(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	55.1290	55.2676	55.4041	56.0544	56.1778	56.7593	56.7593	56.8683	56.5339	56.1778	55.9288	55.6708	
alpha	4.6753	4.6845	4.6936	4.7370	4.7452	4.7840	4.7840	4.7912	4.7689	4.7452	4.7286	4.7114	
util living area													
	0.9981	0.9959	0.9886	0.9591	0.8703	0.7010	0.5380	0.6093	0.8626	0.9795	0.9962	0.9986	(86)
MIT	19.6034	19.7629	20.0450	20.4310	20.7604	20.9401	20.9864	20.9763	20.8323	20.4054	19.9385	19.5791	(87)
Th 2	19.8726	19.8751	19.8775	19.8890	19.8912	19.9013	19.9013	19.9031	19.8974	19.8912	19.8868	19.8823	(88)
util rest of house													
	0.9975	0.9945	0.9843	0.9432	0.8216	0.6049	0.4113	0.4781	0.7914	0.9687	0.9946	0.9981	(89)
MIT 2	18.0181	18.2525	18.6641	19.2220	19.6584	19.8623	19.8965	19.8936	19.7607	19.1964	18.5178	17.9892	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	18.3034	18.5243	18.9126	19.4395	19.8567	20.0562	20.0926	20.0884	19.9535	19.4139	18.7734	18.2752	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3034	18.5243	18.9126	19.4395	19.8567	20.0562	20.0926	20.0884	19.9535	19.4139	18.7734	18.2752	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9918	0.9791	0.9348	0.8198	0.6195	0.4341	0.5016	0.7957	0.9621	0.9921	0.9969	(94)
Useful gains	586.5773	678.3954	775.0768	862.2453	840.1232	635.8298	423.2382	441.9933	615.6453	632.1438	575.2284	555.7569	(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													
	1766.6077	1714.4727	1558.1495	1307.6773	1009.8067	668.5613	427.9542	451.0792	720.1073	1091.1734	1451.6124	1758.3970	(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													
	877.9427	696.2440	582.6061	320.7110	126.2445	0.0000	0.0000	0.0000	0.0000	341.5180	630.9965	894.7642	(98)
Space heating												4471.0270	(98)
Space heating per m2											(98) / (4) =	44.6433	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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												4781.8471	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	877.9427	696.2440	582.6061	320.7110	126.2445	0.0000	0.0000	0.0000	0.0000	341.5180	630.9965	894.7642	(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)													
	938.9761	744.6459	623.1081	343.0065	135.0209	0.0000	0.0000	0.0000	0.0000	365.2599	674.8626	956.9671	(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													
	213.7260	188.4071	197.9355	177.5284	174.0389	155.6063	149.5347	163.9599	163.6308	184.0822	194.5320	208.6150	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.1850	87.9874	87.5240	86.3734	83.9741	79.8000	79.8000	79.8000	79.8000	86.4407	87.7281	88.2624	(217)
Fuel for water heating, kWh/month													
	242.3608	214.1297	226.1500	205.5359	207.2531	194.9954	187.3868	205.4635	205.0511	212.9579	221.7443	236.3577	(219)
Water heating fuel used												2559.3862	(219)
Annual totals kWh/year													
Space heating fuel - main system												4781.8471	(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)												406.0108	(232)
Total delivered energy for all uses												7822.2440	(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	4781.8471	0.2160	1032.8790	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2559.3862	0.2160	552.8274	(264)
Space and water heating			1585.7064	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	406.0108	0.5190	210.7196	(268)
Total CO2, kg/m2/year			1835.3510	(272)
Emissions per m2 for space and water heating			15.8333	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1040	(272b)
Emissions per m2 for pumps and fans			0.3887	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8333 * 1.00) + 2.1040 + 0.3887, rounded to 2 d.p.			18.3300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	1	=	1 * 40 =	40.0000	(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) =	80.0000 / (5) =	0.3197	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.5697	(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) =	0.4843	(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	0.6174	0.6053	0.5932	0.5327	0.5206	0.4600	0.4600	0.4479	0.4843	0.5206	0.5448	0.5690	(22b)
Effective ac	0.6906	0.6832	0.6760	0.6419	0.6355	0.6058	0.6058	0.6003	0.6173	0.6355	0.6484	0.6619	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1100	5.5638			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2900	36.3747			(29a)
External Roof 1	50.5800		50.5800	0.1100	5.5638			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.7075			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		81.4096	(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	57.0261	56.4150	55.8159	53.0021	52.4756	50.0249	50.0249	49.5710	50.9689	52.4756	53.5406	54.6541	(38)
Heat transfer coeff	138.4358	137.8246	137.2255	134.4117	133.8853	131.4345	131.4345	130.9807	132.3785	133.8853	134.9503	136.0637	(39)
Average = Sum(39)m / 12 =												134.4092	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3823	1.3762	1.3702	1.3421	1.3368	1.3124	1.3124	1.3078	1.3218	1.3368	1.3475	1.3586	(40)
HLP (average)												1.3421	(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	2.7409	(42)
Average daily hot water use (litres/day)	99.2966	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(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													

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	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													
	34.4206	30.1045	31.0651	27.0833	25.9871	22.4249	20.7800	23.8453	24.1301	28.1213	30.6966	33.3345	(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	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.9900	20.4195	16.6063	12.5720	9.3977	7.9340	8.5729	11.1434	14.9567	18.9909	22.1652	23.6290	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	256.5700	259.2324	252.5233	238.2403	220.2106	203.2652	191.9447	189.2823	195.9914	210.2744	228.3041	245.2495	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	46.2643	44.7984	41.7542	37.6158	34.9289	31.1457	27.9301	32.0502	33.5140	37.7975	42.6342	44.8045	(72)
Total internal gains													
	389.9380	388.5640	374.9974	352.5417	328.6509	306.4585	292.5613	296.5895	308.5758	331.1765	357.2172	377.7966	(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	
Northeast	10.3200	11.2829	0.6300	0.0000	0.7700	56.4850	(75)
Southeast	4.9500	36.7938	0.6300	0.0000	0.7700	88.3510	(77)
Southwest	0.6600	36.7938	0.6300	0.0000	0.7700	11.7801	(79)
Northwest	4.5000	11.2829	0.6300	0.0000	0.7700	24.6301	(81)

Solar gains	181.2463	335.6726	530.8478	777.7014	980.5801	1021.6499	964.9372	806.2177	615.1719	390.2857	221.9978	151.9341	(83)
Total gains	571.1842	724.2365	905.8452	1130.2432	1309.2310	1328.1084	1257.4985	1102.8072	923.7477	721.4622	579.2150	529.7307	(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	50.2389	50.4617	50.6820	51.7430	51.9464	52.9150	52.9150	53.0984	52.5377	51.9464	51.5365	51.1147	
alpha	4.3493	4.3641	4.3788	4.4495	4.4631	4.5277	4.5277	4.5399	4.5025	4.4631	4.4358	4.4076	
util living area													
	0.9983	0.9949	0.9824	0.9299	0.7959	0.6014	0.4524	0.5298	0.8136	0.9737	0.9962	0.9988	(86)
MIT	19.4330	19.6504	20.0083	20.4787	20.8158	20.9614	20.9914	20.9834	20.8529	20.3743	19.8244	19.4129	(87)
Th 2	19.7769	19.7816	19.7863	19.8080	19.8121	19.8312	19.8312	19.8347	19.8238	19.8121	19.8038	19.7952	(88)
util rest of house													
	0.9977	0.9931	0.9759	0.9050	0.7336	0.5047	0.3361	0.4038	0.7292	0.9600	0.9946	0.9983	(89)
MIT 2	18.3620	18.5821	18.9395	19.4064	19.6981	19.8154	19.8293	19.8305	19.7474	19.3216	18.7735	18.3560	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	18.5547	18.7744	19.1318	19.5993	19.8992	20.0216	20.0384	20.0380	19.9463	19.5110	18.9625	18.5461	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5547	18.7744	19.1318	19.5993	19.8992	20.0216	20.0384	20.0380	19.9463	19.5110	18.9625	18.5461	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9910	0.9713	0.8997	0.7386	0.5212	0.3571	0.4266	0.7394	0.9553	0.9929	0.9977	(94)
Useful gains	569.3342	717.6997	879.8288	1016.9108	967.0596	692.2290	449.0972	470.4483	683.0018	689.1831	575.1311	528.4994	(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													
	1973.3608	1912.2275	1733.4072	1438.1141	1097.7527	712.5860	451.9213	476.5022	773.9199	1193.0577	1600.8530	1951.9891	(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													
	1044.5958	802.7227	635.0623	303.2664	97.2357	0.0000	0.0000	0.0000	0.0000	374.8827	738.5198	1059.0763	(98)
Space heating												5055.3616	(98)
Space heating per m2											(98) / (4) =	50.4779	(99)

8c. Space cooling requirement

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	1235.4844	972.6154	995.4530	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9162	0.9534	0.9266	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1131.9181	927.3076	922.4066	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1657.5023	1572.7002	1393.7565	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	378.4207	480.1721	350.6843	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											1209.2771	(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	94.6052	120.0430	87.6711	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											302.3193	(107)
Space cooling per m2											3.0187	(108)
Energy for space heating											50.4779	(99)
Energy for space cooling											3.0187	(108)
Total											53.4966	(109)
Dwelling Fabric Energy Efficiency (DFEE)											53.5	(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)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(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	0.4442	0.4355	0.4268	0.3832	0.3745	0.3310	0.3310	0.3223	0.3484	0.3745	0.3919	0.4093	(22b)
Effective ac	0.5986	0.5948	0.5911	0.5734	0.5701	0.5548	0.5548	0.5519	0.5607	0.5701	0.5768	0.5838	(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 Opaque door			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1300	6.5754			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.1800	22.5774			(29a)
External Roof 1	50.5800		50.5800	0.1300	6.5754			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.9334			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.7899	(36)
Total fabric heat loss					(33) + (36) =		76.7233	(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	49.4327	49.1164	48.8063	47.3501	47.0776	45.8092	45.8092	45.5743	46.2978	47.0776	47.6288	48.2050	(38)
Heat transfer coeff	126.1560	125.8397	125.5297	124.0734	123.8009	122.5325	122.5325	122.2976	123.0211	123.8009	124.3521	124.9284	(39)
Average = Sum(39)m / 12 =												124.0721	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2597	1.2565	1.2534	1.2389	1.2362	1.2235	1.2235	1.2211	1.2284	1.2362	1.2417	1.2474	(40)
HLP (average)												1.2389	(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												2.7409	(42)
Average daily hot water use (litres/day)												99.2966	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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													
	34.4206	30.1045	31.0651	27.0833	25.9871	22.4249	20.7800	23.8453	24.1301	28.1213	30.6966	33.3345	(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	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	137.0455	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.9900	20.4195	16.6063	12.5720	9.3977	7.9340	8.5729	11.1434	14.9567	18.9909	22.1652	23.6290	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	256.5700	259.2324	252.5233	238.2403	220.2106	203.2652	191.9447	189.2823	195.9914	210.2744	228.3041	245.2495	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	36.7046	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	46.2643	44.7984	41.7542	37.6158	34.9289	31.1457	27.9301	32.0502	33.5140	37.7975	42.6342	44.8045	(72)
Total internal gains													
	389.9380	388.5640	374.9974	352.5417	328.6509	306.4585	292.5613	296.5895	308.5758	331.1765	357.2172	377.7966	(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	
Northeast	10.3200	11.2829	0.6300	0.7000	0.7700	35.5856	(75)
Southeast	4.9500	36.7938	0.6300	0.7000	0.7700	55.6611	(77)
Southwest	0.6600	36.7938	0.6300	0.7000	0.7700	7.4215	(79)
Northwest	4.5000	11.2829	0.6300	0.7000	0.7700	15.5170	(81)

Solar gains	114.1851	211.4737	334.4341	489.9519	617.7655	643.6394	607.9104	507.9171	387.5583	245.8800	139.8586	95.7185	(83)
Total gains	504.1231	600.0377	709.4315	842.4936	946.4164	950.0980	900.4717	804.5066	696.1341	577.0565	497.0758	473.5151	(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	55.1290	55.2676	55.4041	56.0544	56.1778	56.7593	56.7593	56.8683	56.5339	56.1778	55.9288	55.6708	
alpha	4.6753	4.6845	4.6936	4.7370	4.7452	4.7840	4.7840	4.7912	4.7689	4.7452	4.7286	4.7114	
util living area													
	0.9991	0.9976	0.9926	0.9705	0.8961	0.7396	0.5770	0.6559	0.8975	0.9876	0.9980	0.9993	(86)
MIT	19.5261	19.6869	19.9728	20.3691	20.7200	20.9245	20.9819	20.9677	20.7928	20.3375	19.8633	19.5022	(87)
Th 2	19.8726	19.8751	19.8775	19.8890	19.8912	19.9013	19.9013	19.9031	19.8974	19.8912	19.8868	19.8823	(88)
util rest of house													
	0.9987	0.9968	0.9898	0.9583	0.8532	0.6442	0.4438	0.5200	0.8365	0.9808	0.9972	0.9991	(89)
MIT 2	18.5292	18.6917	18.9782	19.3759	19.7004	19.8666	19.8967	19.8938	19.7764	19.3517	18.8774	18.5130	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	18.7086	18.8708	19.1572	19.5546	19.8839	20.0569	20.0920	20.0870	19.9593	19.5291	19.0548	18.6910	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7086	18.8708	19.1572	19.5546	19.8839	20.0569	20.0920	20.0870	19.9593	19.5291	19.0548	18.6910	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9957	0.9873	0.9536	0.8528	0.6591	0.4680	0.5446	0.8407	0.9776	0.9962	0.9987	(94)
Useful gains	503.2160	597.4624	700.4183	803.3749	807.1453	626.1928	421.4041	438.0981	585.2643	564.1294	495.2105	472.8844	(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													
	1817.7322	1758.0821	1588.8487	1321.9496	1013.1712	668.6517	427.8804	450.9173	720.8130	1105.4283	1486.6035	1810.3308	(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													
	978.0001	779.9364	660.9922	373.3738	153.2833	0.0000	0.0000	0.0000	0.0000	402.7264	713.8030	995.0601	(98)
Space heating												5057.1753	(98)
Space heating per m2											(98) / (4) =	50.4960	(99)

8c. Space cooling requirement

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	1151.8058	906.7407	929.4621	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8486	0.9104	0.8720	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	977.4708	825.5360	810.5009	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1215.6719	1155.3962	1045.0935	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	171.5048	245.4160	174.5369	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling                                                                                                  591.4577 (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   42.8762   61.3540   43.6342    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                  147.8644 (107)
Space cooling per m2                                                                                             1.4764 (108)
Energy for space heating                                                                                        50.4960 (99)
Energy for space cooling                                                                                         1.4764 (108)
Total                                                                                                           51.9724 (109)
Target Fabric Energy Efficiency (TFEE)                                                                          59.8 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	1	=	1 * 40 =	40.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.3000	3.0000	3.1000	2.9000	2.8000	2.8000	2.9000	3.2000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8250	0.7500	0.7750	0.7250	0.7000	0.7000	0.7250	0.8000	(22a)
Adj infilt rate	0.3310	0.3048	0.3048	0.2874	0.2874	0.2613	0.2700	0.2526	0.2439	0.2439	0.2526	0.2787	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5810	0.5548	0.5548	0.5374	0.5374	0.5113	0.5200	0.5026	0.5000	0.5000	0.5026	0.5287	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1100	5.5638			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2900	36.3747			(29a)
External Roof 1	50.5800		50.5800	0.1100	5.5638			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.7075			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		81.4096	(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	47.9720	45.8145	45.8145	44.3762	44.3762	42.2186	42.9378	41.4995	41.2869	41.2869	41.4995	43.6570	(38)
Heat transfer coeff	129.3817	127.2241	127.2241	125.7858	125.7858	123.6283	124.3475	122.9091	122.6965	122.6965	122.9091	125.0666	(39)
Average = Sum(39)m / 12 =												124.9713	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2919	1.2703	1.2703	1.2560	1.2560	1.2344	1.2416	1.2273	1.2251	1.2251	1.2273	1.2488	(40)
HLP (average)												1.2478	(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		2.7409 (42)
Average daily hot water use (litres/day)		99.2966 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2969	21.2502	21.9283	19.1177	18.3438	15.8293	14.6682	16.8320	17.0330	19.8503	21.6682	23.5303	(46)
Water storage loss:													

CALCULATION OF HEAT DEMAND 09 Jan 2014

Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(64)
Total per year (kWh/year) = Sum(64)m =												2190.9984	(64)
RHI water heating demand												2191	(64)
Heat gains from water heating, kWh/month													
	96.5737	85.6864	91.3233	83.7151	83.3777	76.4260	75.2301	80.0264	79.0941	86.7171	89.3688	94.8743	(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	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.4750	51.0488	41.5157	31.4300	23.4943	19.8349	21.4323	27.8585	37.3917	47.4773	55.4130	59.0724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	382.9404	386.9141	376.9004	355.5825	328.6725	303.3809	286.4846	282.5109	292.5245	313.8424	340.7524	366.0440	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	129.8033	127.5096	122.7464	116.2709	112.0668	106.1472	101.1157	107.5624	109.8530	116.5553	124.1233	127.5192	(72)
Total internal gains													
	682.2233	677.4771	653.1671	615.2881	576.2383	541.3676	521.0372	529.9364	551.7737	589.8795	632.2933	664.6402	(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	
Northeast	10.3200	13.3408	0.6300	0.0000	0.7700	66.7873	(75)
Southeast	4.9500	41.5040	0.6300	0.0000	0.7700	99.6613	(77)
Southwest	0.6600	41.5040	0.6300	0.0000	0.7700	13.2882	(79)
Northwest	4.5000	13.3408	0.6300	0.0000	0.7700	29.1224	(81)

Solar gains	208.8591	332.5544	543.7676	814.2314	1000.6575	1115.1085	1047.3399	880.3882	671.1782	438.8678	253.9929	167.5696	(83)
Total gains	891.0824	1010.0315	1196.9347	1429.5195	1576.8957	1656.4761	1568.3771	1410.3246	1222.9519	1028.7473	886.2862	832.2098	(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	53.7546	54.6662	54.6662	55.2913	55.2913	56.2562	55.9309	56.5854	56.6834	56.6834	56.5854	55.6092	
alpha	4.5836	4.6444	4.6444	4.6861	4.6861	4.7504	4.7287	4.7724	4.7789	4.7789	4.7724	4.7073	
util living area													
	0.9879	0.9777	0.9379	0.8218	0.6323	0.3998	0.2692	0.3129	0.5960	0.8813	0.9739	0.9908	(86)
MIT	19.9124	20.0966	20.4307	20.7731	20.9453	20.9951	20.9994	20.9989	20.9706	20.7377	20.2979	19.9047	(87)
Th 2	19.8472	19.8641	19.8641	19.8755	19.8755	19.8926	19.8869	19.8983	19.9000	19.9000	19.8983	19.8812	(88)
util rest of house													
	0.9839	0.9705	0.9185	0.7757	0.5604	0.3194	0.1813	0.2176	0.5013	0.8373	0.9640	0.9877	(89)
MIT 2	18.4491	18.7254	19.1934	19.6451	19.8331	19.8904	19.8868	19.8980	19.8828	19.6373	19.0414	18.4622	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	18.7124	18.9721	19.4161	19.8480	20.0333	20.0891	20.0870	20.0961	20.0785	19.8353	19.2675	18.7218	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5624	18.8221	19.2661	19.6980	19.8833	19.9391	19.9370	19.9461	19.9285	19.6853	19.1175	18.5718	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9614	0.9058	0.7676	0.5609	0.3228	0.1852	0.2218	0.5039	0.8270	0.9544	0.9824	(94)
Useful gains	870.9867	971.0617	1084.1908	1097.2521	884.5595	534.7250	290.5132	312.7559	616.2075	850.7709	845.8739	817.5658	(95)
Ext temp.	5.0000	5.5000	7.3000	9.7000	12.6000	15.6000	17.6000	17.4000	14.8000	11.3000	7.8000	4.9000	(96)
Heat loss rate W													
	1754.7295	1694.8970	1522.3716	1257.6103	916.1296	536.4394	290.5948	312.9404	629.2478	1028.8478	1391.0255	1709.8838	(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													
	657.5047	486.4174	326.0065	115.4579	23.4882	0.0000	0.0000	0.0000	0.0000	132.4892	392.5091	663.8846	(98)
Space heating												2797.7575	(98)
RHI space heating demand												2798	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	1	=	1 * 40 =	40.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(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	0.4442	0.4355	0.4268	0.3832	0.3745	0.3310	0.3310	0.3223	0.3484	0.3745	0.3919	0.4093	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6942	0.6855	0.6768	0.6332	0.6245	0.5810	0.5810	0.5723	0.5984	0.6245	0.6419	0.6593	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1100	5.5638			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2900	36.3747			(29a)
External Roof 1	50.5800		50.5800	0.1100	5.5638			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.7075			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.7021	(36)
Total fabric heat loss (33) + (36) =	81.4096	(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	57.3213	56.6021	55.8829	52.2871	51.5679	47.9720	47.9720	47.2528	49.4104	51.5679	53.0062	54.4446	(38)
Heat transfer coeff	138.7309	138.0117	137.2926	133.6967	132.9775	129.3817	129.3817	128.6625	130.8200	132.9775	134.4159	135.8542	(39)
Average = Sum(39)m / 12 =												133.5169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3852	1.3781	1.3709	1.3350	1.3278	1.2919	1.2919	1.2847	1.3062	1.3278	1.3421	1.3565	(40)
HLP (average)												1.3332	(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	2.7409	(42)
Average daily hot water use (litres/day)	99.2966	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2969	21.2502	21.9283	19.1177	18.3438	15.8293	14.6682	16.8320	17.0330	19.8503	21.6682	23.5303	(46)

Water storage loss:

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(64)
Total per year (kWh/year) = Sum(64)m =												2190.9984	(64)
Heat gains from water heating, kWh/month													
	96.5737	85.6864	91.3233	83.7151	83.3777	76.4260	75.2301	80.0264	79.0941	86.7171	89.3688	94.8743	(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	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.4750	51.0488	41.5157	31.4300	23.4943	19.8349	21.4323	27.8585	37.3917	47.4773	55.4130	59.0724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	382.9404	386.9141	376.9004	355.5825	328.6725	303.3809	286.4846	282.5109	292.5245	313.8424	340.7524	366.0440	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	129.8033	127.5096	122.7464	116.2709	112.0668	106.1472	101.1157	107.5624	109.8530	116.5553	124.1233	127.5192	(72)
Total internal gains													
	682.2233	677.4771	653.1671	615.2881	576.2383	541.3676	521.0372	529.9364	551.7737	589.8795	632.2933	664.6402	(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	
Northeast	10.3200	11.2829	0.6300	0.0000	0.7700	56.4850	(75)
Southeast	4.9500	36.7938	0.6300	0.0000	0.7700	88.3510	(77)
Southwest	0.6600	36.7938	0.6300	0.0000	0.7700	11.7801	(79)
Northwest	4.5000	11.2829	0.6300	0.0000	0.7700	24.6301	(81)

Solar gains	181.2463	335.6726	530.8478	777.7014	980.5801	1021.6499	964.9372	806.2177	615.1719	390.2857	221.9978	151.9341	(83)
Total gains	863.4695	1013.1496	1184.0149	1392.9895	1556.8183	1563.0175	1485.9743	1336.1540	1166.9456	980.1652	854.2911	816.5743	(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	50.1320	50.3933	50.6572	52.0197	52.3010	53.7546	53.7546	54.0551	53.1636	52.3010	51.7414	51.1936	
alpha	4.3421	4.3596	4.3771	4.4680	4.4867	4.5836	4.5836	4.6037	4.5442	4.4867	4.4494	4.4129	
util living area													
	0.9913	0.9820	0.9556	0.8725	0.7133	0.5158	0.3802	0.4371	0.7017	0.9268	0.9831	0.9931	(86)
MIT	19.6864	19.8952	20.2254	20.6350	20.8853	20.9801	20.9960	20.9928	20.9236	20.5689	20.0681	19.6702	(87)
Th 2	19.7747	19.7802	19.7857	19.8135	19.8191	19.8472	19.8472	19.8528	19.8359	19.8191	19.8080	19.7968	(88)
util rest of house													
	0.9885	0.9762	0.9413	0.8355	0.6460	0.4289	0.2821	0.3311	0.6092	0.8961	0.9766	0.9908	(89)
MIT 2	18.0713	18.3763	18.8490	19.4213	19.7207	19.8358	19.8460	19.8503	19.7833	19.3567	18.6483	18.0630	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	18.3619	18.6496	19.0966	19.6397	19.9303	20.0417	20.0529	20.0559	19.9885	19.5748	18.9038	18.3522	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2119	18.4996	18.9466	19.4897	19.7803	19.8917	19.9029	19.9059	19.8385	19.4248	18.7538	18.2022	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9830	0.9675	0.9284	0.8237	0.6436	0.4324	0.2869	0.3361	0.6095	0.8830	0.9682	0.9862	(94)
Useful gains	848.7514	980.2250	1099.2472	1147.3943	1001.9419	675.8150	426.3273	449.0586	711.2115	865.4382	827.1304	805.2978	(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													
	1930.0127	1876.9012	1708.8277	1415.8063	1074.4928	684.6524	427.3344	451.0782	750.7067	1173.4973	1566.4493	1902.2583	(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													
	804.4584	602.5664	453.5279	193.2566	53.9779	0.0000	0.0000	0.0000	0.0000	229.1960	532.3096	816.1386	(98)
Space heating												3685.4314	(98)
Space heating per m2											(98) / (4) =	36.7991	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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)												0.1000	(201)
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
Space heating requirement												3661.0246	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	804.4584	602.5664	453.5279	193.2566	53.9779	0.0000	0.0000	0.0000	0.0000	229.1960	532.3096	816.1386	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	799.1309	598.5759	450.5244	191.9768	53.6204	0.0000	0.0000	0.0000	0.0000	227.6781	528.7844	810.7337	(211)
Water heating requirement													
	123.7628	92.7025	69.7735	29.7318	8.3043	0.0000	0.0000	0.0000	0.0000	35.2609	81.8938	125.5598	(215)
Water heating													
Water heating requirement													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(64)
Efficiency of water heater												79.9000	(216)
(217)m	87.9011	87.5590	86.7835	84.8360	81.9977	79.9000	79.9000	79.9000	79.9000	85.1945	87.2077	87.9780	(217)
Fuel for water heating, kWh/month													
	245.0182	216.8772	229.9785	211.1405	214.2580	196.7471	189.2146	207.2687	206.7903	218.0071	224.8960	238.9949	(219)
Water heating fuel used												2599.1911	(219)
Annual totals kWh/year													
Space heating fuel - main system												3661.0246	(211)
Space heating fuel - secondary												566.9894	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.8080, total flow = 37.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												56.1702	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												131.1702	(231)
Electricity for lighting (calculated in Appendix L)												406.0108	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.25 * 1029 * 1.00) =										-1029.1867		-1029.1867	(233)
Total delivered energy for all uses												6335.1993	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3661.0246	3.4800	127.4037	(240)
Space heating - secondary	566.9894	4.2300	23.9837	(242)
Water heating (other fuel)	2599.1911	3.4800	90.4518	(247)
Mechanical ventilation fans	56.1702	13.1900	7.4088	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	406.0108	13.1900	53.5528	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1029.1867	13.1900	-135.7497	(252)
Total energy cost			296.9436	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.8592	(257)
SAP value		88.0138	
SAP rating (Section 12)		88	(258)
SAP band		B	

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	3661.0246	0.2160	790.7813	(261)
Space heating - secondary	566.9894	0.0190	10.7728	(263)
Water heating (other fuel)	2599.1911	0.2160	561.4253	(264)
Space and water heating			1362.9794	(265)
Pumps and fans	131.1702	0.5190	68.0773	(267)
Energy for lighting	406.0108	0.5190	210.7196	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total kg/year			1107.6284	(272)
CO2 emissions per m2			11.0600	(273)
EI value			89.7746	
EI rating			90	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9060 = 3.841, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9060 = 0.2384, stars = 4
Water heating energy efficiency	3.48 / 0.8409 = 4.139, stars = 4
Water heating environmental impact	0.216 / 0.8409 = 0.2569, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	1	=	1 * 40 =	40.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.3000	3.0000	3.1000	2.9000	2.8000	2.8000	2.9000	3.2000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8250	0.7500	0.7750	0.7250	0.7000	0.7000	0.7250	0.8000	(22a)
Adj infilt rate	0.3310	0.3048	0.3048	0.2874	0.2874	0.2613	0.2700	0.2526	0.2439	0.2439	0.2526	0.2787	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5810	0.5548	0.5548	0.5374	0.5374	0.5113	0.5200	0.5026	0.5000	0.5000	0.5026	0.5287	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1100	5.5638			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2900	36.3747			(29a)
External Roof 1	50.5800		50.5800	0.1100	5.5638			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.7075			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.7021	(36)
Total fabric heat loss (33) + (36) =	81.4096	(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	47.9720	45.8145	45.8145	44.3762	44.3762	42.2186	42.9378	41.4995	41.2869	41.2869	41.4995	43.6570	(38)
Heat transfer coeff	129.3817	127.2241	127.2241	125.7858	125.7858	123.6283	124.3475	122.9091	122.6965	122.6965	122.9091	125.0666	(39)
Average = Sum(39)m / 12 =												124.9713	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2919	1.2703	1.2703	1.2560	1.2560	1.2344	1.2416	1.2273	1.2251	1.2251	1.2273	1.2488	(40)
HLP (average)												1.2478	(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	2.7409 (42)
Average daily hot water use (litres/day)	99.2966 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2969	21.2502	21.9283	19.1177	18.3438	15.8293	14.6682	16.8320	17.0330	19.8503	21.6682	23.5303	(46)

Water storage loss:

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Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(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													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(64)
								Total per year (kWh/year) = Sum(64)m =				2190.9984	(64)
Heat gains from water heating, kWh/month													
	96.5737	85.6864	91.3233	83.7151	83.3777	76.4260	75.2301	80.0264	79.0941	86.7171	89.3688	94.8743	(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	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.4750	51.0488	41.5157	31.4300	23.4943	19.8349	21.4323	27.8585	37.3917	47.4773	55.4130	59.0724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	382.9404	386.9141	376.9004	355.5825	328.6725	303.3809	286.4846	282.5109	292.5245	313.8424	340.7524	366.0440	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	129.8033	127.5096	122.7464	116.2709	112.0668	106.1472	101.1157	107.5624	109.8530	116.5553	124.1233	127.5192	(72)
Total internal gains													
	682.2233	677.4771	653.1671	615.2881	576.2383	541.3676	521.0372	529.9364	551.7737	589.8795	632.2933	664.6402	(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	
Northeast	10.3200	13.3408	0.6300	0.0000	0.7700	66.7873	(75)
Southeast	4.9500	41.5040	0.6300	0.0000	0.7700	99.6613	(77)
Southwest	0.6600	41.5040	0.6300	0.0000	0.7700	13.2882	(79)
Northwest	4.5000	13.3408	0.6300	0.0000	0.7700	29.1224	(81)

Solar gains	208.8591	332.5544	543.7676	814.2314	1000.6575	1115.1085	1047.3399	880.3882	671.1782	438.8678	253.9929	167.5696	(83)
Total gains	891.0824	1010.0315	1196.9347	1429.5195	1576.8957	1656.4761	1568.3771	1410.3246	1222.9519	1028.7473	886.2862	832.2098	(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	53.7546	54.6662	54.6662	55.2913	55.2913	56.2562	55.9309	56.5854	56.6834	56.6834	56.5854	55.6092	
alpha	4.5836	4.6444	4.6444	4.6861	4.6861	4.7504	4.7287	4.7724	4.7789	4.7789	4.7724	4.7073	
util living area													
	0.9879	0.9777	0.9379	0.8218	0.6323	0.3998	0.2692	0.3129	0.5960	0.8813	0.9739	0.9908	(86)
MIT	19.9124	20.0966	20.4307	20.7731	20.9453	20.9951	20.9994	20.9989	20.9706	20.7377	20.2979	19.9047	(87)
Th 2	19.8472	19.8641	19.8641	19.8755	19.8755	19.8926	19.8869	19.8983	19.9000	19.9000	19.8983	19.8812	(88)
util rest of house													
	0.9839	0.9705	0.9185	0.7757	0.5604	0.3194	0.1813	0.2176	0.5013	0.8373	0.9640	0.9877	(89)
MIT 2	18.4491	18.7254	19.1934	19.6451	19.8331	19.8904	19.8868	19.8980	19.8828	19.6373	19.0414	18.4622	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	18.7124	18.9721	19.4161	19.8480	20.0333	20.0891	20.0870	20.0961	20.0785	19.8353	19.2675	18.7218	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5624	18.8221	19.2661	19.6980	19.8833	19.9391	19.9370	19.9461	19.9285	19.6853	19.1175	18.5718	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9614	0.9058	0.7676	0.5609	0.3228	0.1852	0.2218	0.5039	0.8270	0.9544	0.9824	(94)
Useful gains	870.9867	971.0617	1084.1908	1097.2521	884.5595	534.7250	290.5132	312.7559	616.2075	850.7709	845.8739	817.5658	(95)
Ext temp.	5.0000	5.5000	7.3000	9.7000	12.6000	15.6000	17.6000	17.4000	14.8000	11.3000	7.8000	4.9000	(96)
Heat loss rate W													
	1754.7295	1694.8970	1522.3716	1257.6103	916.1296	536.4394	290.5948	312.9404	629.2478	1028.8478	1391.0255	1709.8838	(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													
	657.5047	486.4174	326.0065	115.4579	23.4882	0.0000	0.0000	0.0000	0.0000	132.4892	392.5091	663.8846	(98)
Space heating												2797.7575	(98)
Space heating per m2											(98) / (4) =	27.9357	(99)

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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)												0.1000	(201)
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
Space heating requirement												2779.2293	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	657.5047	486.4174	326.0065	115.4579	23.4882	0.0000	0.0000	0.0000	0.0000	132.4892	392.5091	663.8846	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	653.1503	483.1960	323.8475	114.6933	23.3326	0.0000	0.0000	0.0000	0.0000	131.6118	389.9097	659.4880	(211)
Water heating requirement													
	101.1546	74.8334	50.1549	17.7628	3.6136	0.0000	0.0000	0.0000	0.0000	20.3830	60.3860	102.1361	(215)
Water heating													
Water heating requirement													
	215.3738	189.8954	199.5833	179.1230	175.6867	157.2010	151.1825	165.6077	165.2255	185.7300	196.1267	210.2628	(64)
Efficiency of water heater												79.9000	(216)
(217)m	87.4742	87.0722	85.9407	83.5214	80.9265	79.9000	79.9000	79.9000	79.9000	83.7681	86.4663	87.5481	(217)
Fuel for water heating, kWh/month													
	246.2142	218.0895	232.2338	214.4636	217.0942	196.7471	189.2146	207.2687	206.7903	221.7192	226.8245	240.1682	(219)
Water heating fuel used												2616.8281	(219)
Annual totals kWh/year													
Space heating fuel - main system												2779.2293	(211)
Space heating fuel - secondary												430.4242	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.8080, total flow = 37.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												56.1702	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												131.1702	(231)
Electricity for lighting (calculated in Appendix L)												406.0108	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.25 * 1096 * 1.00) =										-1095.8363		-1095.8363	(233)
Total delivered energy for all uses												5267.8263	(238)

10a. Fuel costs - using BEDF prices (480)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2779.2293	3.7400	103.9432	(240)
Space heating - secondary	430.4242	4.9900	21.4782	(242)
Water heating (other fuel)	2616.8281	3.7400	97.8694	(247)
Mechanical ventilation fans	56.1702	19.1200	10.7397	(249)
Pumps and fans for heating	75.0000	19.1200	14.3400	(249)
Energy for lighting	406.0108	19.1200	77.6293	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit	-1095.8363	19.1200	-209.5239	(252)
Total energy cost			210.4758	(255)

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	2779.2293	0.2160	600.3135	(261)
Space heating - secondary	430.4242	0.0190	8.1781	(263)
Water heating (other fuel)	2616.8281	0.2160	565.2349	(264)
Space and water heating			1173.7265	(265)
Pumps and fans	131.1702	0.5190	68.0773	(267)
Energy for lighting	406.0108	0.5190	210.7196	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	0.5190	-568.7390	(269)
Total kg/year			883.7844	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2779.2293	1.2200	3390.6598	(261)
Space heating - secondary	430.4242	1.0400	447.6412	(263)
Water heating (other fuel)	2616.8281	1.2200	3192.5302	(264)
Space and water heating			7030.8312	(265)
Pumps and fans	131.1702	3.0700	402.6924	(267)
Energy for lighting	406.0108	3.0700	1246.4531	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

PV Unit	-1095.8363	3.0700	-3364.2174 (269)
Primary energy kWh/year			5315.7594 (272)
Primary energy kWh/m2/year			53.0780 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 90

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.6	-£ 41	-266 kg (30.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£41	2.66 kg/m²	B 90	A 92
Total Savings	£41	2.66 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 480 TEST (28 Jul 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£103	£112	-£10
Mains gas	£296	£245	£51
Wood	£21	£22	-£0
Space heating	£245	£246	-£2
Water heating	£98	£55	£43
Lighting	£78	£78	£0
Generated (PV)	-£210	-£210	£0
Total cost of fuels	£210	£169	£41
Total cost of uses	£211	£169	£41
Delivered energy	53 kWh/m²	40 kWh/m²	13 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.6 tonnes	0.3 tonnes
CO2 emissions per m²	9 kg/m²	6 kg/m²	3 kg/m²
Primary energy	53 kWh/m²	38 kWh/m²	15 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	1	=	1 * 40 =	40.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(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	0.4442	0.4355	0.4268	0.3832	0.3745	0.3310	0.3310	0.3223	0.3484	0.3745	0.3919	0.4093	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.6942	0.6855	0.6768	0.6332	0.6245	0.5810	0.5810	0.5723	0.5984	0.6245	0.6419	0.6593	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1100	5.5638			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2900	36.3747			(29a)
External Roof 1	50.5800		50.5800	0.1100	5.5638			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.7075			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		81.4096	(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	57.3213	56.6021	55.8829	52.2871	51.5679	47.9720	47.9720	47.2528	49.4104	51.5679	53.0062	54.4446	(38)
Heat transfer coeff	138.7309	138.0117	137.2926	133.6967	132.9775	129.3817	129.3817	128.6625	130.8200	132.9775	134.4159	135.8542	(39)
Average = Sum(39)m / 12 =												133.5169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3852	1.3781	1.3709	1.3350	1.3278	1.2919	1.2919	1.2847	1.3062	1.3278	1.3421	1.3565	(40)
HLP (average)												1.3332	(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 2.7409 (42)
Average daily hot water use (litres/day) 99.2966 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2969	21.2502	21.9283	19.1177	18.3438	15.8293	14.6682	16.8320	17.0330	19.8503	21.6682	23.5303	(46)

Water storage loss:

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	19.3706	17.4960	19.3706	18.7457	19.3706	18.7457	19.3706	19.3706	18.7457	19.3706	18.7457	19.3706	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	204.6124	180.1754	187.4261	161.9552	152.1310	134.1800	127.3941	142.7498	149.4083	173.5728	185.7124	199.5014	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1608	(H8)
Utilisation factor												0.5775	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												99.2966	(H14)
Volume ratio Veff/V												1.1632	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-920.8525	(H17)
Solar input	-26.7029	-44.5594	-75.8898	-101.7073	-125.6508	-123.5348	-121.9022	-106.5066	-83.4160	-56.9633	-31.6735	-22.3458	(63)
										Solar input (sum of months) = Sum(63)m =		-920.8525	(63)
Output from w/h													
	177.9095	135.6160	111.5363	60.2478	26.4801	10.6452	5.4919	36.2432	65.9923	116.6095	154.0389	177.1556	(64)
										Total per year (kWh/year) = Sum(64)m =		1077.9664	(64)
Heat gains from water heating, kWh/month													
	87.9645	77.9104	81.5976	69.9808	64.5331	58.0092	56.1994	61.7401	66.4404	76.9914	81.0373	86.2651	(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	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.4750	51.0488	41.5157	31.4300	23.4943	19.8349	21.4323	27.8585	37.3917	47.4773	55.4130	59.0724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	382.9404	386.9141	376.9004	355.5825	328.6725	303.3809	286.4846	282.5109	292.5245	313.8424	340.7524	366.0440	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	118.2319	115.9382	109.6742	97.1955	86.7381	80.5683	75.5368	82.9840	92.2783	103.4830	112.5519	115.9477	(72)
Total internal gains													
	670.6519	665.9056	640.0949	596.2127	550.9095	515.7887	495.4583	505.3580	534.1991	576.8073	620.7219	653.0688	(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	
Northeast	10.3200	11.2829	0.6300	0.0000	0.7700	56.4850	(75)
Southeast	4.9500	36.7938	0.6300	0.0000	0.7700	88.3510	(77)
Southwest	0.6600	36.7938	0.6300	0.0000	0.7700	11.7801	(79)
Northwest	4.5000	11.2829	0.6300	0.0000	0.7700	24.6301	(81)

Solar gains	181.2463	335.6726	530.8478	777.7014	980.5801	1021.6499	964.9372	806.2177	615.1719	390.2857	221.9978	151.9341	(83)
Total gains	851.8981	1001.5782	1170.9426	1373.9141	1531.4896	1537.4386	1460.3954	1311.5757	1149.3710	967.0930	842.7197	805.0028	(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	50.1320	50.3933	50.6572	52.0197	52.3010	53.7546	53.7546	54.0551	53.1636	52.3010	51.7414	51.1936	
alpha	4.3421	4.3596	4.3771	4.4680	4.4867	4.5836	4.5836	4.6037	4.5442	4.4867	4.4494	4.4129	
util living area													
	0.9918	0.9827	0.9572	0.8770	0.7213	0.5235	0.3866	0.4448	0.7092	0.9297	0.9839	0.9935	(86)
MIT	19.6764	19.8856	20.2158	20.6255	20.8800	20.9789	20.9957	20.9923	20.9202	20.5605	20.0584	19.6601	(87)
Th 2	19.7747	19.7802	19.7857	19.8135	19.8191	19.8472	19.8472	19.8528	19.8359	19.8191	19.8080	19.7968	(88)
util rest of house													
	0.9890	0.9771	0.9433	0.8408	0.6542	0.4357	0.2870	0.3372	0.6168	0.8999	0.9777	0.9913	(89)
MIT 2	18.0569	18.3626	18.8358	19.4097	19.7156	19.8351	19.8459	19.8501	19.7806	19.3460	18.6345	18.0484	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	18.3483	18.6367	19.0841	19.6285	19.9251	20.0409	20.0528	20.0556	19.9857	19.5645	18.8907	18.3384	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1983	18.4867	18.9341	19.4785	19.7751	19.8909	19.9028	19.9056	19.8357	19.4145	18.7407	18.1884	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9837	0.9686	0.9305	0.8288	0.6515	0.4391	0.2919	0.3422	0.6168	0.8867	0.9696	0.9869	(94)
Useful gains	838.0190	970.1745	1089.6113	1138.6378	997.7130	675.1346	426.2352	448.8664	708.9329	857.5649	817.0650	794.4227	(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	1928.1217	1875.1186	1707.1093	1414.3109	1073.8131	684.5446	427.3179	451.0449	750.3407	1172.1318	1564.7003	1900.3783	(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	811.0364	608.1225	459.4185	198.4846	56.6185	0.0000	0.0000	0.0000	0.0000	234.0378	538.2975	822.8310	(98)
Space heating												3728.8467	(98)
Space heating per m2											(98) / (4) =	37.2326	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	3704.1524	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	811.0364	608.1225	459.4185	198.4846	56.6185	0.0000	0.0000	0.0000	0.0000	234.0378	538.2975	822.8310	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	805.6653	604.0952	456.3760	197.1702	56.2435	0.0000	0.0000	0.0000	0.0000	232.4878	534.7326	817.3818	(211)
Water heating requirement	124.7748	93.5573	70.6798	30.5361	8.7105	0.0000	0.0000	0.0000	0.0000	36.0058	82.8150	126.5894	(215)
Water heating													
Water heating requirement	177.9095	135.6160	111.5363	60.2478	26.4801	10.6452	5.4919	36.2432	65.9923	116.6095	154.0389	177.1556	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.2831	88.2530	88.0937	87.6400	86.6327	79.9000	79.9000	79.9000	79.9000	86.4735	87.7646	88.3169	(217)
Fuel for water heating, kWh/month	201.5215	153.6672	126.6110	68.7447	30.5660	13.3231	6.8735	45.3607	82.5936	134.8500	175.5138	200.5910	(219)
Water heating fuel used												1240.2160	(219)
Annual totals kWh/year													
Space heating fuel - main system												3704.1524	(211)
Space heating fuel - secondary												573.6687	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.8080, total flow = 37.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												56.1702	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												181.1702	(231)
Electricity for lighting (calculated in Appendix L)												406.0108	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.25 * 1029 * 1.00) =										-1029.1867		-1029.1867	(233)
Total delivered energy for all uses												5076.0314	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3704.1524	3.4800	128.9045	(240)
Space heating - secondary	573.6687	4.2300	24.2662	(242)
Water heating (other fuel)	1240.2160	3.4800	43.1595	(247)
Mechanical ventilation fans	56.1702	13.1900	7.4088	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	406.0108	13.1900	53.5528	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1029.1867	13.1900	-135.7497	(252)
Total energy cost			258.0296	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.7466	(257)
SAP value	89.5846	
SAP rating (Section 12)	90	(258)
SAP band	B	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	3704.1524	0.2160	800.0969	(261)
Space heating - secondary	573.6687	0.0190	10.8997	(263)
Water heating (other fuel)	1240.2160	0.2160	267.8867	(264)
Space and water heating			1078.8833	(265)
Pumps and fans	181.1702	0.5190	94.0273	(267)
Energy for lighting	406.0108	0.5190	210.7196	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total kg/year			849.4823	(272)
CO2 emissions per m2			8.4800	(273)
EI value			92.1577	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5800 (1b)	x	2.3500 (2b)	=	118.8630	(1b) - (3b)
First floor	49.5700 (1c)	x	2.6500 (2c)	=	131.3605	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	250.2235	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	1	=	1 * 40 =	40.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(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) =	0.1599	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4099	(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) =	0.3484	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.3000	3.0000	3.1000	2.9000	2.8000	2.8000	2.9000	3.2000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8250	0.7500	0.7750	0.7250	0.7000	0.7000	0.7250	0.8000	(22a)
Adj infilt rate	0.3310	0.3048	0.3048	0.2874	0.2874	0.2613	0.2700	0.2526	0.2439	0.2439	0.2526	0.2787	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5810	0.5548	0.5548	0.5374	0.5374	0.5113	0.5200	0.5026	0.5000	0.5000	0.5026	0.5287	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			20.4300	1.3258	27.0852			(27)
Heat Loss Floor 1			50.5800	0.1100	5.5638			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2900	36.3747			(29a)
External Roof 1	50.5800		50.5800	0.1100	5.5638			(30)
Total net area of external elements Aum(A, m2)			249.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.7075			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		81.4096	(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	47.9720	45.8145	45.8145	44.3762	44.3762	42.2186	42.9378	41.4995	41.2869	41.2869	41.4995	43.6570	(38)
Heat transfer coeff	129.3817	127.2241	127.2241	125.7858	125.7858	123.6283	124.3475	122.9091	122.6965	122.6965	122.9091	125.0666	(39)
Average = Sum(39)m / 12 =												124.9713	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2919	1.2703	1.2703	1.2560	1.2560	1.2344	1.2416	1.2273	1.2251	1.2251	1.2273	1.2488	(40)
HLP (average)												1.2478	(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												2.7409	(42)
Average daily hot water use (litres/day)												99.2966	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.2263	105.2544	101.2825	97.3107	93.3388	89.3670	89.3670	93.3388	97.3107	101.2825	105.2544	109.2263	(44)
Energy conte	161.9794	141.6682	146.1889	127.4510	122.2923	105.5290	97.7881	112.2133	113.5535	132.3356	144.4547	156.8684	(45)
Energy content (annual)										Total = Sum(45)m =		1562.3224	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2969	21.2502	21.9283	19.1177	18.3438	15.8293	14.6682	16.8320	17.0330	19.8503	21.6682	23.5303	(46)

Water storage loss:

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	19.3706	17.4960	19.3706	18.7457	19.3706	18.7457	19.3706	19.3706	18.7457	19.3706	18.7457	19.3706	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	204.6124	180.1754	187.4261	161.9552	152.1310	134.1800	127.3941	142.7498	149.4083	173.5728	185.7124	199.5014	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1145.1228	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1923.8063	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2314	(H8)
Utilisation factor												0.5561	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												99.2966	(H14)
Volume ratio Veff/V												1.1632	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-940.6510	(H17)
Solar input	-29.6522	-42.3746	-74.1996	-101.2513	-121.8784	-128.2457	-125.8025	-110.5391	-86.7002	-61.3512	-34.8834	-23.7728	(63)
								Solar input (sum of months) = Sum(63)m =				-940.6510	(63)
Output from w/h													
	174.9602	137.8008	113.2265	60.7039	30.2526	5.9342	1.5916	32.2107	62.7081	112.2216	150.8290	175.7286	(64)
								Total per year (kWh/year) = Sum(64)m =				1058.1678	(64)
Heat gains from water heating, kWh/month													
	87.9645	77.9104	81.5976	69.9808	64.5331	58.0092	56.1994	61.7401	66.4404	76.9914	81.0373	86.2651	(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	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.4750	51.0488	41.5157	31.4300	23.4943	19.8349	21.4323	27.8585	37.3917	47.4773	55.4130	59.0724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	382.9404	386.9141	376.9004	355.5825	328.6725	303.3809	286.4846	282.5109	292.5245	313.8424	340.7524	366.0440	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	54.1864	(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)													
	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	-109.6364	(71)
Water heating gains (Table 5)													
	118.2319	115.9382	109.6742	97.1955	86.7381	80.5683	75.5368	82.9840	92.2783	103.4830	112.5519	115.9477	(72)
Total internal gains													
	670.6519	665.9056	640.0949	596.2127	550.9095	515.7887	495.4583	505.3580	534.1991	576.8073	620.7219	653.0688	(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	
Northeast	10.3200	13.3408	0.6300	0.0000	0.7700	66.7873	(75)
Southeast	4.9500	41.5040	0.6300	0.0000	0.7700	99.6613	(77)
Southwest	0.6600	41.5040	0.6300	0.0000	0.7700	13.2882	(79)
Northwest	4.5000	13.3408	0.6300	0.0000	0.7700	29.1224	(81)

Solar gains	208.8591	332.5544	543.7676	814.2314	1000.6575	1115.1085	1047.3399	880.3882	671.1782	438.8678	253.9929	167.5696	(83)
Total gains	879.5110	998.4600	1183.8625	1410.4440	1551.5670	1630.8972	1542.7982	1385.7462	1205.3772	1015.6751	874.7148	820.6383	(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	53.7546	54.6662	54.6662	55.2913	55.2913	56.2562	55.9309	56.5854	56.6834	56.6834	56.5854	55.6092	
alpha	4.5836	4.6444	4.6444	4.6861	4.6861	4.7504	4.7287	4.7724	4.7789	4.7789	4.7724	4.7073	
util living area													
	0.9885	0.9786	0.9400	0.8273	0.6405	0.4058	0.2736	0.3184	0.6034	0.8854	0.9751	0.9913	(86)
MIT	19.9024	20.0871	20.4218	20.7658	20.9423	20.9947	20.9994	20.9988	20.9691	20.7310	20.2885	19.8945	(87)
Th 2	19.8472	19.8641	19.8641	19.8755	19.8755	19.8926	19.8869	19.8983	19.9000	19.9000	19.8983	19.8812	(88)
util rest of house													
	0.9847	0.9717	0.9212	0.7819	0.5684	0.3243	0.1843	0.2215	0.5080	0.8423	0.9657	0.9884	(89)
MIT 2	18.4348	18.7119	19.1816	19.6368	19.8306	19.8902	19.8867	19.8980	19.8818	19.6295	19.0283	18.4476	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	18.6989	18.9594	19.4047	19.8400	20.0307	20.0889	20.0869	20.0961	20.0774	19.8277	19.2551	18.7079	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5489	18.8094	19.2547	19.6900	19.8807	19.9389	19.9369	19.9461	19.9274	19.6777	19.1051	18.5579	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9628	0.9085	0.7734	0.5687	0.3278	0.1883	0.2257	0.5105	0.8319	0.9563	0.9833	(94)
Useful gains	860.5404	961.3351	1075.5844	1090.8979	882.4148	534.5849	290.5052	312.7369	615.3442	844.9092	836.4716	806.9045	(95)
Ext temp.	5.0000	5.5000	7.3000	9.7000	12.6000	15.6000	17.6000	17.4000	14.8000	11.3000	7.8000	4.9000	(96)
Heat loss rate W													
	1752.9775	1693.2734	1520.9291	1256.5973	915.8028	536.4169	290.5931	312.9366	629.1149	1027.9089	1389.4942	1708.1489	(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													
	663.9732	491.8626	331.3365	119.3036	24.8406	0.0000	0.0000	0.0000	0.0000	136.1518	398.1763	670.5258	(98)
Space heating												2836.1703	(98)
Space heating per m2											(98) / (4) =	28.3192	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	2817.3878	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	663.9732	491.8626	331.3365	119.3036	24.8406	0.0000	0.0000	0.0000	0.0000	136.1518	398.1763	670.5258	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	659.5760	488.6052	329.1422	118.5135	24.6761	0.0000	0.0000	0.0000	0.0000	135.2501	395.5394	666.0852	(211)
Water heating requirement													
	102.1497	75.6712	50.9748	18.3544	3.8216	0.0000	0.0000	0.0000	0.0000	20.9464	61.2579	103.1578	(215)
Water heating													
Water heating requirement													
	174.9602	137.8008	113.2265	60.7039	30.2526	5.9342	1.5916	32.2107	62.7081	112.2216	150.8290	175.7286	(64)
Efficiency of water heater												79.9000	(216)
(217)m	87.9331	87.8085	87.3797	86.4202	84.1219	79.9000	79.9000	79.9000	79.9000	85.1490	87.1432	87.9440	(217)
Fuel for water heating, kWh/month													
	198.9697	156.9333	129.5799	70.2427	35.9628	7.4271	1.9920	40.3138	78.4832	131.7944	173.0818	199.8189	(219)
Water heating fuel used												1224.5996	(219)
Annual totals kWh/year													
Space heating fuel - main system												2817.3878	(211)
Space heating fuel - secondary												436.3339	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.8080, total flow = 37.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												56.1702	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												181.1702	(231)
Electricity for lighting (calculated in Appendix L)												406.0108	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.25 * 1096 * 1.00) =										-1095.8363		-1095.8363	(233)
Total delivered energy for all uses												3969.6659	(238)

10a. Fuel costs - using BEDF prices (480)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2817.3878	3.7400	105.3703	(240)
Space heating - secondary	436.3339	4.9900	21.7731	(242)
Water heating (other fuel)	1224.5996	3.7400	45.8000	(247)
Mechanical ventilation fans	56.1702	19.1200	10.7397	(249)
Pumps and fans for heating	75.0000	19.1200	14.3400	(249)
Pump for solar water heating	50.0000	19.1200	9.5600	(249)
Energy for lighting	406.0108	19.1200	77.6293	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit	-1095.8363	19.1200	-209.5239	(252)
Total energy cost			169.6885	(255)

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	2817.3878	0.2160	608.5558	(261)
Space heating - secondary	436.3339	0.0190	8.2903	(263)
Water heating (other fuel)	1224.5996	0.2160	264.5135	(264)
Space and water heating			881.3596	(265)
Pumps and fans	181.1702	0.5190	94.0273	(267)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy for lighting	406.0108	0.5190	210.7196 (268)
Energy saving/generation technologies			
PV Unit	-1095.8363	0.5190	-568.7390 (269)
Total kg/year			617.3675 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2817.3878	1.2200	3437.2131	(261)
Space heating - secondary	436.3339	1.0400	453.7873	(263)
Water heating (other fuel)	1224.5996	1.2200	1494.0115	(264)
Space and water heating			5385.0118	(265)
Pumps and fans	181.1702	3.0700	556.1924	(267)
Energy for lighting	406.0108	3.0700	1246.4531	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	3.0700	-3364.2174	(269)
Primary energy kWh/year			3823.4400	(272)
Primary energy kWh/m2/year			38.1771	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		660.59 (P1)
Transmission heat loss coefficient		81.41 (37)
Summer heat loss coefficient		742.00 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	10.3200	98.8453	0.6300	0.0000	0.9000	578.3872
South East	4.9500	119.9223	0.6300	0.0000	0.9000	336.5801
South West	0.6600	119.9223	0.6300	0.0000	0.9000	44.8773
North West	4.5000	98.8453	0.6300	0.0000	0.9000	252.2037
total:						1212.0483

	Jun	Jul	Aug	
Solar gains	1297	1212	1035	(P4)
Internal gains	538	518	527	
Total summer gains	1835	1730	1562	(P5)
Summer gain/loss ratio	2.47	2.33	2.11	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	18.72	20.48	20.16	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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

Property Reference	SECLISVYNE	**Issued on Date**	12/09/2021
Assessment Reference	001	**Prop Type Ref**	Vyne
Property	Plot 35, Greatham, Hampshire, GU22		

SAP Rating	89 B	**DER**	11.90	**TER**	18.43
Environmental	91 B	**% DER<TER**	35.42		
CO_2 Emissions (t/year)	0.72	**DFEE**	44.26	**TFEE**	52.56
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.78		

Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: 01635261582, info@southernenergyconsultants.co.uk	**Assessor ID**	d168-0001
Client	Cove Homes, COV001		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r16

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

Semi-Detached House, total floor area 80 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) 18.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.90 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.29 (max. 0.30)	0.29 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.35 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: No cylinder

---

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

---

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

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8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1600 0.1600
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North East: 8.85 m², No overhang
Windows facing South West: 5.81 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Floor U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
Photovoltaic array 0.75 kW

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)	
Ground floor	40.1700 (1b)	x	2.3500 (2b)	=	94.3995	(1b) - (3b)
First floor	40.1700 (1c)	x	2.6500 (2c)	=	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.8500	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1100	4.4187			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.2900	21.2193			(29a)
External Roof 1	40.1700		40.1700	0.1100	4.4187			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.6123			(33)
Party Wall 1			41.2000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.9284	(36)
Total fabric heat loss					(33) + (36) =		58.5407	(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	34.5280	34.1759	33.8238	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	(38)
Heat transfer coeff	93.0687	92.7165	92.3644	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	(39)
Average = Sum(39)m / 12 =												91.9398	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1584	1.1541	1.1497	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	(40)
HLP (average)												1.1444	(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	2.4693	(42)
Average daily hot water use (litres/day)	92.8454	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)
Energy content (annual)										Total = Sum(45)m =		1460.8199	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7184	19.8696	20.5037	17.8756	17.1521	14.8009	13.7152	15.7384	15.9264	18.5607	20.2604	22.0015	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
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)
Combi loss     14.1201    12.7382    14.0672    13.5730    13.9961    13.5107    13.9399    13.9763    13.5447    14.0378    13.6318    14.1086 (61)
Total heat required for water heating calculated for each month
              165.5758   145.2023   150.7584   132.7437   128.3432   112.1835   105.3748   118.8992   119.7207   137.7757   148.7014   160.7854 (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
              165.5758   145.2023   150.7584   132.7437   128.3432   112.1835   105.3748   118.8992   119.7207   137.7757   148.7014   160.7854 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =   1626.0643 (64)
Heat gains from water heating, kWh/month
               53.8891    47.2289    48.9666    43.0175    41.5194    36.1864    33.8871    38.3809    38.6897    44.6523    48.3186    52.2972 (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          123.4640   123.4640   123.4640   123.4640   123.4640   123.4640   123.4640   123.4640   123.4640   123.4640   123.4640   123.4640 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               20.0028    17.7663    14.4485    10.9385     8.1766     6.9031     7.4590     9.6955    13.0133    16.5233    19.2852    20.5587 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              220.1497   222.4341   216.6774   204.4219   188.9515   174.4115   164.6979   162.4135   168.1703   180.4258   195.8961   210.4361 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               35.3464    35.3464    35.3464    35.3464    35.3464    35.3464    35.3464    35.3464    35.3464    35.3464    35.3464    35.3464 (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)
              -98.7712   -98.7712   -98.7712   -98.7712   -98.7712   -98.7712   -98.7712   -98.7712   -98.7712   -98.7712   -98.7712   -98.7712 (71)
Water heating gains (Table 5)
               72.4315    70.2811    65.8154    59.7465    55.8057    50.2589    45.5472    51.5873    53.7357    60.0165    67.1092    70.2919 (72)
Total internal gains
              375.6232   373.5207   359.9805   338.1461   315.9730   294.6127   280.7433   286.7355   297.9584   320.0048   345.3297   364.3260 (73)


-------------------------------------------------------------------------------------------------------------------
6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                           m2           Table 6a      Specific data      Specific data       factor                W
                                                           W/m2      or Table 6b        or Table 6c         Table 6d
-------------------------------------------------------------------------------------------------------------------
Northeast                                8.8500           11.2829           0.6300            0.0000           0.7700           48.4392 (75)
Southwest                                5.8100           36.7938           0.6300            0.0000           0.7700          103.7009 (79)
-------------------------------------------------------------------------------------------------------------------

Solar gains    152.1401   275.2403   419.3326   591.2066   727.5842   751.0827   712.1553   606.0146   478.1597   315.7221   185.1588   128.3042 (83)
Total gains    527.7633   648.7611   779.3130   929.3527  1043.5572  1045.6954   992.8986   892.7501   776.1181   635.7270   530.4884   492.6302 (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            59.9468    60.1744    60.4038    60.8542    60.8542    60.8542    60.8542    60.8542    60.8542    60.8542    60.8542    60.8542
alpha           4.9965     5.0116     5.0269     5.0569     5.0569     5.0569     5.0569     5.0569     5.0569     5.0569     5.0569     5.0569
util living area
                0.9970     0.9913     0.9714     0.8992     0.7408     0.5474     0.4037     0.4667     0.7396     0.9531     0.9930     0.9979 (86)

MIT            19.8001    20.0075    20.3193    20.6796    20.9069    20.9833    20.9970    20.9941    20.9314    20.5930    20.1247    19.7722 (87)
Th 2           19.9534    19.9569    19.9605    19.9674    19.9674    19.9674    19.9674    19.9674    19.9674    19.9674    19.9674    19.9674 (88)
util rest of house
                0.9960     0.9884     0.9621     0.8693     0.6802     0.4650     0.3103     0.3649     0.6557     0.9323     0.9903     0.9971 (89)
MIT 2          18.3615    18.6656    19.1155    19.6127    19.8849    19.9574    19.9664    19.9651    19.9176    19.5110    18.8452    18.3308 (90)
Living area fraction                                                                                  fLA = Living area / (4) =     0.2277 (91)
MIT            18.6890    18.9711    19.3895    19.8556    20.1175    20.1909    20.2010    20.1994    20.1484    19.7573    19.1365    18.6589 (92)
Temperature adjustment                                                                                                        -0.1500
adjusted MIT   18.5390    18.8211    19.2395    19.7056    19.9675    20.0409    20.0510    20.0494    19.9984    19.6073    18.9865    18.5089 (93)


-------------------------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9939     0.9839     0.9536     0.8604     0.6802     0.4711     0.3180     0.3731     0.6585     0.9229     0.9864     0.9956 (94)
Useful gains   524.5585   638.3244   743.1264   799.5944   709.8598   492.5806   315.7272   333.1123   511.0604   586.6927   523.2529   490.4517 (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
             1325.2050  1290.7129  1176.6786   990.6680   757.9741   498.8294   316.3914   334.5786   540.7718   825.7989  1089.7617  1311.8529 (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
              595.6810   438.4051   322.5628   137.5730    35.7970     0.0000     0.0000     0.0000     0.0000   177.8950   407.8863   611.1225 (98)
Space heating                                                                                                                2726.9227 (98)
Space heating per m2                                                                                        (98) / (4) =     33.9423 (99)


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8c. Space cooling requirement
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Not applicable
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3013.1742	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	595.6810	438.4051	322.5628	137.5730	35.7970	0.0000	0.0000	0.0000	0.0000	177.8950	407.8863	611.1225	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	658.2111	484.4255	356.4230	152.0144	39.5547	0.0000	0.0000	0.0000	0.0000	196.5690	450.7031	675.2734	(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													
	165.5758	145.2023	150.7584	132.7437	128.3432	112.1835	105.3748	118.8992	119.7207	137.7757	148.7014	160.7854	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7842	89.6821	89.4556	88.8998	87.9784	87.3000	87.3000	87.3000	87.3000	89.0750	89.6223	89.8143	(217)
Fuel for water heating, kWh/month													
	184.4154	161.9078	168.5288	149.3184	145.8803	128.5035	120.7043	136.1961	137.1371	154.6739	165.9201	179.0199	(219)
Water heating fuel used												1832.2054	(219)
Annual totals kWh/year													
Space heating fuel - main system												3013.1742	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												45.0868	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												120.0868	(231)
Electricity for lighting (calculated in Appendix L)												353.2556	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 1080 * 1.00) =										-647.7148		-647.7148	(233)
Total delivered energy for all uses												4671.0073	(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	3013.1742	0.2160	650.8456	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1832.2054	0.2160	395.7564	(264)
Space and water heating			1046.6020	(265)
Pumps and fans	120.0868	0.5190	62.3251	(267)
Energy for lighting	353.2556	0.5190	183.3397	(268)
Energy saving/generation technologies				
PV Unit	-647.7148	0.5190	-336.1640	(269)
Total CO2, kg/year			956.1027	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.9000	(273)

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

DER		11.9000	ZC1
Total Floor Area	TFA	80.3400	
Assumed number of occupants	N	2.4693	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2380	ZC2
CO2 emissions from cooking, equation (L16)		2.2189	ZC3
Total CO2 emissions		30.3569	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		30.3569	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)	
Ground floor	40.1700 (1b)	x	2.3500 (2b)	=	94.3995	(1b) - (3b)
First floor	40.1700 (1c)	x	2.6500 (2c)	=	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.8500	(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							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1494	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3994	(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) =	0.3395	(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	0.4328	0.4243	0.4158	0.3734	0.3649	0.3225	0.3225	0.3140	0.3395	0.3649	0.3819	0.3989	(22b)
Effective ac	0.5937	0.5900	0.5865	0.5697	0.5666	0.5520	0.5520	0.5493	0.5576	0.5666	0.5729	0.5795	(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 Opaque door			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1300	5.2221			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.1800	13.1706			(29a)
External Roof 1	40.1700		40.1700	0.1300	5.2221			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.1704			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.2501	(36)
Total fabric heat loss					(33) + (36) =		54.4205	(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	39.3483	39.1072	38.8709	37.7611	37.5534	36.5868	36.5868	36.4078	36.9591	37.5534	37.9735	38.4127	(38)
Heat transfer coeff	93.7688	93.5277	93.2914	92.1816	91.9739	91.0073	91.0073	90.8283	91.3796	91.9739	92.3940	92.8332	(39)
Average = Sum(39)m / 12 =												92.1806	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1671	1.1641	1.1612	1.1474	1.1448	1.1328	1.1328	1.1305	1.1374	1.1448	1.1500	1.1555	(40)
HLP (average)												1.1474	(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												2.4693	(42)
Average daily hot water use (litres/day)												92.8454	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)
Energy content (annual)										Total = Sum(45)m =		1460.8199	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7184	19.8696	20.5037	17.8756	17.1521	14.8009	13.7152	15.7384	15.9264	18.5607	20.2604	22.0015	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	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)
Combi loss	50.9589	45.2984	48.2593	44.8710	44.4742	41.2081	42.5817	44.4742	44.8710	48.2593	48.5340	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4147	177.7626	184.9504	164.0417	158.8213	139.8810	134.0166	149.3971	151.0470	171.9972	183.6036	197.6357	(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													
	202.4147	177.7626	184.9504	164.0417	158.8213	139.8810	134.0166	149.3971	151.0470	171.9972	183.6036	197.6357	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.5690	(64)
Heat gains from water heating, kWh/month													
	63.0988	55.3689	57.5146	50.8420	49.1390	43.1108	41.0475	46.0054	46.5213	53.2077	57.0441	61.5098	(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	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0028	17.7663	14.4485	10.9385	8.1766	6.9031	7.4590	9.6955	13.0133	16.5233	19.2852	20.5587	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1497	222.4341	216.6774	204.4219	188.9515	174.4115	164.6979	162.4135	168.1703	180.4258	195.8961	210.4361	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	(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)													
	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	(71)
Water heating gains (Table 5)													
	84.8102	82.3943	77.3046	70.6139	66.0470	59.8760	55.1714	61.8352	64.6129	71.5157	79.2280	82.6744	(72)
Total internal gains													
	388.0019	385.6339	371.4697	349.0134	326.2143	304.2298	290.3676	296.9834	308.8356	331.5040	357.4485	376.7085	(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	
Northeast	8.8500	11.2829	0.6300	0.7000	0.7700	30.5167	(75)
Southwest	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(79)

Solar gains	95.8482	173.4014	264.1795	372.4602	458.3780	473.1821	448.6578	381.7892	301.2406	198.9049	116.6500	80.8317	(83)
Total gains	483.8501	559.0353	635.6492	721.4736	784.5924	777.4120	739.0254	678.7726	610.0762	530.4089	474.0985	457.5401	(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	59.4992	59.6525	59.8036	60.5237	60.6603	61.3046	61.3046	61.4254	61.0548	60.6603	60.3845	60.0988	
alpha	4.9666	4.9768	4.9869	5.0349	5.0440	5.0870	5.0870	5.0950	5.0703	5.0440	5.0256	5.0066	
util living area													
	0.9980	0.9955	0.9876	0.9576	0.8684	0.6969	0.5306	0.5945	0.8487	0.9766	0.9958	0.9985	(86)
MIT	19.7379	19.8931	20.1543	20.5035	20.7964	20.9523	20.9902	20.9832	20.8679	20.4869	20.0506	19.7122	(87)
Th 2	19.9464	19.9488	19.9512	19.9623	19.9644	19.9742	19.9742	19.9760	19.9704	19.9644	19.9602	19.9558	(88)
util rest of house													
	0.9973	0.9939	0.9831	0.9415	0.8210	0.6056	0.4127	0.4726	0.7773	0.9648	0.9940	0.9980	(89)
MIT 2	18.2658	18.4940	18.8748	19.3791	19.7657	19.9428	19.9706	19.9691	19.8636	19.3654	18.7327	18.2350	(90)
Living area fraction									fLA = Living area / (4) =			0.2277	(91)
MIT	18.6009	18.8125	19.1661	19.6351	20.0004	20.1726	20.2027	20.2000	20.0922	19.6207	19.0327	18.5713	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6009	18.8125	19.1661	19.6351	20.0004	20.1726	20.2027	20.2000	20.0922	19.6207	19.0327	18.5713	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9914	0.9785	0.9352	0.8229	0.6245	0.4397	0.5004	0.7871	0.9595	0.9917	0.9969	(94)
Useful gains	481.8888	554.2451	621.9765	674.7034	645.6600	485.4691	324.9323	339.6469	480.1688	508.9394	470.1860	456.1216	(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													
	1340.9827	1301.2087	1181.6341	989.5779	763.4174	507.1498	327.8746	345.1436	547.5690	829.6689	1102.5121	1334.1312	(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													
	639.1659	501.9595	416.3852	226.7096	87.6116	0.0000	0.0000	0.0000	0.0000	238.6227	455.2748	653.2391	(98)
Space heating												3218.9685	(98)
Space heating per m2											(98) / (4) =	40.0668	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3446.4331	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	639.1659	501.9595	416.3852	226.7096	87.6116	0.0000	0.0000	0.0000	0.0000	238.6227	455.2748	653.2391	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	684.3318	537.4299	445.8086	242.7298	93.8025	0.0000	0.0000	0.0000	0.0000	255.4847	487.4463	699.3995	(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													
	202.4147	177.7626	184.9504	164.0417	158.8213	139.8810	134.0166	149.3971	151.0470	171.9972	183.6036	197.6357	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7455	87.5211	87.0331	85.8660	83.6215	80.3000	80.3000	80.3000	80.3000	85.8756	87.2463	87.8339	(217)
Fuel for water heating, kWh/month													
	230.6837	203.1083	212.5058	191.0438	189.9288	174.1980	166.8949	186.0487	188.1034	200.2863	210.4427	225.0107	(219)
Water heating fuel used												2378.2553	(219)
Annual totals kWh/year													
Space heating fuel - main system												3446.4331	(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)												353.2556	(232)
Total delivered energy for all uses												6252.9440	(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	3446.4331	0.2160	744.4295	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2378.2553	0.2160	513.7031	(264)
Space and water heating			1258.1327	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.2556	0.5190	183.3397	(268)
Total CO2, kg/m2/year			1480.3973	(272)
Emissions per m2 for space and water heating			15.6601	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2820	(272b)
Emissions per m2 for pumps and fans			0.4845	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.6601 * 1.00) + 2.2820 + 0.4845, rounded to 2 d.p.			18.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1700 (1b)	x	2.3500 (2b)	=	94.3995	(1b) - (3b)
First floor	40.1700 (1c)	x	2.6500 (2c)	=	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.8500	(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							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1494	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3994	(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) =	0.3395	(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	0.4328	0.4243	0.4158	0.3734	0.3649	0.3225	0.3225	0.3140	0.3395	0.3649	0.3819	0.3989	(22b)
Effective ac	0.5937	0.5900	0.5865	0.5697	0.5666	0.5520	0.5520	0.5493	0.5576	0.5666	0.5729	0.5795	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1100	4.4187			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.2900	21.2193			(29a)
External Roof 1	40.1700		40.1700	0.1100	4.4187			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6123			(33)
Party Wall 1			41.2000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.9284	(36)
Total fabric heat loss (33) + (36) =	58.5407	(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	39.3483	39.1072	38.8709	37.7611	37.5534	36.5868	36.5868	36.4078	36.9591	37.5534	37.9735	38.4127	(38)
Heat transfer coeff	97.8889	97.6479	97.4116	96.3017	96.0941	95.1274	95.1274	94.9484	95.4998	96.0941	96.5142	96.9533	(39)
Average = Sum(39)m / 12 =												96.3007	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2184	1.2154	1.2125	1.1987	1.1961	1.1841	1.1841	1.1818	1.1887	1.1961	1.2013	1.2068	(40)
HLP (average)												1.1987	(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	2.4693 (42)
Average daily hot water use (litres/day)	92.8454 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)
Energy content (annual)										Total = Sum(45)m =		1460.8199	(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)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	(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	(59)

Heat gains from water heating, kWh/month

	32.1844	28.1486	29.0469	25.3238	24.2988	20.9680	19.4299	22.2961	22.5624	26.2943	28.7023	31.1688 (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	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	(66)

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

	20.0028	17.7663	14.4485	10.9385	8.1766	6.9031	7.4590	9.6955	13.0133	16.5233	19.2852	20.5587 (67)

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

	220.1497	222.4341	216.6774	204.4219	188.9515	174.4115	164.6979	162.4135	168.1703	180.4258	195.8961	210.4361 (68)

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

	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464 (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)

	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712 (71)

Water heating gains (Table 5)

	43.2585	41.8879	39.0415	35.1719	32.6596	29.1222	26.1155	29.9679	31.3367	35.3418	39.8643	41.8936 (72)

Total internal gains

	343.4502	342.1275	330.2066	310.5714	289.8270	270.4760	258.3116	262.1161	272.5594	292.3301	315.0848	332.9276 (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	
Northeast	8.8500	11.2829	0.6300	0.0000	0.7700	48.4392	(75)
Southwest	5.8100	36.7938	0.6300	0.0000	0.7700	103.7009	(79)

Solar gains	152.1401	275.2403	419.3326	591.2066	727.5842	751.0827	712.1553	606.0146	478.1597	315.7221	185.1588	128.3042 (83)
Total gains	495.5903	617.3678	749.5392	901.7781	1017.4112	1021.5587	970.4669	868.1307	750.7191	608.0522	500.2436	461.2318 (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	56.9949	57.1356	57.2742	57.9342	58.0594	58.6494	58.6494	58.7600	58.4207	58.0594	57.8067	57.5449	
alpha	4.7997	4.8090	4.8183	4.8623	4.8706	4.9100	4.9100	4.9173	4.8947	4.8706	4.8538	4.8363	
util living area	0.9977	0.9932	0.9773	0.9164	0.7718	0.5761	0.4273	0.4944	0.7721	0.9632	0.9948	0.9984	(86)
MIT	19.6834	19.8922	20.2141	20.6073	20.8743	20.9764	20.9955	20.9912	20.9079	20.5204	20.0226	19.6482	(87)
Th 2	19.9053	19.9077	19.9100	19.9211	19.9231	19.9328	19.9328	19.9346	19.9291	19.9231	19.9189	19.9146	(88)
util rest of house	0.9970	0.9909	0.9695	0.8893	0.7112	0.4884	0.3258	0.3844	0.6880	0.9458	0.9926	0.9978	(89)
MIT 2	18.7120	18.9214	19.2401	19.6205	19.8459	19.9231	19.9318	19.9323	19.8824	19.5512	19.0611	18.6843	(90)
Living area fraction									fLA = Living area / (4) =			0.2277	(91)
MIT	18.9332	19.1424	19.4618	19.8452	20.0800	20.1629	20.1739	20.1734	20.1159	19.7719	19.2800	18.9037	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9332	19.1424	19.4618	19.8452	20.0800	20.1629	20.1739	20.1734	20.1159	19.7719	19.2800	18.9037	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9887	0.9654	0.8871	0.7207	0.5079	0.3490	0.4096	0.7042	0.9427	0.9909	0.9971	(94)
Useful gains	493.5985	610.3948	723.6048	799.9864	733.2664	518.8760	338.6948	355.5527	528.6253	573.1887	495.6691	459.8995	(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	1432.4248	1390.7434	1262.6299	1054.0400	805.2680	529.1814	339.9783	358.2775	574.5143	881.3619	1175.5450	1425.5748	(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	698.4868	524.3943	401.0346	182.9186	53.5691	0.0000	0.0000	0.0000	0.0000	229.2808	489.5106	718.4624	(98)
Space heating												3297.6573	(98)
Space heating per m2											(98) / (4) =	41.0463	(99)

8c. Space cooling requirement

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	894.1978	703.9430	721.6080	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9421	0.9708	0.9538	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	842.4290	683.4220	688.2887	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1286.2550	1224.6407	1106.6141	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	319.5548	402.6667	311.2341	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1033.4556	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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   79.8887  100.6667   77.8085    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          258.3639 (107)
Space cooling per m2                                                                                                     3.2159 (108)
Energy for space heating                                                                                                41.0463 (99)
Energy for space cooling                                                                                                 3.2159 (108)
Total                                                                                                                   44.2622 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                   44.3 (109)


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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)	
Ground floor	40.1700 (1b)	x	2.3500 (2b)	=	94.3995	(1b) - (3b)
First floor	40.1700 (1c)	x	2.6500 (2c)	=	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.8500	(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							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1494	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3994	(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) =	0.3395	(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	0.4328	0.4243	0.4158	0.3734	0.3649	0.3225	0.3225	0.3140	0.3395	0.3649	0.3819	0.3989	(22b)
Effective ac	0.5937	0.5900	0.5865	0.5697	0.5666	0.5520	0.5520	0.5493	0.5576	0.5666	0.5729	0.5795	(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 Opaque door			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1300	5.2221			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.1800	13.1706			(29a)
External Roof 1	40.1700		40.1700	0.1300	5.2221			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.1704			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.2501	(36)
Total fabric heat loss					(33) + (36) =		54.4205	(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	39.3483	39.1072	38.8709	37.7611	37.5534	36.5868	36.5868	36.4078	36.9591	37.5534	37.9735	38.4127	(38)
Heat transfer coeff	93.7688	93.5277	93.2914	92.1816	91.9739	91.0073	91.0073	90.8283	91.3796	91.9739	92.3940	92.8332	(39)
Average = Sum(39)m / 12 =												92.1806	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1671	1.1641	1.1612	1.1474	1.1448	1.1328	1.1328	1.1305	1.1374	1.1448	1.1500	1.1555	(40)
HLP (average)												1.1474	(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	2.4693	(42)
Average daily hot water use (litres/day)	92.8454	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)
Energy content (annual)										Total = Sum(45)m =		1460.8199	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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													
	32.1844	28.1486	29.0469	25.3238	24.2988	20.9680	19.4299	22.2961	22.5624	26.2943	28.7023	31.1688	(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	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	123.4640	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0028	17.7663	14.4485	10.9385	8.1766	6.9031	7.4590	9.6955	13.0133	16.5233	19.2852	20.5587	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1497	222.4341	216.6774	204.4219	188.9515	174.4115	164.6979	162.4135	168.1703	180.4258	195.8961	210.4361	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	35.3464	(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)													
	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	(71)
Water heating gains (Table 5)													
	43.2585	41.8879	39.0415	35.1719	32.6596	29.1222	26.1155	29.9679	31.3367	35.3418	39.8643	41.8936	(72)
Total internal gains													
	343.4502	342.1275	330.2066	310.5714	289.8270	270.4760	258.3116	262.1161	272.5594	292.3301	315.0848	332.9276	(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	
Northeast	8.8500	11.2829	0.6300	0.7000	0.7700	30.5167	(75)
Southwest	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(79)

Solar gains	95.8482	173.4014	264.1795	372.4602	458.3780	473.1821	448.6578	381.7892	301.2406	198.9049	116.6500	80.8317	(83)
Total gains	439.2985	515.5289	594.3861	683.0316	748.2050	743.6581	706.9695	643.9053	573.8000	491.2350	431.7348	413.7593	(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	59.4992	59.6525	59.8036	60.5237	60.6603	61.3046	61.3046	61.4254	61.0548	60.6603	60.3845	60.0988	
alpha	4.9666	4.9768	4.9869	5.0349	5.0440	5.0870	5.0870	5.0950	5.0703	5.0440	5.0256	5.0066	
util living area													
	0.9987	0.9968	0.9907	0.9654	0.8850	0.7199	0.5523	0.6218	0.8720	0.9828	0.9972	0.9990	(86)
MIT	19.6864	19.8435	20.1088	20.4667	20.7740	20.9448	20.9883	20.9795	20.8475	20.4457	20.0020	19.6614	(87)
Th 2	19.9464	19.9488	19.9512	19.9623	19.9644	19.9742	19.9742	19.9760	19.9704	19.9644	19.9602	19.9558	(88)
util rest of house													
	0.9982	0.9957	0.9872	0.9518	0.8411	0.6287	0.4308	0.4967	0.8059	0.9738	0.9961	0.9987	(89)
MIT 2	18.7477	18.9062	19.1717	19.5300	19.8113	19.9489	19.9712	19.9701	19.8837	19.5164	19.0739	18.7302	(90)
Living area fraction									fLA = Living area / (4) =			0.2277	(91)
MIT	18.9614	19.1196	19.3851	19.7433	20.0305	20.1756	20.2028	20.1999	20.1031	19.7279	19.2852	18.9422	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9614	19.1196	19.3851	19.7433	20.0305	20.1756	20.2028	20.1999	20.1031	19.7279	19.2852	18.9422	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9945	0.9847	0.9482	0.8443	0.6480	0.4587	0.5254	0.8159	0.9711	0.9950	0.9983	(94)
Useful gains	438.2628	512.6947	585.2875	647.6783	631.7068	481.8658	324.3162	338.3081	468.1762	477.0254	429.5743	413.0353	(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													
	1374.7810	1329.9258	1202.0674	999.5492	766.1872	507.4219	327.8778	345.1384	548.5616	839.5324	1125.8383	1368.5668	(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													
	696.7695	549.1793	458.8842	253.3471	100.0535	0.0000	0.0000	0.0000	0.0000	269.7052	501.3101	710.9154	(98)
Space heating												3540.1642	(98)
Space heating per m2											(98) / (4) =	44.0648	(99)

8c. Space cooling requirement

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	855.4684	673.4539	690.2949	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8804	0.9347	0.9076	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	753.1515	629.4901	626.5161	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	961.4361	916.6566	844.5325	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	149.9649	213.6519	162.2042	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												525.8210	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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    37.4912    53.4130    40.5510     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          131.4553 (107)
Space cooling per m2                                                                                                                     1.6362 (108)
Energy for space heating                                                                                                                44.0648 (99)
Energy for space cooling                                                                                                                 1.6362 (108)
Total                                                                                                                                   45.7010 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                  52.6 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1700	(1b)	x 2.3500	(2b) =	94.3995	(1b) - (3b)
First floor	40.1700	(1c)	x 2.6500	(2c) =	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		200.8500	(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							0 * 10 =		0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.3000	3.0000	3.1000	2.9000	2.8000	2.8000	2.9000	3.2000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8250	0.7500	0.7750	0.7250	0.7000	0.7000	0.7250	0.8000	(22a)
Adj infilt rate	0.2019	0.1859	0.1859	0.1753	0.1753	0.1594	0.1647	0.1541	0.1488	0.1488	0.1541	0.1700	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1100	4.4187			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.2900	21.2193			(29a)
External Roof 1	40.1700		40.1700	0.1100	4.4187			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.6123			(33)
Party Wall 1			41.2000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.9284	(36)
Total fabric heat loss					(33) + (36) =		58.5407	(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	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	(38)
Heat transfer coeff	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	(39)
Average = Sum(39)m / 12 =												91.6809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	(40)
HLP (average)												1.1412	(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	2.4693	(42)
Average daily hot water use (litres/day)	92.8454	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)
Energy content (annual)										Total = Sum(45)m =		1460.8199	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7184	19.8696	20.5037	17.8756	17.1521	14.8009	13.7152	15.7384	15.9264	18.5607	20.2604	22.0015	(46)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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	(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	(57)
Combi loss	14.1201	12.7382	14.0672	13.5730	13.9961	13.5107	13.9399	13.9763	13.5447	14.0378	13.6318	14.1086 (61)

Total heat required for water heating calculated for each month

	165.5758	145.2023	150.7584	132.7437	128.3432	112.1835	105.3748	118.8992	119.7207	137.7757	148.7014	160.7854 (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

	165.5758	145.2023	150.7584	132.7437	128.3432	112.1835	105.3748	118.8992	119.7207	137.7757	148.7014	160.7854 (64)

Total per year (kWh/year) = Sum(64)m = 1626.0643 (64)

RHI water heating demand 1626 (64)

Heat gains from water heating, kWh/month

	53.8891	47.2289	48.9666	43.0175	41.5194	36.1864	33.8871	38.3809	38.6897	44.6523	48.3186	52.2972 (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	148.1568	148.1568	148.1568	148.1568	148.1568	148.1568	148.1568	148.1568	148.1568	148.1568	148.1568	148.1568	(66)

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

	50.0070	44.4158	36.1213	27.3462	20.4416	17.2576	18.6475	24.2387	32.5332	41.3083	48.2129	51.3968 (67)

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

	328.5816	331.9912	323.3990	305.1073	282.0172	260.3157	245.8178	242.4082	251.0004	269.2922	292.3823	314.0837 (68)

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

	52.2850	52.2850	52.2850	52.2850	52.2850	52.2850	52.2850	52.2850	52.2850	52.2850	52.2850	52.2850 (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)

	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712	-98.7712 (71)

Water heating gains (Table 5)

	72.4315	70.2811	65.8154	59.7465	55.8057	50.2589	45.5472	51.5873	53.7357	60.0165	67.1092	70.2919 (72)

Total internal gains

	555.6907	551.3587	530.0063	496.8705	462.9350	432.5028	414.6831	422.9048	441.9398	475.2876	512.3749	540.4430 (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	
Northeast	8.8500	13.3408	0.6300	0.0000	0.7700	57.2740	(75)
Southwest	5.8100	41.5040	0.6300	0.0000	0.7700	116.9762	(79)

Solar gains	174.2502	270.7357	426.2807	614.9701	738.8337	816.4144	769.5177	657.9053	517.8778	352.3685	210.4801	140.6976 (83)
Total gains	729.9409	822.0944	956.2870	1111.8406	1201.7687	1248.9172	1184.2007	1080.8100	959.8176	827.6561	722.8550	681.1407 (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	60.8542	60.8542	60.8542	60.8542	60.8542	60.8542	60.8542	60.8542	60.8542	60.8542	60.8542	60.8542	
alpha	5.0569	5.0569	5.0569	5.0569	5.0569	5.0569	5.0569	5.0569	5.0569	5.0569	5.0569	5.0569	
util living area	0.9851	0.9725	0.9256	0.8041	0.6148	0.3942	0.2630	0.3048	0.5744	0.8634	0.9689	0.9891	(86)
MIT	20.1243	20.2723	20.5658	20.8337	20.9634	20.9967	20.9997	20.9993	20.9800	20.7954	20.4031	20.0606	(87)
Th 2	19.9674	19.9674	19.9674	19.9674	19.9674	19.9674	19.9674	19.9674	19.9674	19.9674	19.9674	19.9674	(88)
util rest of house	0.9803	0.9642	0.9044	0.7586	0.5483	0.3199	0.1833	0.2177	0.4864	0.8174	0.9577	0.9856	(89)
MIT 2	18.8413	19.0521	19.4590	19.7994	19.9390	19.9659	19.9673	19.9672	19.9556	19.7649	19.2416	18.7497	(90)
Living area fraction									fLA = Living area / (4) =			0.2277	(91)
MIT	19.1334	19.3298	19.7109	20.0349	20.1722	20.2006	20.2023	20.2022	20.1888	19.9995	19.5060	19.0481	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9834	19.1798	19.5609	19.8849	20.0222	20.0506	20.0523	20.0522	20.0388	19.8495	19.3560	18.8981	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9742	0.9559	0.8944	0.7546	0.5519	0.3259	0.1898	0.2249	0.4928	0.8114	0.9490	0.9805	(94)
Useful gains	711.1038	785.8287	855.3485	838.9586	663.2918	407.0708	224.7911	243.0551	472.9507	671.5444	685.9917	667.8703	(95)
Ext temp.	5.0000	5.5000	7.3000	9.7000	12.6000	15.6000	17.6000	17.4000	14.8000	11.3000	7.8000	4.9000	(96)
Heat loss rate W	1282.0102	1254.1807	1124.0936	933.7597	680.4724	408.0314	224.8320	243.1549	480.2998	783.8254	1059.4633	1283.3604	(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	424.7544	314.7326	199.9463	68.2569	12.7824	0.0000	0.0000	0.0000	0.0000	83.5370	268.8996	457.9247	(98)

Space heating 1830.8338 (98)

RHI space heating demand 1831 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1700 (1b)	x	2.3500 (2b)	=	94.3995	(1b) - (3b)
First floor	40.1700 (1c)	x	2.6500 (2c)	=	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.8500	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1100	4.4187			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.2900	21.2193			(29a)
External Roof 1	40.1700		40.1700	0.1100	4.4187			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.6123			(33)
Party Wall 1			41.2000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.9284	(36)
Total fabric heat loss (33) + (36) =	58.5407	(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	34.5280	34.1759	33.8238	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	(38)
Heat transfer coeff	93.0687	92.7165	92.3644	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	(39)

Average = Sum(39)m / 12 = 91.9398 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1584	1.1541	1.1497	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	(40)

HLP (average) 1.1444 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 2.4693 (42)
Average daily hot water use (litres/day) 92.8454 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)

Energy content (annual) Total = Sum(45)m = 1460.8199 (45)

Distribution loss (46)m = 0.15 x (45)m	22.7184	19.8696	20.5037	17.8756	17.1521	14.8009	13.7152	15.7384	15.9264	18.5607	20.2604	22.0015	(46)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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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)
Combi loss     14.1201   12.7382   14.0672   13.5730   13.9961   13.5107   13.9399   13.9763   13.5447   14.0378   13.6318   14.1086 (61)
Total heat required for water heating calculated for each month
              165.5758  145.2023  150.7584  132.7437  128.3432  112.1835  105.3748  118.8992  119.7207  137.7757  148.7014  160.7854 (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
              165.5758  145.2023  150.7584  132.7437  128.3432  112.1835  105.3748  118.8992  119.7207  137.7757  148.7014  160.7854 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =   1626.0643 (64)
Heat gains from water heating, kWh/month
               53.8891   47.2289   48.9666   43.0175   41.5194   36.1864   33.8871   38.3809   38.6897   44.6523   48.3186   52.2972 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m         148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               50.0070   44.4158   36.1213   27.3462   20.4416   17.2576   18.6475   24.2387   32.5332   41.3083   48.2129   51.3968 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              328.5816  331.9912  323.3990  305.1073  282.0172  260.3157  245.8178  242.4082  251.0004  269.2922  292.3823  314.0837 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850 (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)
              -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712 (71)
Water heating gains (Table 5)
               72.4315   70.2811   65.8154   59.7465   55.8057   50.2589   45.5472   51.5873   53.7357   60.0165   67.1092   70.2919 (72)
Total internal gains
              555.6907  551.3587  530.0063  496.8705  462.9350  432.5028  414.6831  422.9048  441.9398  475.2876  512.3749  540.4430 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                           m2           Table 6a      Specific data    Specific data        factor                W
                                                           W/m2      or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------
Northeast                                8.8500           11.2829           0.6300           0.0000           0.7700          48.4392 (75)
Southwest                                5.8100           36.7938           0.6300           0.0000           0.7700         103.7009 (79)
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Solar gains    152.1401  275.2403  419.3326  591.2066  727.5842  751.0827  712.1553  606.0146  478.1597  315.7221  185.1588  128.3042 (83)
Total gains    707.8308  826.5990  949.3389 1088.0772 1190.5192 1183.5855 1126.8383 1028.9194  920.0995  791.0097  697.5337  668.7473 (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            59.9468   60.1744   60.4038   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542
alpha           4.9965    5.0116    5.0269    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569
util living area
                0.9892    0.9762    0.9410    0.8429    0.6729    0.4884    0.3567    0.4072    0.6515    0.9022    0.9779    0.9916 (86)

MIT            20.0032   20.1989   20.4786   20.7749   20.9396   20.9899   20.9983   20.9968   20.9612   20.7192   20.3066   19.9730 (87)
Th 2           19.9534   19.9569   19.9605   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674 (88)
util rest of house
                0.9859    0.9692    0.9241    0.8044    0.6114    0.4129    0.2737    0.3172    0.5679    0.8672    0.9701    0.9890 (89)
MIT 2          18.6558   18.9391   19.3339   19.7283   19.9159   19.9615   19.9668   19.9662   19.9410   19.6710   19.1047   18.6226 (90)
Living area fraction                                                                              fLA = Living area / (4) =     0.2277 (91)
MIT            18.9626   19.2259   19.5945   19.9666   20.1489   20.1956   20.2016   20.2008   20.1732   19.9096   19.3783   18.9300 (92)
Temperature adjustment                                                                                                      -0.1500
adjusted MIT   18.8126   19.0759   19.4445   19.8166   19.9989   20.0456   20.0516   20.0508   20.0232   19.7596   19.2283   18.7800 (93)


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8. Space heating requirement
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                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation     0.9807    0.9613    0.9140    0.7982    0.6134    0.4187    0.2805    0.3246    0.5727    0.8588    0.9625    0.9847 (94)
Useful gains  694.2007  794.6135  867.6624  868.4563  730.2838  495.5699  316.0794  333.9376  526.9185  679.3377  671.3898  658.5244 (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
             1350.6647 1314.3425 1195.6110 1000.8431  760.8539  499.2597  316.4493  334.7101  543.0458  839.7627 1111.9372 1336.7091 (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
              488.4092  349.2579  243.9938   95.3185   22.7442    0.0000    0.0000    0.0000    0.0000  119.3562  317.1941  504.5694 (98)
Space heating                                                                                                            2140.8431 (98)
Space heating per m2                                                                                        (98) / (4) =     26.6473 (99)


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8c. Space cooling requirement
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Not applicable
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CALCULATION OF ENERGY RATINGS 09 Jan 2014

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2365.5725	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	488.4092	349.2579	243.9938	95.3185	22.7442	0.0000	0.0000	0.0000	0.0000	119.3562	317.1941	504.5694	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	539.6787	385.9203	269.6064	105.3243	25.1317	0.0000	0.0000	0.0000	0.0000	131.8853	350.4907	557.5352	(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													
	165.5758	145.2023	150.7584	132.7437	128.3432	112.1835	105.3748	118.8992	119.7207	137.7757	148.7014	160.7854	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6679	89.5362	89.2506	88.6095	87.7672	87.3000	87.3000	87.3000	87.3000	88.7568	89.4535	89.7054	(217)
Fuel for water heating, kWh/month													
	184.6546	162.1716	168.9159	149.8075	146.2314	128.5035	120.7043	136.1961	137.1371	155.2284	166.2333	179.2372	(219)
Water heating fuel used												1835.0209	(219)
Annual totals kWh/year													
Space heating fuel - main system												2365.5725	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												45.0868	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												120.0868	(231)
Electricity for lighting (calculated in Appendix L)												353.2556	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 1080 * 1.00) =										-647.7148		-647.7148	(233)
Total delivered energy for all uses												4026.2210	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2365.5725	3.4800	82.3219	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1835.0209	3.4800	63.8587	(247)
Mechanical ventilation fans	45.0868	13.1900	5.9469	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	353.2556	13.1900	46.5944	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-647.7148	13.1900	-85.4336	(252)
Total energy cost			243.1809	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.8149	(257)
SAP value		88.6325	
SAP rating (Section 12)		89	(258)
SAP band		B	

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	2365.5725	0.2160	510.9637	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1835.0209	0.2160	396.3645	(264)
Space and water heating			907.3282	(265)
Pumps and fans	120.0868	0.5190	62.3251	(267)
Energy for lighting	353.2556	0.5190	183.3397	(268)
Energy saving/generation technologies				
PV Unit	-647.7148	0.5190	-336.1640	(269)
Total kg/year			816.8289	(272)
CO2 emissions per m2			10.1700	(273)
EI value			91.2673	
EI rating			91	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8850 = 3.932, stars = 4
Water heating environmental impact	0.216 / 0.8850 = 0.2441, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1700 (1b)	x	2.3500 (2b)	=	94.3995	(1b) - (3b)
First floor	40.1700 (1c)	x	2.6500 (2c)	=	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.8500	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.3000	3.0000	3.1000	2.9000	2.8000	2.8000	2.9000	3.2000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8250	0.7500	0.7750	0.7250	0.7000	0.7000	0.7250	0.8000	(22a)
Adj infilt rate	0.2019	0.1859	0.1859	0.1753	0.1753	0.1594	0.1647	0.1541	0.1488	0.1488	0.1541	0.1700	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1100	4.4187			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.2900	21.2193			(29a)
External Roof 1	40.1700		40.1700	0.1100	4.4187			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.6123			(33)
Party Wall 1			41.2000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.9284	(36)
Total fabric heat loss					(33) + (36) =		58.5407	(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	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	(38)
Heat transfer coeff	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	(39)
Average = Sum(39)m / 12 =												91.6809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	(40)
HLP (average)												1.1412	(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	2.4693	(42)
Average daily hot water use (litres/day)	92.8454	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)
Energy content (annual)										Total = Sum(45)m =		1460.8199	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7184	19.8696	20.5037	17.8756	17.1521	14.8009	13.7152	15.7384	15.9264	18.5607	20.2604	22.0015	(46)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

```
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)
Combi loss     14.1201   12.7382   14.0672   13.5730   13.9961   13.5107   13.9399   13.9763   13.5447   14.0378   13.6318   14.1086 (61)
Total heat required for water heating calculated for each month
              165.5758  145.2023  150.7584  132.7437  128.3432  112.1835  105.3748  118.8992  119.7207  137.7757  148.7014  160.7854 (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
              165.5758  145.2023  150.7584  132.7437  128.3432  112.1835  105.3748  118.8992  119.7207  137.7757  148.7014  160.7854 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =   1626.0643 (64)
Heat gains from water heating, kWh/month
               53.8891   47.2289   48.9666   43.0175   41.5194   36.1864   33.8871   38.3809   38.6897   44.6523   48.3186   52.2972 (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         148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               50.0070   44.4158   36.1213   27.3462   20.4416   17.2576   18.6475   24.2387   32.5332   41.3083   48.2129   51.3968 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              328.5816  331.9912  323.3990  305.1073  282.0172  260.3157  245.8178  242.4082  251.0004  269.2922  292.3823  314.0837 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850 (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)
              -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712 (71)
Water heating gains (Table 5)
               72.4315   70.2811   65.8154   59.7465   55.8057   50.2589   45.5472   51.5873   53.7357   60.0165   67.1092   70.2919 (72)
Total internal gains
              555.6907  551.3587  530.0063  496.8705  462.9350  432.5028  414.6831  422.9048  441.9398  475.2876  512.3749  540.4430 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                           m2           Table 6a       Specific data    Specific data       factor                W
                                                           W/m2       or Table 6b      or Table 6c      Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
Northeast                                8.8500           13.3408            0.6300           0.0000           0.7700           57.2740 (75)
Southwest                                5.8100           41.5040            0.6300           0.0000           0.7700          116.9762 (79)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    174.2502  270.7357  426.2807  614.9701  738.8337  816.4144  769.5177  657.9053  517.8778  352.3685  210.4801  140.6976 (83)
Total gains    729.9409  822.0944  956.2870 1111.8406 1201.7687 1248.9172 1184.2007 1080.8100  959.8176  827.6561  722.8550  681.1407 (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           60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542
alpha          5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569
util living area
               0.9851    0.9725    0.9256    0.8041    0.6148    0.3942    0.2630    0.3048    0.5744    0.8634    0.9689    0.9891 (86)

MIT           20.1243   20.2723   20.5658   20.8337   20.9634   20.9967   20.9997   20.9993   20.9800   20.7954   20.4031   20.0606 (87)
Th 2          19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674 (88)
util rest of house
               0.9803    0.9642    0.9044    0.7586    0.5483    0.3199    0.1833    0.2177    0.4864    0.8174    0.9577    0.9856 (89)
MIT 2         18.8413   19.0521   19.4590   19.7994   19.9390   19.9659   19.9673   19.9672   19.9556   19.7649   19.2416   18.7497 (90)
Living area fraction                                                                                 fLA = Living area / (4) =     0.2277 (91)
MIT           19.1334   19.3298   19.7109   20.0349   20.1722   20.2006   20.2023   20.2022   20.1888   19.9995   19.5060   19.0481 (92)
Temperature adjustment                                                                                                       -0.1500
adjusted MIT  18.9834   19.1798   19.5609   19.8849   20.0222   20.0506   20.0523   20.0522   20.0388   19.8495   19.3560   18.8981 (93)
```

---

8. Space heating requirement

```
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9742    0.9559    0.8944    0.7546    0.5519    0.3259    0.1898    0.2249    0.4928    0.8114    0.9490    0.9805 (94)
Useful gains  711.1038  785.8287  855.3485  838.9586  663.2918  407.0708  224.7911  243.0551  472.9507  671.5444  685.9917  667.8703 (95)
Ext temp.       5.0000    5.5000    7.3000    9.7000   12.6000   15.6000   17.6000   17.4000   14.8000   11.3000    7.8000    4.9000 (96)
Heat loss rate W
             1282.0102 1254.1807 1124.0936  933.7597  680.4724  408.0314  224.8320  243.1549  480.2998  783.8254 1059.4633 1283.3604 (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
              424.7544  314.7326  199.9463   68.2569   12.7824    0.0000    0.0000    0.0000    0.0000   83.5370  268.8996  457.9247 (98)
Space heating                                                                                                               1830.8338 (98)
Space heating per m2                                                                                          (98) / (4) =    22.7886 (99)
```

8c. Space cooling requirement

Not applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2023.0208	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	424.7544	314.7326	199.9463	68.2569	12.7824	0.0000	0.0000	0.0000	0.0000	83.5370	268.8996	457.9247	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	469.3419	347.7708	220.9352	75.4219	14.1242	0.0000	0.0000	0.0000	0.0000	92.3061	297.1266	505.9941	(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													
	165.5758	145.2023	150.7584	132.7437	128.3432	112.1835	105.3748	118.8992	119.7207	137.7757	148.7014	160.7854	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5790	89.4647	89.0961	88.3610	87.5805	87.3000	87.3000	87.3000	87.3000	88.4809	89.3340	89.6461	(217)
Fuel for water heating, kWh/month													
	184.8377	162.3013	169.2088	150.2289	146.5431	128.5035	120.7043	136.1961	137.1371	155.7123	166.4556	179.3558	(219)
Water heating fuel used												1837.1844	(219)
Annual totals kWh/year													
Space heating fuel - main system												2023.0208	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												45.0868	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												120.0868	(231)
Electricity for lighting (calculated in Appendix L)												353.2556	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 1145 * 1.00) =										-687.0737		-687.0737	(233)
Total delivered energy for all uses												3646.4739	(238)

10a. Fuel costs - using BEDF prices (480)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2023.0208	3.7400	75.6610	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1837.1844	3.7400	68.7107	(247)
Mechanical ventilation fans	45.0868	19.1200	8.6206	(249)
Pumps and fans for heating	75.0000	19.1200	14.3400	(249)
Energy for lighting	353.2556	19.1200	67.5425	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit	-687.0737	19.1200	-131.3685	(252)
Total energy cost			197.5063	(255)

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	2023.0208	0.2160	436.9725	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1837.1844	0.2160	396.8318	(264)
Space and water heating			833.8043	(265)
Pumps and fans	120.0868	0.5190	62.3251	(267)
Energy for lighting	353.2556	0.5190	183.3397	(268)
Energy saving/generation technologies				
PV Unit	-687.0737	0.5190	-356.5912	(269)
Total kg/year			722.8778	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2023.0208	1.2200	2468.0854	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1837.1844	1.2200	2241.3650	(264)
Space and water heating			4709.4504	(265)
Pumps and fans	120.0868	3.0700	368.6665	(267)
Energy for lighting	353.2556	3.0700	1084.4947	(268)
Energy saving/generation technologies				
PV Unit	-687.0737	3.0700	-2109.3162	(269)
Primary energy kWh/year			4053.2953	(272)
Primary energy kWh/m2/year			50.4518	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 27	-182 kg (25.2%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar water heating		£27	2.27 kg/m²	B 90	A 93
	Total Savings	£27	2.27 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 480 TEST (28 Jul 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£91	£100	-£10
Mains gas	£238	£202	£36
Space heating	£193	£193	£0
Water heating	£69	£42	£27
Lighting	£68	£68	£0
Generated (PV)	-£131	-£131	£0
Total cost of fuels	£198	£171	£26
Total cost of uses	£199	£172	£27
Delivered energy	45 kWh/m²	34 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	9 kg/m²	7 kg/m²	2 kg/m²
Primary energy	50 kWh/m²	38 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1700	(1b)	x 2.3500	(2b) =	94.3995	(1b) - (3b)
First floor	40.1700	(1c)	x 2.6500	(2c) =	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	200.8500	(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							0 * 10 =		0.0000	(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) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2500	(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) =		0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1100	4.4187			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.2900	21.2193			(29a)
External Roof 1	40.1700		40.1700	0.1100	4.4187			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.6123			(33)
Party Wall 1			41.2000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.9284	(36)
Total fabric heat loss (33) + (36) =	58.5407	(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	34.5280	34.1759	33.8238	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	(38)
Heat transfer coeff	93.0687	92.7165	92.3644	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	(39)

Average = Sum(39)m / 12 = 91.9398 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1584	1.1541	1.1497	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	(40)

HLP (average) 1.1444 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 2.4693 (42)
Average daily hot water use (litres/day) 92.8454 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)

Energy content (annual) Total = Sum(45)m = 1460.8199 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	22.7184	19.8696	20.5037	17.8756	17.1521	14.8009	13.7152	15.7384	15.9264	18.5607	20.2604	22.0015	(46)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
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)
Combi loss     14.1201   12.7382   14.0672   13.5730   13.9961   13.5107   13.9399   13.9763   13.5447   14.0378   13.6318   14.1086 (61)
Total heat required for water heating calculated for each month
              165.5758  145.2023  150.7584  132.7437  128.3432  112.1835  105.3748  118.8992  119.7207  137.7757  148.7014  160.7854 (62)
Aperture area of solar collector                                                                                                3.0000 (H1)
Zero-loss collector efficiency                                                                                                  0.7000 (H2)
Collector heat loss coefficient                                                                                                 1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                       0.0050 (H3a)
Collector effective heat loss coefficient                                                                                       1.8063 (H3b)
Collector performance ratio                                                                                                     2.5804 (H4)
Annual solar radiation per m2                                                                                                1079.5246 (H5)
Overshading factor                                                                                                              0.8000 (H6)
Solar energy available                                                                                                       1813.6014 (H7)
Adjustment factor for showers                                                                                                   1.0000 (H7a)
Solar-to-load ratio                                                                                                             1.2415 (H8)
Utilisation factor                                                                                                              0.5531 (H9)
Collector performance factor                                                                                                    0.8793 (H10)
Dedicated solar storage volume                                                                                                 75.0000 (H11)
Effective solar volume                                                                                                         75.0000 (H13)
Daily hot water demand                                                                                                         92.8454 (H14)
Volume ratio Veff/V                                                                                                             0.8078 (H15)
Solar storage volume factor                                                                                                     0.9573 (H16)
Solar input                                                                                                                  -844.4094 (H17)
Solar input    -24.4862  -40.8604  -69.5900  -93.2643 -115.2201 -113.2797 -111.7827  -97.6651  -76.4914  -52.2346  -29.0441  -20.4908 (63)
                                                                                    Solar input (sum of months) = Sum(63)m =  -844.4094 (63)
Output from w/h
              141.0896  104.3419   81.1685   39.4795   13.1230    0.0000    0.0000   21.2341   43.2293   85.5411  119.6573  140.2947 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =   789.1589 (64)
Heat gains from water heating, kWh/month
               53.8891   47.2289   48.9666   43.0175   41.5194   36.1864   33.8871   38.3809   38.6897   44.6523   48.3186   52.2972 (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         148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                50.0070   44.4158   36.1213   27.3462   20.4416   17.2576   18.6475   24.2387   32.5332   41.3083   48.2129   51.3968 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               328.5816  331.9912  323.3990  305.1073  282.0172  260.3157  245.8178  242.4082  251.0004  269.2922  292.3823  314.0837 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850 (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)
               -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712 (71)
Water heating gains (Table 5)
                72.4315   70.2811   65.8154   59.7465   55.8057   50.2589   45.5472   51.5873   53.7357   60.0165   67.1092   70.2919 (72)
Total internal gains
               555.6907  551.3587  530.0063  496.8705  462.9350  432.5028  414.6831  422.9048  441.9398  475.2876  512.3749  540.4430 (73)


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6. Solar gains
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[Jan]                                  Area        Solar flux          g              FF          Access          Gains
                                       m2          Table 6a      Specific data  Specific data   factor          W
                                                   W/m2          or Table 6b    or Table 6c     Table 6d
-------------------------------------------------------------------------------------------------------
Northeast                            8.8500         11.2829        0.6300         0.0000         0.7700        48.4392 (75)
Southwest                            5.8100         36.7938        0.6300         0.0000         0.7700       103.7009 (79)
-------------------------------------------------------------------------------------------------------

Solar gains    152.1401  275.2403  419.3326  591.2066  727.5842  751.0827  712.1553  606.0146  478.1597  315.7221  185.1588  128.3042 (83)
Total gains    707.8308  826.5990  949.3389 1088.0772 1190.5192 1183.5855 1126.8383 1028.9194  920.0995  791.0097  697.5337  668.7473 (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            59.9468   60.1744   60.4038   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542
alpha           4.9965    5.0116    5.0269    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569
util living area
                0.9892    0.9762    0.9410    0.8429    0.6729    0.4884    0.3567    0.4072    0.6515    0.9022    0.9779    0.9916 (86)

MIT            20.0032   20.1989   20.4786   20.7749   20.9396   20.9899   20.9983   20.9968   20.9612   20.7192   20.3066   19.9730 (87)
Th 2           19.9534   19.9569   19.9605   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674 (88)
util rest of house
                0.9859    0.9692    0.9241    0.8044    0.6114    0.4129    0.2737    0.3172    0.5679    0.8672    0.9701    0.9890 (89)
MIT 2          18.6558   18.9391   19.3339   19.7283   19.9159   19.9615   19.9668   19.9662   19.9410   19.6710   19.1047   18.6226 (90)
Living area fraction                                                                                 fLA = Living area / (4) =     0.2277 (91)
MIT            18.9626   19.2259   19.5945   19.9666   20.1489   20.1956   20.2016   20.2008   20.1732   19.9096   19.3783   18.9300 (92)
Temperature adjustment                                                                                                         -0.1500
adjusted MIT   18.8126   19.0759   19.4445   19.8166   19.9989   20.0456   20.0516   20.0508   20.0232   19.7596   19.2283   18.7800 (93)


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8. Space heating requirement
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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9807	0.9613	0.9140	0.7982	0.6134	0.4187	0.2805	0.3246	0.5727	0.8588	0.9625	0.9847	(94)
Useful gains	694.2007	794.6135	867.6624	868.4563	730.2838	495.5699	316.0794	333.9376	526.9185	679.3377	671.3898	658.5244	(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	1350.6647	1314.3425	1195.6110	1000.8431	760.8539	499.2597	316.4493	334.7101	543.0458	839.7627	1111.9372	1336.7091	(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	488.4092	349.2579	243.9938	95.3185	22.7442	0.0000	0.0000	0.0000	0.0000	119.3562	317.1941	504.5694	(98)
Space heating												2140.8431	(98)
Space heating per m2											(98) / (4) =	26.6473	(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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2365.5725	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	488.4092	349.2579	243.9938	95.3185	22.7442	0.0000	0.0000	0.0000	0.0000	119.3562	317.1941	504.5694	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	539.6787	385.9203	269.6064	105.3243	25.1317	0.0000	0.0000	0.0000	0.0000	131.8853	350.4907	557.5352	(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	141.0896	104.3419	81.1685	39.4795	13.1230	0.0000	0.0000	21.2341	43.2293	85.5411	119.6573	140.2947	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7626	89.7433	89.6794	89.5388	89.3023	87.3000	87.3000	87.3000	87.3000	89.1360	89.6004	89.7840	(217)
Fuel for water heating, kWh/month	157.1810	116.2671	90.5096	44.0920	14.6951	0.0000	0.0000	24.3231	49.5181	95.9670	133.5455	156.2580	(219)
Water heating fuel used												882.3563	(219)
Annual totals kWh/year													
Space heating fuel - main system												2365.5725	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												45.0868	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												170.0868	(231)
Electricity for lighting (calculated in Appendix L)												353.2556	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 1080 * 1.00) =										-647.7148		-647.7148	(233)
Total delivered energy for all uses												3123.5564	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2365.5725	3.4800	82.3219	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.3563	3.4800	30.7060	(247)
Mechanical ventilation fans	45.0868	13.1900	5.9469	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	353.2556	13.1900	46.5944	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-647.7148	13.1900	-85.4336	(252)
Total energy cost			216.6232	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.7259	(257)
SAP value	89.8740	
SAP rating (Section 12)	90	(258)
SAP band	B	

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

	Energy	Emission factor	Emissions	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	2365.5725	0.2160	510.9637	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.3563	0.2160	190.5890	(264)
Space and water heating			701.5526	(265)
Pumps and fans	170.0868	0.5190	88.2751	(267)
Energy for lighting	353.2556	0.5190	183.3397	(268)
Energy saving/generation technologies				
PV Unit	-647.7148	0.5190	-336.1640	(269)
Total kg/year			637.0034	(272)
CO2 emissions per m2			7.9300	(273)
EI value			93.1898	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1700	(1b)	x 2.3500	(2b) =	94.3995	(1b) - (3b)
First floor	40.1700	(1c)	x 2.6500	(2c) =	106.4505	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	200.8500	(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							0 * 10 =		0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.3000	3.0000	3.1000	2.9000	2.8000	2.8000	2.9000	3.2000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8250	0.7500	0.7750	0.7250	0.7000	0.7000	0.7250	0.8000	(22a)
Adj infilt rate	0.2019	0.1859	0.1859	0.1753	0.1753	0.1594	0.1647	0.1541	0.1488	0.1488	0.1541	0.1700	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.40)			14.6600	1.3258	19.4356			(27)
Heat Loss Floor 1			40.1700	0.1100	4.4187			(28a)
External Wall 1	89.9500	16.7800	73.1700	0.2900	21.2193			(29a)
External Roof 1	40.1700		40.1700	0.1100	4.4187			(30)
Total net area of external elements Aum(A, m2)			170.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.6123			(33)
Party Wall 1			41.2000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.9284	(36)
Total fabric heat loss					(33) + (36) =		58.5407	(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	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	33.1403	(38)
Heat transfer coeff	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	91.6809	(39)
Average = Sum(39)m / 12 =												91.6809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	1.1412	(40)
HLP (average)												1.1412	(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	2.4693	(42)
Average daily hot water use (litres/day)	92.8454	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1300	98.4161	94.7023	90.9885	87.2747	83.5609	83.5609	87.2747	90.9885	94.7023	98.4161	102.1300	(44)
Energy conte	151.4558	132.4642	136.6912	119.1707	114.3471	98.6729	91.4349	104.9229	106.1760	123.7379	135.0696	146.6768	(45)
Energy content (annual)										Total = Sum(45)m =		1460.8199	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7184	19.8696	20.5037	17.8756	17.1521	14.8009	13.7152	15.7384	15.9264	18.5607	20.2604	22.0015	(46)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
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)
Combi loss     14.1201   12.7382   14.0672   13.5730   13.9961   13.5107   13.9399   13.9763   13.5447   14.0378   13.6318   14.1086 (61)
Total heat required for water heating calculated for each month
               165.5758  145.2023  150.7584  132.7437  128.3432  112.1835  105.3748  118.8992  119.7207  137.7757  148.7014  160.7854 (62)
Aperture area of solar collector                                                                                                3.0000 (H1)
Zero-loss collector efficiency                                                                                                  0.7000 (H2)
Collector heat loss coefficient                                                                                                 1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                       0.0050 (H3a)
Collector effective heat loss coefficient                                                                                       1.8063 (H3b)
Collector performance ratio                                                                                                     2.5804 (H4)
Annual solar radiation per m2                                                                                                1145.1228 (H5)
Overshading factor                                                                                                              0.8000 (H6)
Solar energy available                                                                                                       1923.8063 (H7)
Adjustment factor for showers                                                                                                   1.0000 (H7a)
Solar-to-load ratio                                                                                                             1.3169 (H8)
Utilisation factor                                                                                                              0.5320 (H9)
Collector performance factor                                                                                                    0.8793 (H10)
Dedicated solar storage volume                                                                                                 75.0000 (H11)
Effective solar volume                                                                                                         75.0000 (H13)
Daily hot water demand                                                                                                         92.8454 (H14)
Volume ratio Veff/V                                                                                                             0.8078 (H15)
Solar storage volume factor                                                                                                     0.9573 (H16)
Solar input                                                                                                                  -861.5475 (H17)
Solar input    -27.1586  -38.8112  -67.9598  -92.7366 -111.6291 -117.4610 -115.2232 -101.2434  -79.4092  -56.1919  -31.9499  -21.7736 (63)
                                                                          Solar input (sum of months) = Sum(63)m =  -861.5475 (63)
Output from w/h
               138.4172  106.3912   82.7986   40.0071   16.7141    0.0000    0.0000   17.6559   40.3115   81.5838  116.7515  139.0118 (64)
                                                                           Total per year (kWh/year) = Sum(64)m =   779.6426 (64)
Heat gains from water heating, kWh/month
                53.8891   47.2289   48.9666   43.0175   41.5194   36.1864   33.8871   38.3809   38.6897   44.6523   48.3186   52.2972 (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         148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568  148.1568 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                50.0070   44.4158   36.1213   27.3462   20.4416   17.2576   18.6475   24.2387   32.5332   41.3083   48.2129   51.3968 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               328.5816  331.9912  323.3990  305.1073  282.0172  260.3157  245.8178  242.4082  251.0004  269.2922  292.3823  314.0837 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850   52.2850 (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)
               -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712  -98.7712 (71)
Water heating gains (Table 5)
                72.4315   70.2811   65.8154   59.7465   55.8057   50.2589   45.5472   51.5873   53.7357   60.0165   67.1092   70.2919 (72)
Total internal gains
               555.6907  551.3587  530.0063  496.8705  462.9350  432.5028  414.6831  422.9048  441.9398  475.2876  512.3749  540.4430 (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	
Northeast	8.8500	13.3408	0.6300	0.0000	0.7700	57.2740	(75)
Southwest	5.8100	41.5040	0.6300	0.0000	0.7700	116.9762	(79)

```
Solar gains    174.2502  270.7357  426.2807  614.9701  738.8337  816.4144  769.5177  657.9053  517.8778  352.3685  210.4801  140.6976 (83)
Total gains    729.9409  822.0944  956.2870 1111.8406 1201.7687 1248.9172 1184.2007 1080.8100  959.8176  827.6561  722.8550  681.1407 (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           60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542   60.8542
alpha          5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569    5.0569
util living area
                0.9851    0.9725    0.9256    0.8041    0.6148    0.3942    0.2630    0.3048    0.5744    0.8634    0.9689    0.9891 (86)

MIT           20.1243   20.2723   20.5658   20.8337   20.9634   20.9967   20.9997   20.9993   20.9800   20.7954   20.4031   20.0606 (87)
Th 2          19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674   19.9674 (88)
util rest of house
                0.9803    0.9642    0.9044    0.7586    0.5483    0.3199    0.1833    0.2177    0.4864    0.8174    0.9577    0.9856 (89)
MIT 2         18.8413   19.0521   19.4590   19.7994   19.9390   19.9659   19.9673   19.9672   19.9556   19.7649   19.2416   18.7497 (90)
Living area fraction                                                                                 fLA = Living area / (4) =     0.2277 (91)
MIT           19.1334   19.3298   19.7109   20.0349   20.1722   20.2006   20.2023   20.2022   20.1888   19.9995   19.5060   19.0481 (92)
Temperature adjustment                                                                                                         -0.1500
adjusted MIT  18.9834   19.1798   19.5609   19.8849   20.0222   20.0506   20.0523   20.0522   20.0388   19.8495   19.3560   18.8981 (93)
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8. Space heating requirement

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9742	0.9559	0.8944	0.7546	0.5519	0.3259	0.1898	0.2249	0.4928	0.8114	0.9490	0.9805	(94)
Useful gains	711.1038	785.8287	855.3485	838.9586	663.2918	407.0708	224.7911	243.0551	472.9507	671.5444	685.9917	667.8703	(95)
Ext temp.	5.0000	5.5000	7.3000	9.7000	12.6000	15.6000	17.6000	17.4000	14.8000	11.3000	7.8000	4.9000	(96)
Heat loss rate W													
	1282.0102	1254.1807	1124.0936	933.7597	680.4724	408.0314	224.8320	243.1549	480.2998	783.8254	1059.4633	1283.3604	(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													
	424.7544	314.7326	199.9463	68.2569	12.7824	0.0000	0.0000	0.0000	0.0000	83.5370	268.8996	457.9247	(98)
Space heating												1830.8338	(98)
Space heating per m2											(98) / (4) =	22.7886	(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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2023.0208	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	424.7544	314.7326	199.9463	68.2569	12.7824	0.0000	0.0000	0.0000	0.0000	83.5370	268.8996	457.9247	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	469.3419	347.7708	220.9352	75.4219	14.1242	0.0000	0.0000	0.0000	0.0000	92.3061	297.1266	505.9941	(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													
	138.4172	106.3912	82.7986	40.0071	16.7141	0.0000	0.0000	17.6559	40.3115	81.5838	116.7515	139.0118	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6919	89.6696	89.5389	89.2905	88.6585	87.3000	87.3000	87.3000	87.3000	88.8901	89.5067	89.7340	(217)
Fuel for water heating, kWh/month													
	154.3251	118.6480	92.4722	44.8055	18.8522	0.0000	0.0000	20.2244	46.1758	91.7805	130.4388	154.9154	(219)
Water heating fuel used												872.6379	(219)
Annual totals kWh/year													
Space heating fuel - main system												2023.0208	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												45.0868	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												170.0868	(231)
Electricity for lighting (calculated in Appendix L)												353.2556	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 1145 * 1.00) =										-687.0737		-687.0737	(233)
Total delivered energy for all uses												2731.9274	(238)

10a. Fuel costs - using BEDF prices (480)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2023.0208	3.7400	75.6610	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	872.6379	3.7400	32.6367	(247)
Mechanical ventilation fans	45.0868	19.1200	8.6206	(249)
Pumps and fans for heating	75.0000	19.1200	14.3400	(249)
Pump for solar water heating	50.0000	19.1200	9.5600	(249)
Energy for lighting	353.2556	19.1200	67.5425	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit	-687.0737	19.1200	-131.3685	(252)
Total energy cost			170.9922	(255)

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	2023.0208	0.2160	436.9725	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	872.6379	0.2160	188.4898	(264)
Space and water heating			625.4623	(265)
Pumps and fans	170.0868	0.5190	88.2751	(267)
Energy for lighting	353.2556	0.5190	183.3397	(268)
Energy saving/generation technologies				
PV Unit	-687.0737	0.5190	-356.5912	(269)
Total kg/year			540.4857	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2023.0208	1.2200	2468.0854	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	872.6379	1.2200	1064.6182	(264)
Space and water heating			3532.7036	(265)
Pumps and fans	170.0868	3.0700	522.1665	(267)
Energy for lighting	353.2556	3.0700	1084.4947	(268)
Energy saving/generation technologies				
PV Unit	-687.0737	3.0700	-2109.3162	(269)
Primary energy kWh/year			3030.0486	(272)
Primary energy kWh/m2/year			37.7153	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	530.24 (P1)
Transmission heat loss coefficient	58.54 (37)
Summer heat loss coefficient	588.78 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	8.8500	98.8453	0.6300	0.0000	0.9000	496.0006
South West	5.8100	119.9223	0.6300	0.0000	0.9000	395.0566
total:						891.0572

	Jun	Jul	Aug	
Solar gains	950	891	774	(P4)
Internal gains	430	412	420	
Total summer gains	1380	1303	1194	(P5)
Summer gain/loss ratio	2.34	2.21	2.03	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	18.59	20.36	20.08	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

COVE HOMES

Job no:	3693
Date:	16/09/2021
Assessor name:	S.R.Smith
Registration no:	Cove Homes
Development name:	Liss Forest Nursery

Southern Energy Consultants
Residential & Commercial Energy Solutions

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

	House Type:	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10	
	Description:	All																			
Installation Type	**Unit of measure**	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		Dual		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Click to Select		Click to Select		Click to Select	
WC	Full flush volume	4	5.84		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	2.6	7.70		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	5	9.48		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		Bath & Shower		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Bath	Capacity to overflow	193	21.23		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	8	34.96		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	6	13.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a washing machine been specified?		No		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Washing Machine	Litres / kg		17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a dishwasher been specified?		No		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Dishwasher	Litres / place setting		4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a waste disposal unit been specified?		No	0.00	Select option:	0.00	No	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Calculated Use		113.9		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Normalisation factor		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91
Code for Sustainable Homes	**Total Consumption**		**103.6**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	Mandatory level		**Level 3/4**		-		-		-		-		-		-		-		-		-
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0
	Total Consumption		**108.6**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	17.K Compliance?		**Yes**		-		-		-		-		-		-		-		-		-

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