COVE HOMES

LISS FOREST NURSERY - GREATHAM

Energy & Sustainability Statement

24th May 2022

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. With regards to emissions reductions, although a minimum requirement of 19% is required by Policy SD48, the Applicant is responsive to the current 'climate emergency' and the sensitive location of the development in a national park setting, and will therefore target a minimum emissions reduction of 39% against current standards set by Building Regulations.

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	1,667	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 39% reduction (**27,346 $kgCO_2$/year)** in carbon dioxide emissions rather than the 19% reduction that is required by Policy SD48. A 39% reduction is the reduction in emissions exceeds the reduction 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 39% 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. Note that the exact construction specification to determine this performance will be finalised at the detailed design stage.

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	0.23	28.00
Roof (joists)	0.20	0.08	60.00
Roof (rafters)	0.20	0.15	25.00
Ground floor	0.25	0.08-0.10	60.00-68.00
Windows	2.00	1.00	50.00

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	Indicative Specification
Main external walls	0.23	300 mm construction, including 100 mm bricks, 50 mm cavity fully filled with Kingspan K108 insulation (thermal conductivity of 0.018 W/m^2), lightweight aircrete blocks (thermal conductivity of 0.15 W/m^{2}K), and plasterboard (taped and jointed).
Party walls	0.00	Fully filled and sealed.
Roof (joists)	0.08	One layer of 100 mm mineral wool insulation (thermal conductivity of 0.044 W/m^{2}K) laid between ceiling joists and one layer of 400 mm mineral wool insulation (thermal conductivity of 0.044 W/m^{2}K) laid over to provide a total thickness of 500mm.
Roof (rafters)	0.15	Layer of 165 mm ThermaPitch TP10 insulation (thermal conductivity of 0.022 W/m^{2}K) between rafters and 37.5 mm Kooltherm K18 internal insulated dry lining board (thermal conductivity of 0.022 W/m^{2}K) insulation underneath.
Ground floor	0.08-0.10	Beam and block construction (175mm beam) to include 200 mm Xtratherm Thin-R insulation (thermal conductivity maximum of 0.022 W/m^{2}K) with screed topping.
Windows	1.00	PVCu triple-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 (unless air source heat pumps are specified) 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 10 m^3/hm^2 to 5 m^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 **60,310 kgCO_2/year**, with the outcomes for each dwelling type and in

aggregate summarised in Table 4 overleaf. This is a reduction of **9,809 kgCO_2/year** from the baseline of **70,119 kgCO_2/year**, equal to **13.99%**. 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)	Percentage reduction from baseline
Private dwellings				
Vyne A/C	1,292	6	7,752	12.76
Pemberley	1,245	3	3,735	13.42
Longstock	1,431	4	5,724	13.41
Houghton	1,580	1	1,580	13.94
Dean	1,522	4	6,088	14.59
Hyde	1,563	1	1,563	14.03
Oakleigh	2,105	1	2,105	14.22
Alverstoke	2,335	2	4,670	13.90
Avington	2,329	2	4,658	14.50
Hillier	2,342	2	4,684	14.31
Omerley	2,566	2	5,132	14.81
Omerley - DG	2,571	1	2,571	17.36
Sub-total		**29**	**50,262**	**14.22**
Affordable dwellings				
Romsey (average)	1,007	2	2,014	10.65
Vyne B	1,292	4	5,168	12.76
Longstock	1,433	2	2,866	14.04
Sub-total		**8**	**10,048**	**12.79**
TOTAL		**37**	**60,310**	**13.99**

Renewable energy objective and feasibility

2.13 Energy efficiency measures have reduced site-wide emissions from the baseline scenario by 9,809 $kgCO_2$/year, however, the Applicant must now deliver at least a further **17,537 $kgCO_2$/year** reduction in carbon dioxide emissions through technically feasible renewable energy installations. This section outlines the feasible and policy compliant options that can be considered further for implementation at the detailed design stage.

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 39% 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, both of which can deliver the 39% reduction in site-wide emissions alone and not in combination. Therefore, two options present themselves for the Applicant, which can be given greater attention at the detailed design stage: (1) provision of ASHPs to all dwellings, or (2) provision of solar photovoltaic output to all dwellings. Further illustrative SAP calculations have been undertaken to demonstrate the impact of Option 2, which would require a total of 38.75 kWp of solar photovoltaic output (likely an average of 4 panels per dwelling) across the site. In the Appendix, further SAP calculations demonstrate the impact of introducing 1.25 kWp installations of solar photovoltaic output to the Houghton (Plot 24) and Dean (Plot 30) types, respectively. These demonstrate in excess of 40% betterments of their respective baseline emissions standards. In addition, SAP calculations are provided which show that the provision of air source heat pumps to these dwellings will also deliver reductions in emissions in excess of 40%.

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 (triple likely to be installed) 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 or triple 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 will enable the site to reduce its carbon dioxide emissions overall by at least 39% compared to the standard set by Part L1a of Building Regulations (2013). If Air Surce Heat Pumps are specified throughout then the minimum reduction in site-wide emissions will be 55%.

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 energy efficiency measures and 1.25 kWp solar PV
Type Houghton (Plot 24) with energy efficiency measures and air source heat pump
Type Dean (Plot 30) with energy efficiency measures and 1.25 kWp solar PV
Type Dean (Plot 30) with energy efficiency measures and air source heat pump
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
Selwyn House, Stile Castle Way, Southampton, SO14 2HY
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**	04/05/2022
Assessment Reference	Solar PV	**Prop Type Ref**	Houghton
Property	Plot 24, Greatham, Hampshire, GU22		

SAP Rating	89 B	**DER**	10.51	**TER**	18.33
Environmental	91 B	**% DER<TER**	42.65		
CO_2 Emissions (t/year)	0.78	**DFEE**	44.31	**TFEE**	59.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	25.87		

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 4.14r19

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) 10.51 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.3 kWh/m²/yrOK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.08 (max. 0.25)	0.08 (max. 0.70)	OK
Roof	0.08 (max. 0.20)	0.08 (max. 0.35)	OK
Openings	1.00 (max. 2.00)	1.00 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 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): Slight 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 0.08 W/m²K
Floor U-value 0.08 W/m²K
Door U-value 1.00 W/m²K
Window 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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.7021	(36)
Total fabric heat loss (33) + (36) =	63.4081	(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	120.7293	120.0101	119.2910	115.6951	114.9759	111.3801	111.3801	110.6609	112.8184	114.9759	116.4143	117.8526	(39)
Average = Sum(39)m / 12 =												115.5153	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.1983	1.1911	1.1552	1.1480	1.1121	1.1121	1.1050	1.1265	1.1480	1.1624	1.1768	(40)
HLP (average)												1.1534	(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													
	23.3936	20.7780	16.8978	12.7927	9.5627	8.0732	8.7234	11.3390	15.2192	19.3243	22.5543	24.0438	(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													
	476.8806	474.6336	459.2811	434.4176	408.9538	384.5993	368.8974	375.2974	388.1772	413.2676	442.0954	463.9261	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	640.8653	778.3374	939.5720	1138.0522	1296.1453	1308.9492	1241.9358	1104.7324	944.7614	766.3832	642.9505	601.3902	(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	23.0428	23.1809	23.3207	24.0455	24.1959	24.9770	24.9770	25.1394	24.6586	24.1959	23.8969	23.6053	
alpha	2.5362	2.5454	2.5547	2.6030	2.6131	2.6651	2.6651	2.6760	2.6439	2.6131	2.5931	2.5737	
util living area													
	0.9621	0.9385	0.8915	0.7925	0.6506	0.4896	0.3739	0.4276	0.6522	0.8596	0.9429	0.9671	(86)
MIT	18.5503	18.8916	19.4310	20.1132	20.5967	20.8698	20.9535	20.9336	20.7082	20.0414	19.2026	18.5285	(87)
Th 2	19.9156	19.9214	19.9271	19.9560	19.9618	19.9909	19.9909	19.9968	19.9793	19.9618	19.9502	19.9386	(88)
util rest of house													
	0.9563	0.9294	0.8755	0.7632	0.6041	0.4257	0.2951	0.3449	0.5887	0.8323	0.9329	0.9621	(89)
MIT 2	16.6538	17.1477	17.9200	18.8853	19.5253	19.8765	19.9614	19.9517	19.6972	18.8152	17.6189	16.6347	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	16.9950	17.4615	18.1918	19.1062	19.7180	20.0553	20.1399	20.1284	19.8791	19.0359	17.9038	16.9755	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.8450	17.3115	18.0418	18.9562	19.5680	19.9053	19.9899	19.9784	19.7291	18.8859	17.7538	16.8255	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9316	0.8983	0.8389	0.7304	0.5847	0.4200	0.2950	0.3433	0.5714	0.7966	0.9032	0.9398	(94)
Useful gains	597.0337	699.1885	788.2523	831.2147	757.8264	549.7482	366.4251	379.2901	539.8326	610.4874	580.7211	565.1571	(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													
	1514.5502	1489.5085	1376.8384	1163.4588	904.6346	590.8997	377.5682	395.9892	635.0678	952.6752	1240.2575	1487.9441	(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													
	682.6323	531.0950	437.9081	239.2157	109.2253	0.0000	0.0000	0.0000	0.0000	254.5877	474.8662	686.5535	(98)
Space heating												3416.0838	(98)
Space heating per m2											(98) / (4) =	34.1097	(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												3393.4607	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	682.6323	531.0950	437.9081	239.2157	109.2253	0.0000	0.0000	0.0000	0.0000	254.5877	474.8662	686.5535	(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)													
	678.1116	527.5779	435.0080	237.6315	108.5019	0.0000	0.0000	0.0000	0.0000	252.9017	471.7214	682.0068	(211)
Water heating requirement													
	105.0204	81.7069	67.3705	36.8024	16.8039	0.0000	0.0000	0.0000	0.0000	39.1673	73.0563	105.6236	(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	87.5565	87.2768	86.6970	85.4058	83.4354	79.9000	79.9000	79.9000	79.9000	85.4754	86.9378	87.6209	(217)
Fuel for water heating, kWh/month													
	245.9827	217.5783	230.2079	209.7317	210.5662	196.7471	189.2146	207.2687	206.7903	217.2906	225.5942	239.9689	(219)
Water heating fuel used												2596.9412	(219)
Annual totals kWh/year													
Space heating fuel - main system												3393.4607	(211)
Space heating fuel - secondary												525.5513	(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)												413.1378	(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												6031.0745	(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	3393.4607	0.2160	732.9875	(261)
Space heating - secondary	525.5513	0.0190	9.9855	(263)
Water heating (other fuel)	2596.9412	0.2160	560.9393	(264)
Space and water heating			1303.9123	(265)
Pumps and fans	131.1702	0.5190	68.0773	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total CO2, kg/year			1052.2602	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.5100	(273)

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

DER		10.5100	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		27.5361	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		27.5361	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

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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)


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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      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)


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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                                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)
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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)


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7. Mean internal temperature (heating season)
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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)


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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   0.9961     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)


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8c. Space cooling requirement
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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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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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =		58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	120.4342	119.8230	119.2239	116.4101	115.8837	113.4329	113.4329	112.9791	114.3769	115.8837	116.9487	118.0621	(39)
Average = Sum(39)m / 12 =												116.4076	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2025	1.1964	1.1905	1.1624	1.1571	1.1326	1.1326	1.1281	1.1421	1.1571	1.1677	1.1789	(40)
HLP (average)												1.1623	(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)

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													
	23.3936	20.7780	16.8978	12.7927	9.5627	8.0732	8.7234	11.3390	15.2192	19.3243	22.5543	24.0438	(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													
	390.3415	388.9224	375.2889	352.7624	328.8159	306.5978	292.7118	296.7851	308.8383	331.5098	357.6062	378.2114	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	554.3263	692.6261	855.5798	1056.3970	1216.0074	1230.9477	1165.7502	1026.2201	865.4224	684.6255	558.4614	515.6755	(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	23.0993	23.2171	23.3338	23.8978	24.0064	24.5250	24.5250	24.6235	24.3226	24.0064	23.7877	23.5634	
alpha	2.5400	2.5478	2.5556	2.5932	2.6004	2.6350	2.6350	2.6416	2.6215	2.6004	2.5858	2.5709	
util living area													
	0.9723	0.9516	0.9088	0.8160	0.6774	0.5192	0.4007	0.4612	0.6897	0.8858	0.9577	0.9766	(86)
MIT	18.4205	18.7702	19.3267	20.0292	20.5480	20.8442	20.9426	20.9166	20.6560	19.9346	19.0661	18.3863	(87)
Th 2	19.9180	19.9229	19.9276	19.9502	19.9545	19.9743	19.9743	19.9780	19.9666	19.9545	19.9459	19.9370	(88)
util rest of house													
	0.9679	0.9441	0.8948	0.7885	0.6312	0.4527	0.3164	0.3728	0.6269	0.8621	0.9499	0.9729	(89)
MIT 2	17.5626	17.9106	18.4581	19.1449	19.6181	19.8803	19.9493	19.9391	19.7368	19.0757	18.2229	17.5416	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.7169	18.0653	18.6144	19.3040	19.7855	20.0537	20.1280	20.1149	19.9022	19.2303	18.3746	17.6935	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7169	18.0653	18.6144	19.3040	19.7855	20.0537	20.1280	20.1149	19.9022	19.2303	18.3746	17.6935	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9556	0.9272	0.8734	0.7690	0.6231	0.4581	0.3295	0.3853	0.6225	0.8419	0.9345	0.9621	(94)
Useful gains	529.7175	642.1930	747.2566	812.4149	757.6717	563.9331	384.1581	395.3928	538.7279	576.3566	521.8689	496.1346	(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													
	1615.8588	1577.5037	1444.3213	1211.1311	936.9722	618.6305	400.1953	419.7105	663.6342	1000.1078	1318.5488	1593.0768	(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													
	808.0891	628.5288	518.6161	287.0757	133.3996	0.0000	0.0000	0.0000	0.0000	315.2709	573.6096	816.1250	(98)
Space heating												4080.7147	(98)
Space heating per m2											(98) / (4) =	40.7460	(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	1066.2694	839.4035	858.6409	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8423	0.8867	0.8552	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	898.1322	744.2856	734.3051	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1544.1233	1465.6622	1304.4996	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	465.1135	536.7042	424.2247	0.0000	0.0000	0.0000	0.0000	(104)

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Space cooling											1426.0424	(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	116.2784	134.1761	106.0562	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											356.5106	(107)
Space cooling per m2											3.5598	(108)
Energy for space heating											40.7460	(99)
Energy for space cooling											3.5598	(108)
Total											44.3058	(109)
Dwelling Fabric Energy Efficiency (DFEE)											44.3	(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													

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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)

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)

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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)

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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.7021	(36)
Total fabric heat loss	(33) + (36) =	63.4081	(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	111.3801	109.2225	109.2225	107.7842	107.7842	105.6267	106.3459	104.9075	104.6949	104.6949	104.9075	107.0650	(39)
Average = Sum(39)m / 12 =												106.9697	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1121	1.0906	1.0906	1.0762	1.0762	1.0547	1.0619	1.0475	1.0454	1.0454	1.0475	1.0690	(40)
HLP (average)												1.0681	(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)

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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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													
	683.2322	678.3731	653.8959	615.8398	576.6507	541.7158	521.4134	530.4254	552.4301	590.7129	633.2660	665.6771	(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	0.5700	0.0000	0.7700	60.4266	(75)
Southeast	4.9500	41.5040	0.5700	0.0000	0.7700	90.1698	(77)
Southwest	0.6600	41.5040	0.5700	0.0000	0.7700	12.0226	(79)
Northwest	4.5000	13.3408	0.5700	0.0000	0.7700	26.3488	(81)

Solar gains	188.9678	300.8826	491.9802	736.6855	905.3568	1008.9077	947.5933	796.5417	607.2564	397.0709	229.8031	151.6106	(83)
Total gains	872.2000	979.2557	1145.8760	1352.5253	1482.0074	1550.6235	1469.0067	1326.9671	1159.6865	987.7838	863.0691	817.2877	(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	24.9770	25.4704	25.4704	25.8103	25.8103	26.3375	26.1594	26.5181	26.5719	26.5719	26.5181	25.9837	
alpha	2.6651	2.6980	2.6980	2.7207	2.7207	2.7558	2.7440	2.7679	2.7715	2.7715	2.7679	2.7322	
util living area													
	0.9180	0.8891	0.8182	0.6919	0.5369	0.3527	0.2422	0.2783	0.5042	0.7449	0.8776	0.9271	(86)
MIT	19.2260	19.5023	19.9823	20.4834	20.7992	20.9567	20.9892	20.9844	20.8807	20.4823	19.8397	19.2269	(87)
Th 2	19.9909	20.0085	20.0085	20.0203	20.0203	20.0380	20.0321	20.0439	20.0457	20.0457	20.0439	20.0262	(88)
util rest of house													
	0.9068	0.8746	0.7952	0.6564	0.4881	0.2944	0.1748	0.2068	0.4402	0.7064	0.8594	0.9171	(89)
MIT 2	17.6642	18.0659	18.7365	19.4182	19.8153	20.0049	20.0272	20.0361	19.9407	19.4550	18.5737	17.6876	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	17.9452	18.3243	18.9606	19.6099	19.9923	20.1762	20.2003	20.2067	20.1098	19.6399	18.8015	17.9645	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7952	18.1743	18.8106	19.4599	19.8423	20.0262	20.0503	20.0567	19.9598	19.4899	18.6515	17.8145	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8744	0.8407	0.7625	0.6342	0.4787	0.2937	0.1761	0.2078	0.4341	0.6809	0.8265	0.8869	(94)
Useful gains	762.6468	823.2936	873.6889	857.7231	709.4863	455.3952	258.7133	275.7732	503.4112	672.6191	713.3080	724.8474	(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													
	1425.1349	1384.3234	1257.2195	1051.9615	780.6090	467.5245	260.5791	278.7121	540.2059	857.4388	1138.4000	1382.6952	(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													
	492.8911	377.0120	285.3468	139.8516	52.9153	0.0000	0.0000	0.0000	0.0000	137.5058	306.0662	489.4388	(98)
Space heating												2281.0276	(98)
RHI space heating demand												2281	(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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.7021	(36)
Total fabric heat loss (33) + (36) =	63.4081	(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	120.7293	120.0101	119.2910	115.6951	114.9759	111.3801	111.3801	110.6609	112.8184	114.9759	116.4143	117.8526	(39)

Average = Sum(39)m / 12 =	115.5153 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.1983	1.1911	1.1552	1.1480	1.1121	1.1121	1.1050	1.1265	1.1480	1.1624	1.1768	(40)
HLP (average)												1.1534	(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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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													
	683.2322	678.3731	653.8959	615.8398	576.6507	541.7158	521.4134	530.4254	552.4301	590.7129	633.2660	665.6771	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	847.2169	982.0769	1134.1867	1319.4744	1463.8422	1466.0657	1394.4518	1259.8604	1109.0142	943.8286	834.1212	803.1413	(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	23.0428	23.1809	23.3207	24.0455	24.1959	24.9770	24.9770	25.1394	24.6586	24.1959	23.8969	23.6053	
alpha	2.5362	2.5454	2.5547	2.6030	2.6131	2.6651	2.6651	2.6760	2.6439	2.6131	2.5931	2.5737	
util living area													
	0.9325	0.9034	0.8492	0.7435	0.6027	0.4469	0.3371	0.3820	0.5887	0.8024	0.9042	0.9393	(86)
MIT	18.8540	19.1666	19.6518	20.2541	20.6663	20.8957	20.9638	20.9496	20.7741	20.2174	19.4655	18.8339	(87)
Th 2	19.9156	19.9214	19.9271	19.9560	19.9618	19.9909	19.9909	19.9968	19.9793	19.9618	19.9502	19.9386	(88)
util rest of house													
	0.9230	0.8903	0.8290	0.7111	0.5558	0.3863	0.2647	0.3059	0.5251	0.7689	0.8891	0.9308	(89)
MIT 2	17.0874	17.5355	18.2231	19.0672	19.6054	19.9006	19.9683	19.9632	19.7661	19.0449	17.9878	17.0721	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	17.4053	17.8290	18.4802	19.2808	19.7963	20.0796	20.1474	20.1407	19.9475	19.2559	18.2537	17.3891	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2553	17.6790	18.3302	19.1308	19.6463	19.9296	19.9974	19.9907	19.7975	19.1059	18.1037	17.2391	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8907	0.8544	0.7921	0.6822	0.5404	0.3824	0.2652	0.3054	0.5128	0.7360	0.8541	0.9003	(94)
Useful gains	754.6112	839.0452	898.3352	900.1202	791.1283	560.6731	369.8071	384.7629	568.7386	694.6119	712.4089	723.0900	(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													
	1564.0835	1533.6114	1411.2321	1183.6482	913.6347	593.6129	378.4066	397.3476	642.7774	977.9745	1280.9865	1536.6870	(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													
	602.2474	466.7485	381.5953	204.1402	91.1448	0.0000	0.0000	0.0000	0.0000	210.8218	409.3759	605.3161	(98)
Space heating												2971.3898	(98)
Space heating per m2											(98) / (4) =	29.6694	(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												2951.7118	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	602.2474	466.7485	381.5953	204.1402	91.1448	0.0000	0.0000	0.0000	0.0000	210.8218	409.3759	605.3161	(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)													
	598.2590	463.6575	379.0681	202.7882	90.5412	0.0000	0.0000	0.0000	0.0000	209.4256	406.6648	601.3074	(211)
Water heating requirement													
	92.6534	71.8075	58.7070	31.4062	14.0223	0.0000	0.0000	0.0000	0.0000	32.4341	62.9809	93.1256	(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	87.2764	86.9740	86.3498	84.9819	83.0209	79.9000	79.9000	79.9000	79.9000	84.9712	86.5725	87.3427	(217)
Fuel for water heating, kWh/month													
	246.7720	218.3360	231.1335	210.7779	211.6176	196.7471	189.2146	207.2687	206.7903	218.5800	226.5462	240.7330	(219)
Water heating fuel used												2604.5168	(219)
Annual totals kWh/year													
Space heating fuel - main system												2951.7118	(211)
Space heating fuel - secondary												457.1369	(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)												413.1378	(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												5528.4867	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2951.7118	3.4800	102.7196	(240)
Space heating - secondary	457.1369	4.2300	19.3369	(242)
Water heating (other fuel)	2604.5168	3.4800	90.6372	(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	413.1378	13.1900	54.4929	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1029.1867	13.1900	-135.7497	(252)
Total energy cost			268.7381	(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] =	0.7776	(257)
SAP value		89.1523	
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	2951.7118	0.2160	637.5697	(261)
Space heating - secondary	457.1369	0.0190	8.6856	(263)
Water heating (other fuel)	2604.5168	0.2160	562.5756	(264)
Space and water heating			1208.8310	(265)
Pumps and fans	131.1702	0.5190	68.0773	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total kg/year			957.1789	(272)
CO2 emissions per m2			9.5600	(273)
EI value			91.1635	
EI rating			91	(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 / 0.8392 = 4.147, stars = 4
Water heating environmental impact	0.216 / 0.8392 = 0.2574, 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)
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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	111.3801	109.2225	109.2225	107.7842	107.7842	105.6267	106.3459	104.9075	104.6949	104.6949	104.9075	107.0650	(39)
Average = Sum(39)m / 12 =												106.9697	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1121	1.0906	1.0906	1.0762	1.0762	1.0547	1.0619	1.0475	1.0454	1.0454	1.0475	1.0690	(40)
HLP (average)												1.0681	(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 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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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													
	683.2322	678.3731	653.8959	615.8398	576.6507	541.7158	521.4134	530.4254	552.4301	590.7129	633.2660	665.6771	(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	0.5700	0.0000	0.7700	60.4266	(75)
Southeast	4.9500	41.5040	0.5700	0.0000	0.7700	90.1698	(77)
Southwest	0.6600	41.5040	0.5700	0.0000	0.7700	12.0226	(79)
Northwest	4.5000	13.3408	0.5700	0.0000	0.7700	26.3488	(81)

Solar gains	188.9678	300.8826	491.9802	736.6855	905.3568	1008.9077	947.5933	796.5417	607.2564	397.0709	229.8031	151.6106	(83)
Total gains	872.2000	979.2557	1145.8760	1352.5253	1482.0074	1550.6235	1469.0067	1326.9671	1159.6865	987.7838	863.0691	817.2877	(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	24.9770	25.4704	25.4704	25.8103	25.8103	26.3375	26.1594	26.5181	26.5719	26.5719	26.5181	25.9837	
alpha	2.6651	2.6980	2.6980	2.7207	2.7207	2.7558	2.7440	2.7679	2.7715	2.7715	2.7679	2.7322	
util living area													
	0.9180	0.8891	0.8182	0.6919	0.5369	0.3527	0.2422	0.2783	0.5042	0.7449	0.8776	0.9271	(86)
MIT	19.2260	19.5023	19.9823	20.4834	20.7992	20.9567	20.9892	20.9844	20.8807	20.4823	19.8397	19.2269	(87)
Th 2	19.9909	20.0085	20.0085	20.0203	20.0203	20.0380	20.0321	20.0439	20.0457	20.0457	20.0439	20.0262	(88)
util rest of house													
	0.9068	0.8746	0.7952	0.6564	0.4881	0.2944	0.1748	0.2068	0.4402	0.7064	0.8594	0.9171	(89)
MIT 2	17.6642	18.0659	18.7365	19.4182	19.8153	20.0049	20.0272	20.0361	19.9407	19.4550	18.5737	17.6876	(90)
Living area fraction									fLA = Living area / (4) =			0.1799	(91)
MIT	17.9452	18.3243	18.9606	19.6099	19.9923	20.1762	20.2003	20.2067	20.1098	19.6399	18.8015	17.9645	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7952	18.1743	18.8106	19.4599	19.8423	20.0262	20.0503	20.0567	19.9598	19.4899	18.6515	17.8145	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8744	0.8407	0.7625	0.6342	0.4787	0.2937	0.1761	0.2078	0.4341	0.6809	0.8265	0.8869	(94)
Useful gains	762.6468	823.2936	873.6889	857.7231	709.4863	455.3952	258.7133	275.7732	503.4112	672.6191	713.3080	724.8474	(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													
	1425.1349	1384.3234	1257.2195	1051.9615	780.6090	467.5245	260.5791	278.7121	540.2059	857.4388	1138.4000	1382.6952	(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													
	492.8911	377.0120	285.3468	139.8516	52.9153	0.0000	0.0000	0.0000	0.0000	137.5058	306.0662	489.4388	(98)
Space heating												2281.0276	(98)
Space heating per m2											(98) / (4) =	22.7761	(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												2265.9215	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	492.8911	377.0120	285.3468	139.8516	52.9153	0.0000	0.0000	0.0000	0.0000	137.5058	306.0662	489.4388	(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)													
	489.6270	374.5152	283.4571	138.9255	52.5649	0.0000	0.0000	0.0000	0.0000	136.5952	304.0393	486.1974	(211)
Water heating requirement													
	75.8294	58.0018	43.8995	21.5156	8.1408	0.0000	0.0000	0.0000	0.0000	21.1547	47.0871	75.2983	(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	86.8009	86.4460	85.5878	83.9938	81.9644	79.9000	79.9000	79.9000	79.9000	83.8604	85.8203	86.8424	(217)
Fuel for water heating, kWh/month													
	248.1240	219.6695	233.1914	213.2574	214.3451	196.7471	189.2146	207.2687	206.7903	221.4753	228.5318	242.1200	(219)
Water heating fuel used												2620.7355	(219)
Annual totals kWh/year													
Space heating fuel - main system												2265.9215	(211)
Space heating fuel - secondary												350.9273	(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)												413.1378	(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												4686.0560	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2265.9215	3.6300	82.2529	(240)
Space heating - secondary	350.9273	5.1600	18.1079	(242)
Water heating (other fuel)	2620.7355	3.6300	95.1327	(247)
Mechanical ventilation fans	56.1702	19.4400	10.9195	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	413.1378	19.4400	80.3140	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1095.8363	19.4400	-213.0306	(252)
Total energy cost			183.2764	(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	2265.9215	0.2160	489.4390	(261)
Space heating - secondary	350.9273	0.0190	6.6676	(263)
Water heating (other fuel)	2620.7355	0.2160	566.0789	(264)
Space and water heating			1062.1855	(265)
Pumps and fans	131.1702	0.5190	68.0773	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	0.5190	-568.7390	(269)
Total kg/year			775.9423	(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	2265.9215	1.2200	2764.4242	(261)
Space heating - secondary	350.9273	1.0400	364.9644	(263)
Water heating (other fuel)	2620.7355	1.2200	3197.2973	(264)
Space and water heating			6326.6859	(265)
Pumps and fans	131.1702	3.0700	402.6924	(267)
Energy for lighting	413.1378	3.0700	1268.3330	(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			4633.4940 (272)
Primary energy kWh/m2/year			46.2655 (273)

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	+ 1.6	-£ 40	-269 kg (34.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£40	2.69 kg/m²	B 91	A 94
Total Savings	£40	2.69 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 493 TEST (31 Mar 2022)
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	£106	£116	-£10
Mains gas	£272	£223	£50
Wood	£18	£18	-£0
Space heating	£221	£222	-£1
Water heating	£95	£54	£41
Lighting	£80	£80	£0
Generated (PV)	-£213	-£213	£0
Total cost of fuels	£183	£144	£40
Total cost of uses	£183	£143	£40
Delivered energy	47 kWh/m²	34 kWh/m²	13 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.5 tonnes	0.3 tonnes
CO2 emissions per m²	8 kg/m²	5 kg/m²	3 kg/m²
Primary energy	46 kWh/m²	31 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)

	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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	120.7293	120.0101	119.2910	115.6951	114.9759	111.3801	111.3801	110.6609	112.8184	114.9759	116.4143	117.8526	(39)
Average = Sum(39)m / 12 =												115.5153	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.1983	1.1911	1.1552	1.1480	1.1121	1.1121	1.1050	1.1265	1.1480	1.1624	1.1768	(40)
HLP (average)												1.1534	(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	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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	671.6608	666.8017	640.8236	596.7644	551.3219	516.1369	495.8345	505.8470	534.8554	577.6407	621.6946	654.1057	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	835.6455	970.5055	1121.1145	1300.3990	1438.5134	1440.4868	1368.8729	1235.2821	1091.4396	930.7564	822.5498	791.5699	(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	23.0428	23.1809	23.3207	24.0455	24.1959	24.9770	24.9770	25.1394	24.6586	24.1959	23.8969	23.6053	
alpha	2.5362	2.5454	2.5547	2.6030	2.6131	2.6651	2.6651	2.6760	2.6439	2.6131	2.5931	2.5737	
util living area	0.9344	0.9055	0.8521	0.7485	0.6097	0.4534	0.3428	0.3886	0.5950	0.8066	0.9068	0.9411	(86)
MIT	18.8378	19.1519	19.6380	20.2405	20.6568	20.8920	20.9623	20.9474	20.7680	20.2057	19.4505	18.8171	(87)
Th 2	19.9156	19.9214	19.9271	19.9560	19.9618	19.9909	19.9909	19.9968	19.9793	19.9618	19.9502	19.9386	(88)
util rest of house	0.9251	0.8926	0.8322	0.7165	0.5627	0.3922	0.2694	0.3115	0.5314	0.7735	0.8920	0.9327	(89)
MIT 2	17.0644	17.5149	18.2043	19.0499	19.5946	19.8971	19.9673	19.9617	19.7598	19.0299	17.9671	17.0482	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.3835	17.8094	18.4623	19.2641	19.7857	20.0761	20.1464	20.1390	19.9412	19.2414	18.2340	17.3665	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2335	17.6594	18.3123	19.1141	19.6357	19.9261	19.9964	19.9890	19.7912	19.0914	18.0840	17.2165	(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	0.8931	0.8569	0.7952	0.6871	0.5468	0.3881	0.2698	0.3109	0.5186	0.7403	0.8571	0.9027	(94)
Useful gains	746.2843	831.6007	891.4602	893.4714	786.5734	559.1044	369.3183	384.0264	566.0668	689.0161	705.0002	714.5390	(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													
	1561.4514	1531.2624	1409.0971	1181.7231	912.4172	593.2259	378.2858	397.1656	642.0750	976.3122	1278.6935	1534.0306	(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													
	606.4843	470.1726	385.1219	207.5412	93.6278	0.0000	0.0000	0.0000	0.0000	213.7483	413.0591	609.7017	(98)
Space heating												2999.4570	(98)
Space heating per m2											(98) / (4) =	29.9496	(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	2979.5931	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	606.4843	470.1726	385.1219	207.5412	93.6278	0.0000	0.0000	0.0000	0.0000	213.7483	413.0591	609.7017	(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)													
	602.4679	467.0589	382.5714	206.1668	93.0078	0.0000	0.0000	0.0000	0.0000	212.3327	410.3236	605.6640	(211)
Water heating requirement													
	93.3053	72.3342	59.2495	31.9294	14.4043	0.0000	0.0000	0.0000	0.0000	32.8844	63.5476	93.8003	(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	87.7126	87.7480	87.7395	87.7346	87.7889	79.9000	79.9000	79.9000	79.9000	86.2414	87.1797	87.7326	(217)
Fuel for water heating, kWh/month													
	202.8324	154.5517	127.1222	68.6706	30.1634	13.3231	6.8735	45.3607	82.5936	135.2130	176.6913	201.9267	(219)
Water heating fuel used												1245.3222	(219)
Annual totals kWh/year													
Space heating fuel - main system												2979.5931	(211)
Space heating fuel - secondary												461.4549	(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)												413.1378	(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												4251.4914	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2979.5931	3.4800	103.6898	(240)
Space heating - secondary	461.4549	4.2300	19.5195	(242)
Water heating (other fuel)	1245.3222	3.4800	43.3372	(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	413.1378	13.1900	54.4929	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1029.1867	13.1900	-135.7497	(252)
Total energy cost			229.1861	(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] =	0.6632	(257)
SAP value	90.7489	
SAP rating (Section 12)	91	(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	2979.5931	0.2160	643.5921	(261)
Space heating - secondary	461.4549	0.0190	8.7676	(263)
Water heating (other fuel)	1245.3222	0.2160	268.9896	(264)
Space and water heating			921.3493	(265)
Pumps and fans	181.1702	0.5190	94.0273	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total kg/year			695.6473	(272)
CO2 emissions per m2			6.9500	(273)
EI value			93.5779	
EI rating			94	(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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	111.3801	109.2225	109.2225	107.7842	107.7842	105.6267	106.3459	104.9075	104.6949	104.6949	104.9075	107.0650	(39)
Average = Sum(39)m / 12 =												106.9697	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1121	1.0906	1.0906	1.0762	1.0762	1.0547	1.0619	1.0475	1.0454	1.0454	1.0475	1.0690	(40)
HLP (average)												1.0681	(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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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													
	671.6608	666.8017	640.8236	596.7644	551.3219	516.1369	495.8345	505.8470	534.8554	577.6407	621.6946	654.1057	(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	0.5700	0.0000	0.7700	60.4266	(75)
Southeast	4.9500	41.5040	0.5700	0.0000	0.7700	90.1698	(77)
Southwest	0.6600	41.5040	0.5700	0.0000	0.7700	12.0226	(79)
Northwest	4.5000	13.3408	0.5700	0.0000	0.7700	26.3488	(81)

Solar gains	188.9678	300.8826	491.9802	736.6855	905.3568	1008.9077	947.5933	796.5417	607.2564	397.0709	229.8031	151.6106	(83)
Total gains	860.6285	967.6843	1132.8038	1333.4499	1456.6787	1525.0446	1443.4278	1302.3888	1142.1119	974.7116	851.4977	805.7163	(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	24.9770	25.4704	25.4704	25.8103	25.8103	26.3375	26.1594	26.5181	26.5719	26.5719	26.5181	25.9837	
alpha	2.6651	2.6980	2.6980	2.7207	2.7207	2.7558	2.7440	2.7679	2.7715	2.7715	2.7679	2.7322	
util living area													
	0.9201	0.8916	0.8216	0.6973	0.5438	0.3580	0.2463	0.2832	0.5102	0.7497	0.8807	0.9292	(86)
MIT	19.2101	19.4879	19.9698	20.4725	20.7926	20.9551	20.9888	20.9837	20.8771	20.4729	19.8257	19.2103	(87)
Th 2	19.9909	20.0085	20.0085	20.0203	20.0203	20.0380	20.0321	20.0439	20.0457	20.0457	20.0439	20.0262	(88)
util rest of house													
	0.9091	0.8773	0.7988	0.6620	0.4948	0.2990	0.1779	0.2106	0.4458	0.7115	0.8628	0.9195	(89)
MIT 2	17.6419	18.0459	18.7197	19.4047	19.8083	20.0036	20.0270	20.0357	19.9372	19.4434	18.5546	17.6642	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.9241	18.3053	18.9446	19.5969	19.9854	20.1748	20.2000	20.2063	20.1063	19.6287	18.7833	17.9424	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7741	18.1553	18.7946	19.4469	19.8354	20.0248	20.0500	20.0563	19.9563	19.4787	18.6333	17.7924	(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	0.8770	0.8435	0.7659	0.6393	0.4850	0.2982	0.1792	0.2116	0.4395	0.6856	0.8299	0.8896	(94)
Useful gains	754.8055	816.2774	867.6321	852.4960	706.4804	454.7762	258.6008	275.5880	501.9180	668.2821	706.6649	716.7335	(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													
	1422.7792	1382.2485	1255.4701	1050.5583	779.8607	467.3783	260.5507	278.6663	539.8427	856.2648	1136.4927	1380.3228	(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													
	496.9725	380.3325	288.5515	142.6049	54.5950	0.0000	0.0000	0.0000	0.0000	139.8591	309.4760	493.7104	(98)
Space heating												2306.1019	(98)
Space heating per m2											(98) / (4) =	23.0265	(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	2290.8297	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	496.9725	380.3325	288.5515	142.6049	54.5950	0.0000	0.0000	0.0000	0.0000	139.8591	309.4760	493.7104	(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)													
	493.6813	377.8138	286.6406	141.6605	54.2334	0.0000	0.0000	0.0000	0.0000	138.9329	307.4265	490.4408	(211)
Water heating requirement													
	76.4573	58.5127	44.3925	21.9392	8.3992	0.0000	0.0000	0.0000	0.0000	21.5168	47.6117	75.9554	(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	87.3123	87.2465	87.0601	86.8647	86.2010	79.9000	79.9000	79.9000	79.9000	85.2209	86.5293	87.2872	(217)
Fuel for water heating, kWh/month													
	200.3844	157.9443	130.0555	69.8832	35.0954	7.4271	1.9920	40.3138	78.4832	131.6832	174.3097	201.3222	(219)
Water heating fuel used												1228.8941	(219)
Annual totals kWh/year													
Space heating fuel - main system												2290.8297	(211)
Space heating fuel - secondary												354.7849	(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)												413.1378	(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												3372.9804	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2290.8297	3.6300	83.1571	(240)
Space heating - secondary	354.7849	5.1600	18.3069	(242)
Water heating (other fuel)	1228.8941	3.6300	44.6089	(247)
Mechanical ventilation fans	56.1702	19.4400	10.9195	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	413.1378	19.4400	80.3140	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1095.8363	19.4400	-213.0306	(252)
Total energy cost			143.5758	(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	2290.8297	0.2160	494.8192	(261)
Space heating - secondary	354.7849	0.0190	6.7409	(263)
Water heating (other fuel)	1228.8941	0.2160	265.4411	(264)
Space and water heating			767.0012	(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	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	0.5190	-568.7390	(269)
Total kg/year			506.7080	(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	2290.8297	1.2200	2794.8122	(261)
Space heating - secondary	354.7849	1.0400	368.9763	(263)
Water heating (other fuel)	1228.8941	1.2200	1499.2508	(264)
Space and water heating			4663.0393	(265)
Pumps and fans	181.1702	3.0700	556.1924	(267)
Energy for lighting	413.1378	3.0700	1268.3330	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	3.0700	-3364.2174	(269)
Primary energy kWh/year			3123.3473	(272)
Primary energy kWh/m2/year			31.1867	(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	100.0
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		63.41 (37)
Summer heat loss coefficient		724.00 (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	0.5700	0.0000	0.9000	523.3027
South East	4.9500	119.9223	0.5700	0.0000	0.9000	304.5248
South West	0.6600	119.9223	0.5700	0.0000	0.9000	40.6033
North West	4.5000	98.8453	0.5700	0.0000	0.9000	228.1843
total:						1096.6151

	Jun	Jul	Aug	
Solar gains	1174	1097	937	(P4)
Internal gains	539	518	527	
Total summer gains	1712	1615	1464	(P5)
Summer gain/loss ratio	2.37	2.23	2.02	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.67	21.43	21.12	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

Property Reference	SECLISHOU	**Issued on Date**	04/05/2022
Assessment Reference	ASHP	**Prop Type Ref**	Houghton
Property	Plot 24, Greatham, Hampshire, GU22		

SAP Rating	93 A	**DER**	7.58	**TER**	27.03
Environmental	94 A	**% DER<TER**	71.96		
CO_2 Emissions (t/year)	0.51	**DFEE**	44.31	**TFEE**	59.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	25.87		

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 4.14r19

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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 27.03 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 7.58 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.8 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	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.08 (max. 0.25)	0.08 (max. 0.70)	OK
Roof	0.08 (max. 0.20)	0.08 (max. 0.35)	OK
Openings	1.00 (max. 2.00)	1.00 (max. 3.30)	OK

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

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

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi Electric Ecodan 5.0 kW PUZ-WM50VHA

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

---
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): Slight 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

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.08 W/m²K
Door U-value 1.00 W/m²K
Window 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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.7021	(36)
Total fabric heat loss (33) + (36) =	63.4081	(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	120.7293	120.0101	119.2910	115.6951	114.9759	111.3801	111.3801	110.6609	112.8184	114.9759	116.4143	117.8526	(39)
Average = Sum(39)m / 12 =												115.5153	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.1983	1.1911	1.1552	1.1480	1.1121	1.1121	1.1050	1.1265	1.1480	1.1624	1.1768	(40)
HLP (average)												1.1534	(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													
	23.3936	20.7780	16.8978	12.7927	9.5627	8.0732	8.7234	11.3390	15.2192	19.3243	22.5543	24.0438	(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)													
	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													
	473.8806	471.6336	456.2811	431.4176	405.9538	381.5993	365.8974	372.2974	385.1772	410.2676	439.0954	460.9261	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	637.8653	775.3374	936.5720	1135.0522	1293.1453	1305.9492	1238.9358	1101.7324	941.7614	763.3832	639.9505	598.3902	(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	23.0428	23.1809	23.3207	24.0455	24.1959	24.9770	24.9770	25.1394	24.6586	24.1959	23.8969	23.6053	
alpha	2.5362	2.5454	2.5547	2.6030	2.6131	2.6651	2.6651	2.6760	2.6439	2.6131	2.5931	2.5737	
util living area													
	0.9624	0.9390	0.8922	0.7933	0.6516	0.4904	0.3747	0.4286	0.6535	0.8605	0.9434	0.9675	(86)
Tweekday	16.6471	17.1416	17.9149	18.8820	19.5236	19.8760	19.9612	19.9515	19.6957	18.8109	17.6126	16.6279	
Tweekend	19.4134	19.6342	19.9833	20.4251	20.7384	20.9155	20.9698	20.9568	20.8104	20.3782	19.8352	19.3992	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	18.5513	18.8873	19.4309	20.1023	20.5962	20.8702	20.9533	20.9334	20.7040	20.0403	19.1812	18.5294	(87)
Th 2	19.9156	19.9214	19.9271	19.9560	19.9618	19.9909	19.9909	19.9968	19.9793	19.9618	19.9502	19.9386	(88)
util rest of house													
	0.9567	0.9299	0.8762	0.7641	0.6050	0.4265	0.2958	0.3458	0.5900	0.8334	0.9336	0.9625	(89)
Tweekday	16.6471	17.1416	17.9149	18.8820	19.5236	19.8760	19.9612	19.9515	19.6957	18.8109	17.6126	16.6279	
Tweekend	16.6471	17.1416	17.9149	18.8820	19.5236	19.8760	19.9612	19.9515	19.6957	18.8109	17.6126	16.6279	
MIT 2	16.6471	17.1416	17.9149	18.8820	19.5236	19.8760	19.9612	19.9515	19.6957	18.8109	17.6126	16.6279	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	16.9897	17.4558	18.1877	19.1015	19.7166	20.0549	20.1398	20.1281	19.8771	19.0321	17.8949	16.9700	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.9897	17.4558	18.1877	19.1015	19.7166	20.0549	20.1398	20.1281	19.8771	19.0321	17.8949	16.9700	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9338	0.9012	0.8431	0.7364	0.5930	0.4308	0.3078	0.3571	0.5830	0.8032	0.9064	0.9417	(94)
Useful gains	595.6162	698.7117	789.5895	835.8689	766.8646	562.5700	381.3538	393.4123	549.0632	613.1128	580.0720	563.5266	(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													
	1532.0220	1506.8175	1394.2339	1180.2671	921.7172	607.5647	394.2577	412.5594	651.7666	969.4855	1256.6769	1504.9798	(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)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

696.6859	543.0471	449.8555	247.9667	115.2103	0.0000	0.0000	0.0000	0.0000	265.1413	487.1555	700.4412	(98)

Space heating 3505.5034 (98)
Space heating per m2 (98) / (4) = 35.0025 (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 %) 287.1313 (206)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)
Space heating requirement 1220.8713 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	696.6859	543.0471	449.8555	247.9667	115.2103	0.0000	0.0000	0.0000	0.0000	265.1413	487.1555	700.4412	(98)
Space heating efficiency (main heating system 1)													
	287.1313	287.1313	287.1313	287.1313	287.1313	0.0000	0.0000	0.0000	0.0000	287.1313	287.1313	287.1313	(210)
Space heating fuel (main heating system)													
	242.6367	189.1285	156.6724	86.3601	40.1246	0.0000	0.0000	0.0000	0.0000	92.3415	169.6630	243.9446	(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													
	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												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month													
	78.7458	69.4303	72.9725	65.4917	64.2353	57.4765	55.2760	60.5501	60.4104	67.9074	71.7086	76.8771	(219)
Water heating fuel used												801.0817	(219)

Annual totals kWh/year
Space heating fuel - main system 1220.8713 (211)
Space heating fuel - secondary 0.0000 (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)
Total electricity for the above, kWh/year 56.1702 (231)
Electricity for lighting (calculated in Appendix L) 413.1378 (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 1462.0742 (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	1220.8713	0.5190	633.6322	(261)
Space heating - secondary	0.0000	0.0190	0.0000	(263)
Water heating (other fuel)	801.0817	0.5190	415.7614	(264)
Space and water heating			1049.3936	(265)
Pumps and fans	56.1702	0.5190	29.1523	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total CO2, kg/year			758.8165	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			7.5800	(273)

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

DER		7.5800	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		24.6061	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		24.6061	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
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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                                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)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                   21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          55.1290    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)


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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)


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8c. Space cooling requirement
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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 (electricity)			1.5500	
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 * 1.55) + 2.1040 + 0.3887, rounded to 2 d.p.			27.0300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =		58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	120.4342	119.8230	119.2239	116.4101	115.8837	113.4329	113.4329	112.9791	114.3769	115.8837	116.9487	118.0621	(39)
Average = Sum(39)m / 12 =												116.4076	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2025	1.1964	1.1905	1.1624	1.1571	1.1326	1.1326	1.1281	1.1421	1.1571	1.1677	1.1789	(40)
HLP (average)												1.1623	(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 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													
	23.3936	20.7780	16.8978	12.7927	9.5627	8.0732	8.7234	11.3390	15.2192	19.3243	22.5543	24.0438	(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													
	390.3415	388.9224	375.2889	352.7624	328.8159	306.5978	292.7118	296.7851	308.8383	331.5098	357.6062	378.2114	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	554.3263	692.6261	855.5798	1056.3970	1216.0074	1230.9477	1165.7502	1026.2201	865.4224	684.6255	558.4614	515.6755	(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	23.0993	23.2171	23.3338	23.8978	24.0064	24.5250	24.5250	24.6235	24.3226	24.0064	23.7877	23.5634	
alpha	2.5400	2.5478	2.5556	2.5932	2.6004	2.6350	2.6350	2.6416	2.6215	2.6004	2.5858	2.5709	
util living area													
	0.9723	0.9516	0.9088	0.8160	0.6774	0.5192	0.4007	0.4612	0.6897	0.8858	0.9577	0.9766	(86)
MIT	18.4205	18.7702	19.3267	20.0292	20.5480	20.8442	20.9426	20.9166	20.6560	19.9346	19.0661	18.3863	(87)
Th 2	19.9180	19.9229	19.9276	19.9502	19.9545	19.9743	19.9743	19.9780	19.9666	19.9545	19.9459	19.9370	(88)
util rest of house													
	0.9679	0.9441	0.8948	0.7885	0.6312	0.4527	0.3164	0.3728	0.6269	0.8621	0.9499	0.9729	(89)
MIT 2	17.5626	17.9106	18.4581	19.1449	19.6181	19.8803	19.9493	19.9391	19.7368	19.0757	18.2229	17.5416	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.7169	18.0653	18.6144	19.3040	19.7855	20.0537	20.1280	20.1149	19.9022	19.2303	18.3746	17.6935	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7169	18.0653	18.6144	19.3040	19.7855	20.0537	20.1280	20.1149	19.9022	19.2303	18.3746	17.6935	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9556	0.9272	0.8734	0.7690	0.6231	0.4581	0.3295	0.3853	0.6225	0.8419	0.9345	0.9621	(94)
Useful gains	529.7175	642.1930	747.2566	812.4149	757.6717	563.9331	384.1581	395.3928	538.7279	576.3566	521.8689	496.1346	(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													
	1615.8588	1577.5037	1444.3213	1211.1311	936.9722	618.6305	400.1953	419.7105	663.6342	1000.1078	1318.5488	1593.0768	(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													
	808.0891	628.5288	518.6161	287.0757	133.3996	0.0000	0.0000	0.0000	0.0000	315.2709	573.6096	816.1250	(98)
Space heating												4080.7147	(98)
Space heating per m2											(98) / (4) =	40.7460	(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	1066.2694	839.4035	858.6409	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8423	0.8867	0.8552	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	898.1322	744.2856	734.3051	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1544.1233	1465.6622	1304.4996	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	465.1135	536.7042	424.2247	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											1426.0424	(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	116.2784	134.1761	106.0562	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											356.5106	(107)
Space cooling per m2											3.5598	(108)
Energy for space heating											40.7460	(99)
Energy for space cooling											3.5598	(108)
Total											44.3058	(109)
Dwelling Fabric Energy Efficiency (DFEE)											44.3	(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

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)

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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.7021	(36)
Total fabric heat loss	(33) + (36) =	63.4081	(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	111.3801	109.2225	109.2225	107.7842	107.7842	105.6267	106.3459	104.9075	104.6949	104.6949	104.9075	107.0650	(39)
Average = Sum(39)m / 12 =												106.9697	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1121	1.0906	1.0906	1.0762	1.0762	1.0547	1.0619	1.0475	1.0454	1.0454	1.0475	1.0690	(40)
HLP (average)												1.0681	(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)

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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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	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)													
	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													
	680.2322	675.3731	650.8959	612.8398	573.6507	538.7158	518.4134	527.4254	549.4301	587.7129	630.2660	662.6771	(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	0.5700	0.0000	0.7700	60.4266	(75)
Southeast	4.9500	41.5040	0.5700	0.0000	0.7700	90.1698	(77)
Southwest	0.6600	41.5040	0.5700	0.0000	0.7700	12.0226	(79)
Northwest	4.5000	13.3408	0.5700	0.0000	0.7700	26.3488	(81)

Solar gains	188.9678	300.8826	491.9802	736.6855	905.3568	1008.9077	947.5933	796.5417	607.2564	397.0709	229.8031	151.6106	(83)
Total gains	869.2000	976.2557	1142.8760	1349.5253	1479.0074	1547.6235	1466.0067	1323.9671	1156.6865	984.7838	860.0691	814.2877	(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	24.9770	25.4704	25.4704	25.8103	25.8103	26.3375	26.1594	26.5181	26.5719	26.5719	26.5181	25.9837	
alpha	2.6651	2.6980	2.6980	2.7207	2.7207	2.7558	2.7440	2.7679	2.7715	2.7715	2.7679	2.7322	
util living area													
	0.9185	0.8897	0.8190	0.6927	0.5377	0.3533	0.2426	0.2789	0.5052	0.7460	0.8784	0.9276	(86)
Tweekday	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	
Tweekend	19.8505	20.0294	20.3402	20.6649	20.8697	20.9719	20.9930	20.9899	20.9225	20.6639	20.2476	19.8510	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.2259	19.4986	19.9818	20.4768	20.7989	20.9568	20.9892	20.9844	20.8790	20.4813	19.8251	19.2267	(87)
Th 2	19.9909	20.0085	20.0085	20.0203	20.0203	20.0380	20.0321	20.0439	20.0457	20.0457	20.0439	20.0262	(88)
util rest of house													
	0.9074	0.8753	0.7960	0.6573	0.4889	0.2950	0.1752	0.2073	0.4411	0.7076	0.8603	0.9177	(89)
Tweekday	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	
Tweekend	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	
MIT 2	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.9405	18.3194	18.9574	19.6070	19.9916	20.1761	20.2003	20.2067	20.1090	19.6375	18.7948	17.9595	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9405	18.3194	18.9574	19.6070	19.9916	20.1761	20.2003	20.2067	20.1090	19.6375	18.7948	17.9595	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8777	0.8446	0.7677	0.6410	0.4874	0.3035	0.1870	0.2197	0.4456	0.6891	0.8313	0.8900	(94)
Useful gains	762.9130	824.5695	877.3739	865.0984	720.8207	469.7309	274.2157	290.8609	515.3992	678.6312	714.9613	724.7524	(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													
	1441.3144	1400.1708	1273.2494	1067.8161	796.6986	483.3576	276.5282	294.4435	555.8279	872.8983	1153.4368	1398.2198	(97)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	504.7306	386.8041	294.5313	145.9568	56.4532	0.0000	0.0000	0.0000	0.0000	144.5347	315.7023	501.0598	(98)
Space heating												2349.7727	(98)
RHI space heating demand												2350	(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	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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.7021	(36)
Total fabric heat loss (33) + (36) =	63.4081	(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	120.7293	120.0101	119.2910	115.6951	114.9759	111.3801	111.3801	110.6609	112.8184	114.9759	116.4143	117.8526	(39)

Average = Sum(39)m / 12 =	115.5153 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.1983	1.1911	1.1552	1.1480	1.1121	1.1121	1.1050	1.1265	1.1480	1.1624	1.1768	(40)
HLP (average)												1.1534	(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)

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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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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	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)													
	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													
	680.2322	675.3731	650.8959	612.8398	573.6507	538.7158	518.4134	527.4254	549.4301	587.7129	630.2660	662.6771	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	844.2169	979.0769	1131.1867	1316.4744	1460.8422	1463.0657	1391.4518	1256.8604	1106.0142	940.8286	831.1212	800.1413	(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	23.0428	23.1809	23.3207	24.0455	24.1959	24.9770	24.9770	25.1394	24.6586	24.1959	23.8969	23.6053	
alpha	2.5362	2.5454	2.5547	2.6030	2.6131	2.6651	2.6651	2.6760	2.6439	2.6131	2.5931	2.5737	
util living area													
	0.9330	0.9040	0.8499	0.7443	0.6036	0.4476	0.3377	0.3827	0.5897	0.8034	0.9049	0.9398	(86)
Tweekday	17.0815	17.5302	18.2188	19.0645	19.6042	19.9002	19.9682	19.9630	19.7650	19.0415	17.9825	17.0659	
Tweekend	19.6100	19.8123	20.1264	20.5164	20.7835	20.9323	20.9765	20.9672	20.8533	20.4923	20.0055	19.5969	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	18.8547	19.1628	19.6517	20.2449	20.6659	20.8960	20.9637	20.9494	20.7709	20.2165	19.4471	18.8345	(87)
Th 2	19.9156	19.9214	19.9271	19.9560	19.9618	19.9909	19.9909	19.9968	19.9793	19.9618	19.9502	19.9386	(88)
util rest of house													
	0.9236	0.8909	0.8297	0.7120	0.5566	0.3870	0.2653	0.3066	0.5262	0.7700	0.8899	0.9313	(89)
Tweekday	17.0815	17.5302	18.2188	19.0645	19.6042	19.9002	19.9682	19.9630	19.7650	19.0415	17.9825	17.0659	
Tweekend	17.0815	17.5302	18.2188	19.0645	19.6042	19.9002	19.9682	19.9630	19.7650	19.0415	17.9825	17.0659	
MIT 2	17.0815	17.5302	18.2188	19.0645	19.6042	19.9002	19.9682	19.9630	19.7650	19.0415	17.9825	17.0659	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.4005	17.8240	18.4766	19.2769	19.7952	20.0793	20.1473	20.1405	19.9460	19.2529	18.2460	17.3841	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4005	17.8240	18.4766	19.2769	19.7952	20.0793	20.1473	20.1405	19.9460	19.2529	18.2460	17.3841	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8936	0.8578	0.7966	0.6884	0.5486	0.3925	0.2768	0.3178	0.5240	0.7431	0.8581	0.9031	(94)
Useful gains	754.3702	839.8963	901.1559	906.2667	801.3732	574.2266	385.1293	399.4719	579.5046	699.1384	713.2156	722.5719	(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													
	1581.6187	1551.0057	1428.7041	1200.5557	930.7551	610.2903	395.1015	413.9274	659.5387	994.8791	1297.5525	1553.7828	(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)

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Space heating kWh

615.4729	477.8656	392.4959	211.8881	96.2601	0.0000	0.0000	0.0000	0.0000	220.0310	420.7226	618.4210 (98)

Space heating 3053.1572 (98)
Space heating per m2 (98) / (4) = 30.4858 (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 %) 287.1313 (206)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)
Space heating requirement 1063.3314 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	615.4729	477.8656	392.4959	211.8881	96.2601	0.0000	0.0000	0.0000	0.0000	220.0310	420.7226	618.4210	(98)
Space heating efficiency (main heating system 1)													
	287.1313	287.1313	287.1313	287.1313	287.1313	0.0000	0.0000	0.0000	0.0000	287.1313	287.1313	287.1313	(210)
Space heating fuel (main heating system)													
	214.3524	166.4276	136.6956	73.7949	33.5248	0.0000	0.0000	0.0000	0.0000	76.6308	146.5262	215.3792	(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													
	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												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month													
	78.7458	69.4303	72.9725	65.4917	64.2353	57.4765	55.2760	60.5501	60.4104	67.9074	71.7086	76.8771	(219)
Water heating fuel used												801.0817	(219)

Annual totals kWh/year
Space heating fuel - main system 1063.3314 (211)
Space heating fuel - secondary 0.0000 (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)
Total electricity for the above, kWh/year 56.1702 (231)
Electricity for lighting (calculated in Appendix L) 413.1378 (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 1304.5343 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1063.3314	13.1900	140.2534	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	801.0817	13.1900	105.6627	(247)
Mechanical ventilation fans	56.1702	13.1900	7.4088	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	413.1378	13.1900	54.4929	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1029.1867	13.1900	-135.7497	(252)
Total energy cost			172.0681	(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] = 0.4979 (257)
SAP value 93.0544
SAP rating (Section 12) 93 (258)
SAP band A

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	1063.3314	0.5190	551.8690	(261)
Space heating - secondary	0.0000	0.0190	0.0000	(263)
Water heating (other fuel)	801.0817	0.5190	415.7614	(264)
Space and water heating			967.6304	(265)
Pumps and fans	56.1702	0.5190	29.1523	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total kg/year			677.0533	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	6.7600 (273)
EI value	93.7496
EI rating	94 (274)
EI band	A

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 2.8713 = 4.594, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.8713 = 0.1808, stars = 5
Water heating energy efficiency	13.19 / 2.7351 = 4.823, stars = 4
Water heating environmental impact	0.519 / 2.7351 = 0.1898, stars = 5

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)
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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	111.3801	109.2225	109.2225	107.7842	107.7842	105.6267	106.3459	104.9075	104.6949	104.6949	104.9075	107.0650	(39)
Average = Sum(39)m / 12 =												106.9697	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1121	1.0906	1.0906	1.0762	1.0762	1.0547	1.0619	1.0475	1.0454	1.0454	1.0475	1.0690	(40)
HLP (average)												1.0681	(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 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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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	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)													
	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													
	680.2322	675.3731	650.8959	612.8398	573.6507	538.7158	518.4134	527.4254	549.4301	587.7129	630.2660	662.6771	(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	0.5700	0.0000	0.7700	60.4266	(75)
Southeast	4.9500	41.5040	0.5700	0.0000	0.7700	90.1698	(77)
Southwest	0.6600	41.5040	0.5700	0.0000	0.7700	12.0226	(79)
Northwest	4.5000	13.3408	0.5700	0.0000	0.7700	26.3488	(81)

Solar gains	188.9678	300.8826	491.9802	736.6855	905.3568	1008.9077	947.5933	796.5417	607.2564	397.0709	229.8031	151.6106	(83)
Total gains	869.2000	976.2557	1142.8760	1349.5253	1479.0074	1547.6235	1466.0067	1323.9671	1156.6865	984.7838	860.0691	814.2877	(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	24.9770	25.4704	25.4704	25.8103	25.8103	26.3375	26.1594	26.5181	26.5719	26.5719	26.5181	25.9837	
alpha	2.6651	2.6980	2.6980	2.7207	2.7207	2.7558	2.7440	2.7679	2.7715	2.7715	2.7679	2.7322	
util living area													
	0.9185	0.8897	0.8190	0.6927	0.5377	0.3533	0.2426	0.2789	0.5052	0.7460	0.8784	0.9276	(86)
Tweekday	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	
Tweekend	19.8505	20.0294	20.3402	20.6649	20.8697	20.9719	20.9930	20.9899	20.9225	20.6639	20.2476	19.8510	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.2259	19.4986	19.9818	20.4768	20.7989	20.9568	20.9892	20.9844	20.8790	20.4813	19.8251	19.2267	(87)
Th 2	19.9909	20.0085	20.0085	20.0203	20.0203	20.0380	20.0321	20.0439	20.0457	20.0457	20.0439	20.0262	(88)
util rest of house													
	0.9074	0.8753	0.7960	0.6573	0.4889	0.2950	0.1752	0.2073	0.4411	0.7076	0.8603	0.9177	(89)
Tweekday	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	
Tweekend	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	
MIT 2	17.6585	18.0607	18.7326	19.4161	19.8145	20.0048	20.0272	20.0361	19.9401	19.4524	18.5687	17.6815	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.9405	18.3194	18.9574	19.6070	19.9916	20.1761	20.2003	20.2067	20.1090	19.6375	18.7948	17.9595	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9405	18.3194	18.9574	19.6070	19.9916	20.1761	20.2003	20.2067	20.1090	19.6375	18.7948	17.9595	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8777	0.8446	0.7677	0.6410	0.4874	0.3035	0.1870	0.2197	0.4456	0.6891	0.8313	0.8900	(94)
Useful gains	762.9130	824.5695	877.3739	865.0984	720.8207	469.7309	274.2157	290.8609	515.3992	678.6312	714.9613	724.7524	(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													
	1441.3144	1400.1708	1273.2494	1067.8161	796.6986	483.3576	276.5282	294.4435	555.8279	872.8983	1153.4368	1398.2198	(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)

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Space heating kWh

	504.7306	386.8041	294.5313	145.9568	56.4532	0.0000	0.0000	0.0000	0.0000	144.5347	315.7023	501.0598 (98)
Space heating												2349.7727 (98)
Space heating per m2											(98) / (4) =	23.4625 (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 %)	291.0885 (206)
Efficiency of secondary/supplementary heating system, %	65.0000 (208)
Space heating requirement	807.2366 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	504.7306	386.8041	294.5313	145.9568	56.4532	0.0000	0.0000	0.0000	0.0000	144.5347	315.7023	501.0598	(98)
Space heating efficiency (main heating system 1)													
	291.0885	291.0885	291.0885	291.0885	291.0885	0.0000	0.0000	0.0000	0.0000	291.0885	291.0885	291.0885	(210)
Space heating fuel (main heating system)													
	173.3942	132.8820	101.1828	50.1417	19.3938	0.0000	0.0000	0.0000	0.0000	49.6532	108.4558	172.1332	(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													
	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												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month													
	78.7458	69.4303	72.9725	65.4917	64.2353	57.4765	55.2760	60.5501	60.4104	67.9074	71.7086	76.8771	(219)
Water heating fuel used												801.0817	(219)
Annual totals kWh/year													
Space heating fuel - main system												807.2366	(211)
Space heating fuel - secondary												0.0000	(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)
Total electricity for the above, kWh/year												56.1702	(231)
Electricity for lighting (calculated in Appendix L)												413.1378	(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												981.7899	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	807.2366	19.4400	156.9268	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	801.0817	19.4400	155.7303	(247)
Mechanical ventilation fans	56.1702	19.4400	10.9195	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	413.1378	19.4400	80.3140	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1095.8363	19.4400	-213.0306	(252)
Total energy cost			190.8600	(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	807.2366	0.5190	418.9558	(261)
Space heating - secondary	0.0000	0.0190	0.0000	(263)
Water heating (other fuel)	801.0817	0.5190	415.7614	(264)
Space and water heating			834.7172	(265)
Pumps and fans	56.1702	0.5190	29.1523	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	0.5190	-568.7390	(269)
Total kg/year			509.5490	(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	807.2366	3.0700	2478.2164	(261)
Space heating - secondary	0.0000	1.0400	0.0000	(263)
Water heating (other fuel)	801.0817	3.0700	2459.3207	(264)

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

Space and water heating			4937.5371 (265)
Pumps and fans	56.1702	3.0700	172.4424 (267)
Energy for lighting	413.1378	3.0700	1268.3330 (268)
Energy saving/generation technologies			
PV Unit	-1095.8363	3.0700	-3364.2174 (269)
Primary energy kWh/year			3014.0951 (272)
Primary energy kWh/m2/year			30.0958 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 93
Current environmental impact rating: A 94

(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	+ 1.5	-£ 58	-154 kg (30.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£58	1.54 kg/m²	A 95	A 95
Total Savings	£58	1.54 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 493 TEST (31 Mar 2022)
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	£404	£346	£58
Space heating	£168	£168	-£0
Water heating	£156	£98	£58
Lighting	£80	£80	£0
Generated (PV)	-£213	-£213	£0
Total cost of fuels	£191	£133	£58
Total cost of uses	£191	£133	£58
Delivered energy	10 kWh/m²	7 kWh/m²	3 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	4 kg/m²	2 kg/m²
Primary energy	30 kWh/m²	21 kWh/m²	9 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)

	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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	120.7293	120.0101	119.2910	115.6951	114.9759	111.3801	111.3801	110.6609	112.8184	114.9759	116.4143	117.8526	(39)
Average = Sum(39)m / 12 =												115.5153	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.1983	1.1911	1.1552	1.1480	1.1121	1.1121	1.1050	1.1265	1.1480	1.1624	1.1768	(40)
HLP (average)												1.1534	(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													
	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	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													
	215.3738	189.8954	198.1876	172.3694	162.8924	144.5942	138.1556	153.5112	159.8226	184.3343	196.1267	210.2628	(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												75.0000	(H13)
Daily hot water demand												99.2966	(H14)
Volume ratio Veff/V												0.7553	(H15)
Solar storage volume factor												0.9439	(H16)
Solar input												-869.1699	(H17)
Solar input	-25.2042	-42.0586	-71.6305	-95.9990	-118.5987	-116.6014	-115.0605	-100.5289	-78.7343	-53.7663	-29.8958	-21.0916	(63)
											Solar input (sum of months) = Sum(63)m =	-869.1699	(63)
Output from w/h													
	190.1696	147.8369	126.5570	76.3704	44.2937	27.9928	23.0951	52.9823	81.0883	130.5680	166.2309	189.1712	(64)
											Total per year (kWh/year) = Sum(64)m =	1256.3561	(64)
Heat gains from water heating, kWh/month													
	96.5737	85.6864	90.2067	78.3122	73.1423	66.3406	64.8085	70.3493	74.7718	85.6005	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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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	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)													
	129.8033	127.5096	121.2456	108.7669	98.3095	92.1397	87.1082	94.5555	103.8498	115.0545	124.1233	127.5192	(72)
Total internal gains													
	680.2322	675.3731	649.3951	605.3358	559.8933	524.7083	504.4059	514.4185	543.4269	586.2121	630.2660	662.6771	(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	0.5700	0.0000	0.7700	51.1055	(75)
Southeast	4.9500	36.7938	0.5700	0.0000	0.7700	79.9366	(77)
Southwest	0.6600	36.7938	0.5700	0.0000	0.7700	10.6582	(79)
Northwest	4.5000	11.2829	0.5700	0.0000	0.7700	22.2844	(81)

Solar gains	163.9847	303.7037	480.2908	703.6346	887.1915	924.3499	873.0384	729.4350	556.5841	353.1156	200.8552	137.4642	(83)
Total gains	844.2169	979.0769	1129.6859	1308.9704	1447.0848	1449.0582	1377.4443	1243.8535	1100.0110	939.3278	831.1212	800.1413	(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	23.0428	23.1809	23.3207	24.0455	24.1959	24.9770	24.9770	25.1394	24.6586	24.1959	23.8969	23.6053	
alpha	2.5362	2.5454	2.5547	2.6030	2.6131	2.6651	2.6651	2.6760	2.6439	2.6131	2.5931	2.5737	
util living area													
	0.9330	0.9040	0.8502	0.7463	0.6073	0.4512	0.3409	0.3862	0.5919	0.8039	0.9049	0.9398	(86)
Tweekday	17.0815	17.5302	18.2167	19.0577	19.5983	19.8983	19.9677	19.9622	19.7629	19.0398	17.9825	17.0659	
Tweekend	19.6100	19.8123	20.1254	20.5130	20.7802	20.9310	20.9760	20.9665	20.8519	20.4915	20.0055	19.5969	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	18.8547	19.1628	19.6502	20.2395	20.6608	20.8940	20.9629	20.9483	20.7688	20.2152	19.4471	18.8345	(87)
Th 2	19.9156	19.9214	19.9271	19.9560	19.9618	19.9909	19.9909	19.9968	19.9793	19.9618	19.9502	19.9386	(88)
util rest of house													
	0.9236	0.8909	0.8301	0.7141	0.5604	0.3902	0.2678	0.3095	0.5283	0.7705	0.8899	0.9313	(89)
Tweekday	17.0815	17.5302	18.2167	19.0577	19.5983	19.8983	19.9677	19.9622	19.7629	19.0398	17.9825	17.0659	
Tweekend	17.0815	17.5302	18.2167	19.0577	19.5983	19.8983	19.9677	19.9622	19.7629	19.0398	17.9825	17.0659	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.0815	17.5302	18.2167	19.0577	19.5983	19.8983	19.9677	19.9622	19.7629	19.0398	17.9825	17.0659	(90)
Living area fraction										fLA = Living area / (4) =		0.1799	(91)
MIT	17.4005	17.8240	18.4746	19.2704	19.7895	20.0775	20.1467	20.1396	19.9439	19.2513	18.2460	17.3841	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4005	17.8240	18.4746	19.2704	19.7895	20.0775	20.1467	20.1396	19.9439	19.2513	18.2460	17.3841	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8936	0.8578	0.7970	0.6903	0.5520	0.3956	0.2794	0.3208	0.5260	0.7436	0.8581	0.9031	(94)
Useful gains	754.3702	839.8963	900.3588	903.6080	798.8274	573.3189	384.8341	399.0458	578.5525	698.4851	713.2156	722.5719	(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	1581.6187	1551.0057	1428.4596	1199.7999	930.0968	610.0798	395.0358	413.8318	659.2998	994.6890	1297.5525	1553.7828	(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	615.4729	477.8656	392.9070	213.2582	97.6645	0.0000	0.0000	0.0000	0.0000	220.3757	420.7226	618.4210	(98)
Space heating												3056.6874	(98)
Space heating per m2											(98) / (4) =	30.5211	(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 %)												287.1313	(206)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
Space heating requirement												1064.5609	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	615.4729	477.8656	392.9070	213.2582	97.6645	0.0000	0.0000	0.0000	0.0000	220.3757	420.7226	618.4210	(98)
Space heating efficiency (main heating system 1)	287.1313	287.1313	287.1313	287.1313	287.1313	0.0000	0.0000	0.0000	0.0000	287.1313	287.1313	287.1313	(210)
Space heating fuel (main heating system)	214.3524	166.4276	136.8388	74.2720	34.0139	0.0000	0.0000	0.0000	0.0000	76.7509	146.5262	215.3792	(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	190.1696	147.8369	126.5570	76.3704	44.2937	27.9928	23.0951	52.9823	81.0883	130.5680	166.2309	189.1712	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	69.5306	54.0527	46.2723	27.9229	16.1948	10.2348	8.4441	19.3716	29.6478	47.7388	60.7780	69.1655	(219)
Water heating fuel used												459.3540	(219)
Annual totals kWh/year													
Space heating fuel - main system												1064.5609	(211)
Space heating fuel - secondary												0.0000	(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)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												106.1702	(231)
Electricity for lighting (calculated in Appendix L)												413.1378	(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												1014.0361	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1064.5609	13.1900	140.4156	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	459.3540	13.1900	60.5888	(247)
Mechanical ventilation fans	56.1702	13.1900	7.4088	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	413.1378	13.1900	54.4929	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1029.1867	13.1900	-135.7497	(252)
Total energy cost			133.7514	(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] =	0.3870	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	94.6011	
SAP rating (Section 12)	95	(258)
SAP band	A	

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	1064.5609	0.5190	552.5071	(261)
Space heating - secondary	0.0000	0.0190	0.0000	(263)
Water heating (other fuel)	459.3540	0.5190	238.4047	(264)
Space and water heating			790.9118	(265)
Pumps and fans	106.1702	0.5190	55.1023	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1029.1867	0.5190	-534.1479	(269)
Total kg/year			526.2847	(272)
CO2 emissions per m2			5.2500	(273)
EI value			95.1414	
EI rating			95	(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 = 1.00)			20.4300	0.9615	19.6442			(27)
Heat Loss Floor 1			50.5800	0.0800	4.0464			(28a)
External Wall 1	147.9800	22.5500	125.4300	0.2300	28.8489			(29a)
External Roof 1	50.5800		50.5800	0.0800	4.0464			(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) =	58.7059			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7021	(36)
Total fabric heat loss					(33) + (36) =		63.4081	(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	111.3801	109.2225	109.2225	107.7842	107.7842	105.6267	106.3459	104.9075	104.6949	104.6949	104.9075	107.0650	(39)
Average = Sum(39)m / 12 =												106.9697	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1121	1.0906	1.0906	1.0762	1.0762	1.0547	1.0619	1.0475	1.0454	1.0454	1.0475	1.0690	(40)
HLP (average)												1.0681	(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													
	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	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													
	215.3738	189.8954	198.1876	172.3694	162.8924	144.5942	138.1556	153.5112	159.8226	184.3343	196.1267	210.2628	(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												75.0000	(H13)
Daily hot water demand												99.2966	(H14)
Volume ratio Veff/V												0.7553	(H15)
Solar storage volume factor												0.9439	(H16)
Solar input												-887.8573	(H17)
Solar input	-27.9880	-39.9964	-70.0352	-95.5686	-115.0380	-121.0480	-118.7419	-104.3351	-81.8342	-57.9079	-32.9256	-22.4385	(63)
											Solar input (sum of months) = Sum(63)m =	-887.8573	(63)
Output from w/h													
	187.3858	149.8990	128.1524	76.8008	47.8544	23.5463	19.4136	49.1761	77.9884	126.4264	163.2011	187.8243	(64)
											Total per year (kWh/year) = Sum(64)m =	1237.6687	(64)
Heat gains from water heating, kWh/month													
	96.5737	85.6864	90.2067	78.3122	73.1423	66.3406	64.8085	70.3493	74.7718	85.6005	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													
	58.4839	51.9449	42.2444	31.9818	23.9067	20.1831	21.8085	28.3475	38.0480	48.3107	56.3857	60.1094	(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	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)													
	129.8033	127.5096	121.2456	108.7669	98.3095	92.1397	87.1082	94.5555	103.8498	115.0545	124.1233	127.5192	(72)
Total internal gains													
	680.2322	675.3731	649.3951	605.3358	559.8933	524.7083	504.4059	514.4185	543.4269	586.2121	630.2660	662.6771	(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	0.5700	0.0000	0.7700	60.4266	(75)
Southeast	4.9500	41.5040	0.5700	0.0000	0.7700	90.1698	(77)
Southwest	0.6600	41.5040	0.5700	0.0000	0.7700	12.0226	(79)
Northwest	4.5000	13.3408	0.5700	0.0000	0.7700	26.3488	(81)

Solar gains	188.9678	300.8826	491.9802	736.6855	905.3568	1008.9077	947.5933	796.5417	607.2564	397.0709	229.8031	151.6106	(83)
Total gains	869.2000	976.2557	1141.3752	1342.0213	1465.2501	1533.6160	1451.9992	1310.9602	1150.6833	983.2830	860.0691	814.2877	(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	24.9770	25.4704	25.4704	25.8103	25.8103	26.3375	26.1594	26.5181	26.5719	26.5719	26.5181	25.9837	
alpha	2.6651	2.6980	2.6980	2.7207	2.7207	2.7558	2.7440	2.7679	2.7715	2.7715	2.7679	2.7322	
util living area													
	0.9185	0.8897	0.8194	0.6949	0.5414	0.3562	0.2449	0.2815	0.5072	0.7466	0.8784	0.9276	(86)
Tweekday	17.6585	18.0607	18.7307	19.4108	19.8107	20.0041	20.0271	20.0359	19.9389	19.4511	18.5687	17.6815	
Tweekend	19.8505	20.0294	20.3393	20.6622	20.8674	20.9713	20.9928	20.9896	20.9217	20.6632	20.2476	19.8510	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.2259	19.4986	19.9803	20.4725	20.7953	20.9559	20.9890	20.9840	20.8777	20.4803	19.8251	19.2267	(87)
Th 2	19.9909	20.0085	20.0085	20.0203	20.0203	20.0380	20.0321	20.0439	20.0457	20.0457	20.0439	20.0262	(88)
util rest of house													
	0.9074	0.8753	0.7965	0.6595	0.4925	0.2975	0.1768	0.2093	0.4431	0.7081	0.8603	0.9177	(89)
Tweekday	17.6585	18.0607	18.7307	19.4108	19.8107	20.0041	20.0271	20.0359	19.9389	19.4511	18.5687	17.6815	
Tweekend	17.6585	18.0607	18.7307	19.4108	19.8107	20.0041	20.0271	20.0359	19.9389	19.4511	18.5687	17.6815	

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

MIT 2	17.6585	18.0607	18.7307	19.4108	19.8107	20.0041	20.0271	20.0359	19.9389	19.4511	18.5687	17.6815 (90)
Living area fraction										fLA = Living area / (4) =		0.1799 (91)
MIT	17.9405	18.3194	18.9556	19.6019	19.9879	20.1753	20.2001	20.2065	20.1078	19.6363	18.7948	17.9595 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9405	18.3194	18.9556	19.6019	19.9879	20.1753	20.2001	20.2065	20.1078	19.6363	18.7948	17.9595 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8777	0.8446	0.7681	0.6431	0.4908	0.3061	0.1888	0.2218	0.4474	0.6897	0.8313	0.8900	(94)
Useful gains	762.9130	824.5695	876.6702	863.0000	719.1276	469.3651	274.1441	290.7486	514.8600	678.1223	714.9613	724.7524	(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	1441.3144	1400.1708	1273.0492	1067.2655	796.2943	483.2781	276.5128	294.4194	555.7045	872.7642	1153.4368	1398.2198	(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	504.7306	386.8041	294.9059	147.0711	57.4120	0.0000	0.0000	0.0000	0.0000	144.8135	315.7023	501.0598	(98)
Space heating												2352.4993	(98)
Space heating per m2											(98) / (4) =	23.4898	(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 %)	291.0885	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	808.1733	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	504.7306	386.8041	294.9059	147.0711	57.4120	0.0000	0.0000	0.0000	0.0000	144.8135	315.7023	501.0598	(98)
Space heating efficiency (main heating system 1)	291.0885	291.0885	291.0885	291.0885	291.0885	0.0000	0.0000	0.0000	0.0000	291.0885	291.0885	291.0885	(210)
Space heating fuel (main heating system)	173.3942	132.8820	101.3114	50.5246	19.7232	0.0000	0.0000	0.0000	0.0000	49.7490	108.4558	172.1332	(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	187.3858	149.8990	128.1524	76.8008	47.8544	23.5463	19.4136	49.1761	77.9884	126.4264	163.2011	187.8243	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	68.5128	54.8067	46.8556	28.0802	17.4967	8.6091	7.0981	17.9800	28.5144	46.2245	59.6702	68.6731	(219)
Water heating fuel used												452.5214	(219)
Annual totals kWh/year													
Space heating fuel - main system												808.1733	(211)
Space heating fuel - secondary												0.0000	(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)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												106.1702	(231)
Electricity for lighting (calculated in Appendix L)												413.1378	(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												684.1664	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	808.1733	19.4400	157.1089	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	452.5214	19.4400	87.9702	(247)
Mechanical ventilation fans	56.1702	19.4400	10.9195	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	413.1378	19.4400	80.3140	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1095.8363	19.4400	-213.0306	(252)
Total energy cost			133.0019	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

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

Space heating - main system 1	808.1733	0.5190	419.4420	(261)
Space heating - secondary	0.0000	0.0190	0.0000	(263)
Water heating (other fuel)	452.5214	0.5190	234.8586	(264)
Space and water heating			654.3006	(265)
Pumps and fans	106.1702	0.5190	55.1023	(267)
Energy for lighting	413.1378	0.5190	214.4185	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	0.5190	-568.7390	(269)
Total kg/year			355.0824	(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	808.1733	3.0700	2481.0921	(261)
Space heating - secondary	0.0000	1.0400	0.0000	(263)
Water heating (other fuel)	452.5214	3.0700	1389.2407	(264)
Space and water heating			3870.3328	(265)
Pumps and fans	106.1702	3.0700	325.9424	(267)
Energy for lighting	413.1378	3.0700	1268.3330	(268)
Energy saving/generation technologies				
PV Unit	-1095.8363	3.0700	-3364.2174	(269)
Primary energy kWh/year			2100.3909	(272)
Primary energy kWh/m2/year			20.9724	(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	100.0
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	63.41	(37)
Summer heat loss coefficient	724.00	(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	0.5700	0.0000	0.9000	523.3027
South East	4.9500	119.9223	0.5700	0.0000	0.9000	304.5248
South West	0.6600	119.9223	0.5700	0.0000	0.9000	40.6033
North West	4.5000	98.8453	0.5700	0.0000	0.9000	228.1843
total:						1096.6151

	Jun	Jul	Aug	
Solar gains	1174	1097	937	(P4)
Internal gains	539	518	527	
Total summer gains	1712	1615	1464	(P5)
Summer gain/loss ratio	2.37	2.23	2.02	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.67	21.43	21.12	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

Property Reference	SECLISDEAN	**Issued on Date**	04/05/2022
Assessment Reference	Gas and Solar PV	**Prop Type Ref**	Dean
Property	Plot 30, Greatham, Hampshire, GU22		

SAP Rating	91 B	**DER**	9.44	**TER**	16.26
Environmental	92 A	**% DER<TER**	41.96		
CO_2 Emissions (t/year)	0.82	**DFEE**	35.81	**TFEE**	49.90
General Requirements Compliance	Pass	**% DFEE<TFEE**	28.23		

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 4.14r19

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 110 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) 16.26 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.44 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)35.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.09 (max. 0.25)	0.09 (max. 0.70)	OK
Roof	0.08 (max. 0.20)	0.08 (max. 0.35)	OK
Openings	1.00 (max. 2.00)	1.00 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 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: None

---

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): Slight 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

---

10 Key features

Party wall U-value	0.00 W/m²K
Roof U-value	0.08 W/m²K
Floor U-value	0.09 W/m²K
Door U-value	1.00 W/m²K
Window U-value	1.00 W/m²K
Thermal bridging y-value	0.036 W/m²K
Photovoltaic array	1.20 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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss	(33) + (36) = 53.6326	(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	47.1118	46.6313	46.1509	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	100.7444	100.2639	99.7835	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 =	99.2041 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9190	0.9147	0.9103	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9050	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:													
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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
								Total per year (kWh/year) = Sum(64)m =				2217.7597	(64)
Heat gains from water heating, kWh/month													
	97.4962	86.4933	92.1559	84.4410	84.0742	77.0270	75.7870	80.6655	79.7409	87.4708	90.1915	95.7677	(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	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9670	23.9519	19.4790	14.7468	11.0234	9.3064	10.0559	13.0711	17.5440	22.2761	25.9995	27.7165	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.0089	273.8212	266.7344	251.6477	232.6033	214.7043	202.7467	199.9345	207.0212	222.1080	241.1523	259.0513	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	131.0433	128.7103	123.8655	117.2791	113.0030	106.9820	101.8643	108.4214	110.7512	117.5683	125.2660	128.7200	(72)
Total internal gains													
	497.2072	494.6712	478.2668	451.8615	424.8176	399.1806	382.8548	389.6149	403.5043	430.1403	460.6057	483.6757	(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	0.5700	0.0000	0.7700	43.8259	(75)
Southwest	5.8100	36.7938	0.5700	0.0000	0.7700	93.8246	(79)

Solar gains	137.6505	249.0270	379.3961	534.9012	658.2905	679.5510	644.3310	548.2989	432.6207	285.6534	167.5246	116.0848	(83)
Total gains	634.8577	743.6982	857.6630	986.7627	1083.1081	1078.7316	1027.1857	937.9138	836.1249	715.7936	628.1303	599.7605	(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	30.2250	30.3698	30.5161	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0150	3.0247	3.0344	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area													
	0.9664	0.9459	0.9052	0.8204	0.6885	0.5328	0.4052	0.4559	0.6721	0.8693	0.9481	0.9710	(86)
MIT	19.1063	19.3838	19.8082	20.3107	20.6905	20.8967	20.9666	20.9516	20.7859	20.2764	19.6118	19.0772	(87)
Th 2	20.1514	20.1551	20.1588	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house													
	0.9617	0.9386	0.8925	0.7968	0.6494	0.4758	0.3345	0.3823	0.6179	0.8465	0.9399	0.9670	(89)
MIT 2	17.5920	17.9940	18.6034	19.3110	19.8174	20.0696	20.1426	20.1303	19.9492	19.2788	18.3347	17.5589	(90)
Living area fraction										fLA = Living area / (4) =		0.1409	(91)
MIT	17.8053	18.1898	18.7731	19.4518	19.9404	20.1861	20.2587	20.2460	20.0670	19.4193	18.5146	17.7727	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6553	18.0398	18.6231	19.3018	19.7904	20.0361	20.1087	20.0960	19.9170	19.2693	18.3646	17.6227	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9142	0.8634	0.7686	0.6302	0.4665	0.3294	0.3759	0.6000	0.8164	0.9159	0.9495	(94)
Useful gains	598.2329	679.8614	740.5025	758.4106	682.6187	503.2242	338.3880	352.5351	501.6966	584.3991	575.2783	569.4591	(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													
	1345.4700	1317.4452	1209.6843	1028.2276	799.7420	537.3629	346.8353	365.3486	575.0176	856.9717	1113.5136	1326.8466	(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													
	555.9443	428.4563	349.0713	194.2683	87.1397	0.0000	0.0000	0.0000	0.0000	202.7940	387.5295	563.4964	(98)
Space heating												2768.6997	(98)
Space heating per m2											(98) / (4) =	25.2572	(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)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3055.9599	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	555.9443	428.4563	349.0713	194.2683	87.1397	0.0000	0.0000	0.0000	0.0000	202.7940	387.5295	563.4964	(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)													
	613.6251	472.9098	385.2884	214.4241	96.1807	0.0000	0.0000	0.0000	0.0000	223.8345	427.7367	621.9607	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
Efficiency of water heater												79.9000	(216)
(217)m	87.3051	86.9909	86.3596	85.0986	83.1293	79.9000	79.9000	79.9000	79.9000	85.1165	86.6674	87.3903	(217)
Fuel for water heating, kWh/month													
	249.8689	221.0831	234.0070	213.0543	213.8614	199.0095	191.3111	209.6743	209.2247	220.8700	229.1531	243.6768	(219)
Water heating fuel used												2634.7941	(219)
Annual totals kWh/year													
Space heating fuel - main system												3055.9599	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												136.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1029 * 1.00) =										-988.0192		-988.0192	(233)
Total delivered energy for all uses												5315.4997	(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	3055.9599	0.2160	660.0873	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2634.7941	0.2160	569.1155	(264)
Space and water heating			1229.2029	(265)
Pumps and fans	136.5187	0.5190	70.8532	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-988.0192	0.5190	-512.7820	(269)
Total CO2, kg/year			1034.4459	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.4400	(273)

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

DER		9.4400	ZC1
Total Floor Area	TFA	109.6200	
Assumed number of occupants	N	2.8125	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.6501	ZC2
CO2 emissions from cooking, equation (L16)		1.7013	ZC3
Total CO2 emissions		25.7914	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		25.7914	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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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) =	0.1460	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3960	(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) =	0.3366	(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	0.4291	0.4207	0.4123	0.3702	0.3618	0.3197	0.3197	0.3113	0.3366	0.3618	0.3786	0.3955	(22b)
Effective ac	0.5921	0.5885	0.5850	0.5685	0.5655	0.5511	0.5511	0.5485	0.5566	0.5655	0.5717	0.5782	(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			54.8100	0.1300	7.1253			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.1800	15.8976			(29a)
External Roof 1	54.8100		54.8100	0.1300	7.1253			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7038			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2595	(36)
Total fabric heat loss					(33) + (36) =		61.9633	(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	53.5449	53.2216	52.9047	51.4160	51.1375	49.8410	49.8410	49.6009	50.3404	51.1375	51.7010	52.2900	(38)
Heat transfer coeff	115.5082	115.1849	114.8680	113.3793	113.1008	111.8043	111.8043	111.5642	112.3037	113.1008	113.6643	114.2533	(39)
Average = Sum(39)m / 12 =												113.3780	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0537	1.0508	1.0479	1.0343	1.0318	1.0199	1.0199	1.0177	1.0245	1.0318	1.0369	1.0423	(40)
HLP (average)												1.0343	(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												2.8125	(42)
Average daily hot water use (litres/day)												100.9975	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(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)

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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													
	216.5006	190.8337	200.4396	179.7115	176.1337	157.4139	151.2097	165.8820	165.5759	186.3490	197.0064	211.3020	(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													
	216.5006	190.8337	200.4396	179.7115	176.1337	157.4139	151.2097	165.8820	165.5759	186.3490	197.0064	211.3020	(64)
								Total per year (kWh/year) = Sum(64)m =				2198.3581	(64)
Heat gains from water heating, kWh/month													
	96.1780	85.3026	90.8377	83.1652	82.7560	75.7513	74.4688	79.3473	78.4651	86.1526	88.9158	94.4495	(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	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.1813	23.2540	18.9114	14.3172	10.7022	9.0353	9.7629	12.6903	17.0328	21.6271	25.2420	26.9090	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.0089	273.8212	266.7344	251.6477	232.6033	214.7043	202.7467	199.9345	207.0212	222.1080	241.1523	259.0513	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	129.2715	126.9384	122.0937	115.5073	111.2312	105.2101	100.0924	106.6496	108.9794	115.7965	123.4941	126.9482	(72)
Total internal gains													
	494.6496	492.2015	475.9274	449.6600	422.7246	397.1376	380.7899	387.4622	401.2212	427.7194	458.0763	481.0963	(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	590.4978	665.6029	740.1070	822.1202	881.1026	870.3197	829.4478	769.2514	702.4619	626.6243	574.7264	561.9280	(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	65.9044	66.0894	66.2717	67.1419	67.3072	68.0877	68.0877	68.2343	67.7849	67.3072	66.9736	66.6283	
alpha	5.3936	5.4060	5.4181	5.4761	5.4871	5.5392	5.5392	5.5490	5.5190	5.4871	5.4649	5.4419	
util living area													
	0.9988	0.9975	0.9931	0.9748	0.9101	0.7537	0.5793	0.6419	0.8849	0.9850	0.9975	0.9991	(86)
MIT	19.8322	19.9612	20.1876	20.5007	20.7811	20.9477	20.9899	20.9829	20.8656	20.5105	20.1194	19.8132	(87)
Th 2	20.0388	20.0412	20.0436	20.0549	20.0570	20.0668	20.0668	20.0686	20.0630	20.0570	20.0527	20.0483	(88)
util rest of house													
	0.9984	0.9966	0.9906	0.9647	0.8739	0.6695	0.4636	0.5244	0.8257	0.9773	0.9964	0.9988	(89)
MIT 2	18.4699	18.6602	18.9918	19.4503	19.8323	20.0301	20.0628	20.0610	19.9478	19.4706	18.9001	18.4490	(90)
Living area fraction										fLA = Living area / (4) =		0.1409	(91)
MIT	18.6618	18.8434	19.1603	19.5983	19.9660	20.1594	20.1934	20.1909	20.0771	19.6171	19.0719	18.6412	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6618	18.8434	19.1603	19.5983	19.9660	20.1594	20.1934	20.1909	20.0771	19.6171	19.0719	18.6412	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9950	0.9872	0.9583	0.8698	0.6786	0.4798	0.5407	0.8267	0.9722	0.9948	0.9981	(94)
Useful gains	589.0486	662.2588	730.6275	787.8768	766.3488	590.6060	397.9881	415.8997	580.7423	609.1952	571.7263	560.8721	(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													
	1658.9019	1606.0745	1454.2582	1212.9657	934.8867	621.5596	401.7572	422.9267	671.2500	1019.8390	1360.7736	1649.9530	(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													
	795.9709	634.2442	538.3812	306.0640	125.3922	0.0000	0.0000	0.0000	0.0000	305.5190	568.1140	810.2762	(98)
Space heating												4083.9616	(98)
Space heating per m2											(98) / (4) =	37.2556	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4367.8734	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	795.9709	634.2442	538.3812	306.0640	125.3922	0.0000	0.0000	0.0000	0.0000	305.5190	568.1140	810.2762	(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)													
	851.3057	678.3360	575.8088	327.3412	134.1093	0.0000	0.0000	0.0000	0.0000	326.7583	607.6086	866.6055	(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													
	216.5006	190.8337	200.4396	179.7115	176.1337	157.4139	151.2097	165.8820	165.5759	186.3490	197.0064	211.3020	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9775	87.7778	87.3234	86.2230	83.9265	79.8000	79.8000	79.8000	79.8000	86.1249	87.4798	88.0578	(217)
Fuel for water heating, kWh/month													
	246.0863	217.4056	229.5370	208.4265	209.8666	197.2606	189.4859	207.8722	207.4886	216.3706	225.2022	239.9583	(219)
Water heating fuel used												2594.9603	(219)
Annual totals kWh/year													
Space heating fuel - main system												4367.8734	(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)												462.3700	(232)
Total delivered energy for all uses												7500.2038	(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	4367.8734	0.2160	943.4607	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2594.9603	0.2160	560.5114	(264)
Space and water heating			1503.9721	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	462.3700	0.5190	239.9700	(268)
Total CO2, kg/m2/year			1782.8671	(272)
Emissions per m2 for space and water heating			13.7199	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1891	(272b)
Emissions per m2 for pumps and fans			0.3551	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.7199 * 1.00) + 2.1891 + 0.3551, rounded to 2 d.p.			16.2600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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) =	0.1460	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3960	(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) =	0.3366	(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	0.4291	0.4207	0.4123	0.3702	0.3618	0.3197	0.3197	0.3113	0.3366	0.3618	0.3786	0.3955	(22b)
Effective ac	0.5921	0.5885	0.5850	0.5685	0.5655	0.5511	0.5511	0.5485	0.5566	0.5655	0.5717	0.5782	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.7852	(36)
Total fabric heat loss					(33) + (36) =		53.6326	(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	53.5449	53.2216	52.9047	51.4160	51.1375	49.8410	49.8410	49.6009	50.3404	51.1375	51.7010	52.2900	(38)
Heat transfer coeff	107.1775	106.8542	106.5373	105.0487	104.7701	103.4736	103.4736	103.2335	103.9730	104.7701	105.3336	105.9226	(39)
Average = Sum(39)m / 12 =												105.0473	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9777	0.9748	0.9719	0.9583	0.9558	0.9439	0.9439	0.9417	0.9485	0.9558	0.9609	0.9663	(40)
HLP (average)												0.9583	(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												2.8125	(42)
Average daily hot water use (litres/day)												100.9975	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(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

	35.0102	30.6202	31.5973	27.5473	26.4323	22.8090	21.1359	24.2538	24.5434	28.6030	31.2224	33.9055 (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	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	(66)

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

	26.9670	23.9519	19.4790	14.7468	11.0234	9.3064	10.0559	13.0711	17.5440	22.2761	25.9995	27.7165	(67)

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

	271.0089	273.8212	266.7344	251.6477	232.6033	214.7043	202.7467	199.9345	207.0212	222.1080	241.1523	259.0513	(68)

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

	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	(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)

	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)

Water heating gains (Table 5)

	47.0568	45.5657	42.4694	38.2601	35.5272	31.6792	28.4085	32.5992	34.0881	38.4449	43.3645	45.5719	(72)

Total internal gains

	410.2206	408.5266	393.8707	369.8425	344.3419	320.8779	306.3990	310.7926	323.8412	348.0169	375.7042	397.5277	(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	0.5700	0.0000	0.7700	43.8259	(75)
Southwest	5.8100	36.7938	0.5700	0.0000	0.7700	93.8246	(79)

Solar gains	137.6505	249.0270	379.3961	534.9012	658.2905	679.5510	644.3310	548.2989	432.6207	285.6534	167.5246	116.0848	(83)
Total gains	547.8711	657.5536	773.2669	904.7437	1002.6323	1000.4289	950.7300	859.0915	756.4619	633.6703	543.2288	513.6124	(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	28.4108	28.4968	28.5815	28.9866	29.0636	29.4278	29.4278	29.4962	29.2864	29.0636	28.9082	28.7474	
alpha	2.8941	2.8998	2.9054	2.9324	2.9376	2.9619	2.9619	2.9664	2.9524	2.9376	2.9272	2.9165	
util living area	0.9772	0.9611	0.9283	0.8558	0.7353	0.5800	0.4491	0.5057	0.7269	0.9034	0.9648	0.9809	(86)
MIT	18.8257	19.1115	19.5636	20.1326	20.5856	20.8562	20.9503	20.9290	20.7064	20.0964	19.3605	18.7795	(87)
Th 2	20.1019	20.1044	20.1068	20.1182	20.1204	20.1303	20.1303	20.1322	20.1265	20.1204	20.1160	20.1115	(88)
util rest of house	0.9739	0.9555	0.9178	0.8345	0.6965	0.5194	0.3700	0.4246	0.6730	0.8844	0.9587	0.9781	(89)
MIT 2	18.0913	18.3756	18.8216	19.3789	19.7991	20.0381	20.1066	20.0961	19.9206	19.3567	18.6332	18.0523	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	18.1947	18.4792	18.9261	19.4851	19.9099	20.1533	20.2254	20.2134	20.0313	19.4609	18.7357	18.1548	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1947	18.4792	18.9261	19.4851	19.9099	20.1533	20.2254	20.2134	20.0313	19.4609	18.7357	18.1548	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9643	0.9423	0.9006	0.8168	0.6864	0.5211	0.3790	0.4326	0.6665	0.8671	0.9464	0.9696	(94)
Useful gains	528.3012	619.5944	696.4223	738.9820	688.1924	521.3642	360.3047	371.6040	504.1660	549.4349	514.0937	498.0057	(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	1489.2008	1450.9972	1323.8402	1111.9486	860.1532	574.6183	375.1327	393.6696	616.6945	928.3597	1225.6254	1478.1242	(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	714.9092	558.7027	466.7989	268.5359	127.9389	0.0000	0.0000	0.0000	0.0000	281.9201	512.3028	729.2082	(98)
Space heating												3660.3167	(98)
Space heating per m2											(98) / (4) =	33.3910	(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	972.6518	765.7046	784.5746	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8396	0.8887	0.8612	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	816.6139	680.5174	675.6588	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1280.6181	1220.2076	1115.4936	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	334.0830	401.5296	327.2371	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1062.8497	(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   83.5208  100.3824   81.8093    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        265.7124 (107)
Space cooling per m2                                                                                                   2.4239 (108)
Energy for space heating                                                                                              33.3910 (99)
Energy for space cooling                                                                                               2.4239 (108)
Total                                                                                                                 35.8149 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                              35.8 (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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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) =	0.1460	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3960	(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) =	0.3366	(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	0.4291	0.4207	0.4123	0.3702	0.3618	0.3197	0.3197	0.3113	0.3366	0.3618	0.3786	0.3955	(22b)
Effective ac	0.5921	0.5885	0.5850	0.5685	0.5655	0.5511	0.5511	0.5485	0.5566	0.5655	0.5717	0.5782	(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			54.8100	0.1300	7.1253			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.1800	15.8976			(29a)
External Roof 1	54.8100		54.8100	0.1300	7.1253			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7038			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2595	(36)
Total fabric heat loss					(33) + (36) =		61.9633	(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	53.5449	53.2216	52.9047	51.4160	51.1375	49.8410	49.8410	49.6009	50.3404	51.1375	51.7010	52.2900	(38)
Heat transfer coeff	115.5082	115.1849	114.8680	113.3793	113.1008	111.8043	111.8043	111.5642	112.3037	113.1008	113.6643	114.2533	(39)
Average = Sum(39)m / 12 =												113.3780	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0537	1.0508	1.0479	1.0343	1.0318	1.0199	1.0199	1.0177	1.0245	1.0318	1.0369	1.0423	(40)
HLP (average)												1.0343	(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												2.8125	(42)
Average daily hot water use (litres/day)												100.9975	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(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													
	35.0102	30.6202	31.5973	27.5473	26.4323	22.8090	21.1359	24.2538	24.5434	28.6030	31.2224	33.9055	(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	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.1813	23.2540	18.9114	14.3172	10.7022	9.0353	9.7629	12.6903	17.0328	21.6271	25.2420	26.9090	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.0089	273.8212	266.7344	251.6477	232.6033	214.7043	202.7467	199.9345	207.0212	222.1080	241.1523	259.0513	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	47.0568	45.5657	42.4694	38.2601	35.5272	31.6792	28.4085	32.5992	34.0881	38.4449	43.3645	45.5719	(72)
Total internal gains													
	409.4349	407.8288	393.3032	369.4128	344.0207	320.6067	306.1060	310.4118	323.3300	347.3678	374.9467	396.7201	(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	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	505.2831	581.2302	657.4827	741.8730	802.3987	793.7888	754.7638	692.2009	624.5706	546.2728	491.5967	477.5518	(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	65.9044	66.0894	66.2717	67.1419	67.3072	68.0877	68.0877	68.2343	67.7849	67.3072	66.9736	66.6283	
alpha	5.3936	5.4060	5.4181	5.4761	5.4871	5.5392	5.5392	5.5490	5.5190	5.4871	5.4649	5.4419	
util living area													
	0.9995	0.9987	0.9961	0.9839	0.9351	0.7999	0.6292	0.6990	0.9218	0.9920	0.9988	0.9996	(86)
MIT	19.7582	19.8884	20.1177	20.4381	20.7360	20.9293	20.9851	20.9742	20.8254	20.4446	20.0475	19.7398	(87)
Th 2	20.0388	20.0412	20.0436	20.0549	20.0570	20.0668	20.0668	20.0686	20.0630	20.0570	20.0527	20.0483	(88)
util rest of house													
	0.9993	0.9982	0.9945	0.9770	0.9060	0.7192	0.5072	0.5778	0.8745	0.9876	0.9983	0.9995	(89)
MIT 2	18.8938	19.0258	19.2563	19.5823	19.8659	20.0314	20.0626	20.0604	19.9547	19.5928	19.1941	18.8830	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	19.0155	19.1473	19.3777	19.7029	19.9885	20.1578	20.1925	20.1891	20.0774	19.7128	19.3143	19.0037	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0155	19.1473	19.3777	19.7029	19.9885	20.1578	20.1925	20.1891	20.0774	19.7128	19.3143	19.0037	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9976	0.9931	0.9737	0.9034	0.7280	0.5245	0.5947	0.8754	0.9853	0.9978	0.9993	(94)
Useful gains	504.7716	579.8557	652.9435	722.3297	724.9206	577.8415	395.8567	411.6226	546.7543	538.2603	490.5046	477.2000	(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													
	1699.7671	1641.0724	1479.2315	1224.8217	937.4313	621.3888	401.6583	422.7257	671.2790	1030.6620	1388.3329	1691.3695	(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													
	889.0766	713.1376	614.7583	361.7942	158.1080	0.0000	0.0000	0.0000	0.0000	366.3469	646.4364	903.3421	(98)
Space heating												4653.0002	(98)
Space heating per m2											(98) / (4) =	42.4466	(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	1050.9603	827.3517	847.8878	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8421	0.9122	0.8796	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	884.9866	754.7256	745.8195	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1038.7298	990.7663	919.9197	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	110.6951	175.6143	129.5306	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												415.8399	(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   27.6738   43.9036   32.3826    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          103.9600 (107)
Space cooling per m2                                                                                                     0.9484 (108)
Energy for space heating                                                                                                42.4466 (99)
Energy for space cooling                                                                                                 0.9484 (108)
Total                                                                                                                   43.3950 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                     49.9 (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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 = 98.8509 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9018	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Water storage loss:

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(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)
Output from w/h	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
Heat gains from water heating, kWh/month	97.4962	86.4933	92.1559	84.4410	84.0742	77.0270	75.7870	80.6655	79.7409	87.4708	90.1915	95.7677	(65)

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

Total per year (kWh/year) = Sum(64)m = 2217.7597 (64)

RHI water heating demand 2218 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)	131.0433	128.7103	123.8655	117.2791	113.0030	106.9820	101.8643	108.4214	110.7512	117.5683	125.2660	128.7200	(72)
Total internal gains	716.8900	711.2165	684.6123	643.6779	601.6689	564.6405	543.5493	553.4470	577.5362	618.7013	664.1318	698.5933	(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	0.5700	0.0000	0.7700	51.8193	(75)
Southwest	5.8100	41.5040	0.5700	0.0000	0.7700	105.8356	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	157.6549	244.9514	385.6826	556.4015	668.4686	738.6606	696.2303	595.2476	468.5561	318.8096	190.4343	127.2979	(83)
Total gains	874.5450	956.1678	1070.2948	1200.0794	1270.1375	1303.3011	1239.7796	1148.6946	1046.0924	937.5109	854.5662	825.8911	(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	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area	0.9195	0.8955	0.8337	0.7257	0.5785	0.3933	0.2674	0.3038	0.5323	0.7617	0.8845	0.9302	(86)
MIT	19.6136	19.7946	20.1763	20.5611	20.8296	20.9622	20.9918	20.9877	20.9001	20.5636	20.0210	19.5320	(87)
Th 2	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house	0.9095	0.8828	0.8140	0.6949	0.5344	0.3373	0.2033	0.2358	0.4735	0.7274	0.8683	0.9213	(89)
MIT 2	18.3279	18.5842	19.1198	19.6420	19.9855	20.1354	20.1619	20.1592	20.0743	19.6580	18.9114	18.2121	(90)
MIT	18.5090	18.7547	19.2686	19.7715	20.1044	20.2518	20.2788	20.2759	20.1906	19.7856	19.0677	18.3980	(92)
adjusted MIT	18.3590	18.6047	19.1186	19.6215	19.9544	20.1018	20.1288	20.1259	20.0406	19.6356	18.9177	18.2480	(93)

Living area fraction fLA = Living area / (4) = 0.1409 (91)

Temperature adjustment -0.1500

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8818	0.8536	0.7852	0.6729	0.5226	0.3329	0.2004	0.2324	0.4642	0.7028	0.8386	0.8948	(94)
Useful gains	771.1768	816.2290	840.4483	807.5339	663.8343	433.8514	248.4664	266.9856	485.5765	658.8436	716.6568	739.0004	(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	1320.5450	1295.4113	1168.2793	980.7460	726.9900	445.0078	249.9699	269.4556	518.0407	823.9797	1098.9911	1319.4582	(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	408.7299	322.0105	243.9063	124.7127	46.9878	0.0000	0.0000	0.0000	0.0000	122.8613	275.2807	431.8606	(98)

Space heating 1976.3497 (98)

RHI space heating demand 1976 (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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	47.1118	46.6313	46.1509	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	100.7444	100.2639	99.7835	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 = 99.2041 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9190	0.9147	0.9103	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9050	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Water storage loss:
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
               218.1484   192.3221   202.0874   181.3062   177.7815   159.0086   152.8575   167.5298   167.1705   187.9968   198.6011   212.9498 (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
               218.1484   192.3221   202.0874   181.3062   177.7815   159.0086   152.8575   167.5298   167.1705   187.9968   198.6011   212.9498 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2217.7597 (64)
Heat gains from water heating, kWh/month
                97.4962    86.4933    92.1559    84.4410    84.0742    77.0270    75.7870    80.6655    79.7409    87.4708    90.1915    95.7677 (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          168.7515   168.7515   168.7515   168.7515   168.7515   168.7515   168.7515   168.7515   168.7515   168.7515   168.7515   168.7515 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                67.4176    59.8797    48.6974    36.8671    27.5586    23.2661    25.1399    32.6777    43.8600    55.6903    64.9989    69.2913 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               404.4909   408.6883   398.1111   375.5935   347.1691   320.4542   302.6070   298.4096   308.9868   331.5044   359.9288   386.6437 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                54.6877    54.6877    54.6877    54.6877    54.6877    54.6877    54.6877    54.6877    54.6877    54.6877    54.6877    54.6877 (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)
              -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010 (71)
Water heating gains (Table 5)
               131.0433   128.7103   123.8655   117.2791   113.0030   106.9820   101.8643   108.4214   110.7512   117.5683   125.2660   128.7200 (72)
Total internal gains
               716.8900   711.2165   684.6123   643.6779   601.6689   564.6405   543.5493   553.4470   577.5362   618.7013   664.1318   698.5933 (73)


-----------------------------------------------------------------------------------------------------
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           11.2829            0.5700            0.0000             0.7700          43.8259 (75)
Southwest                                  5.8100           36.7938            0.5700            0.0000             0.7700          93.8246 (79)
-----------------------------------------------------------------------------------------------------

Solar gains    137.6505   249.0270   379.3961   534.9012   658.2905   679.5510   644.3310   548.2989   432.6207   285.6534   167.5246   116.0848 (83)
Total gains    854.5406   960.2434  1064.0084  1178.5792  1259.9594  1244.1915  1187.8803  1101.7459  1010.1569   904.3546   831.6565   814.6781 (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             30.2250    30.3698    30.5161    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040
alpha            3.0150     3.0247     3.0344     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536
util living area
                 0.9317     0.9039     0.8535     0.7588     0.6252     0.4746     0.3552     0.3960     0.5922     0.7993     0.9020     0.9387 (86)

MIT             19.4299    19.6758    20.0424    20.4619    20.7653    20.9249    20.9767    20.9672    20.8505    20.4558    19.8875    19.4024 (87)
Th 2            20.1514    20.1551    20.1588    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660 (88)
util rest of house
                 0.9232     0.8924     0.8362     0.7316     0.5852     0.4210     0.2916     0.3296     0.5378     0.7698     0.8884     0.9310 (89)
MIT 2           18.0548    18.4070    18.9269    19.5093    19.9061    20.0971    20.1500    20.1423    20.0188    19.5147    18.7224    18.0251 (90)
Living area fraction                                                                               fLA = Living area / (4) =      0.1409 (91)
MIT             18.2484    18.5857    19.0840    19.6435    20.0271    20.2137    20.2665    20.2585    20.1359    19.6472    18.8865    18.2191 (92)
Temperature adjustment                                                                                                           -0.1500
adjusted MIT    18.0984    18.4357    18.9340    19.4935    19.8771    20.0637    20.1165    20.1085    19.9859    19.4972    18.7365    18.0691 (93)


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

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.8965     0.8633     0.8066     0.7071     0.5705     0.4142     0.2877     0.3249     0.5253     0.7427     0.8593     0.9058 (94)
Useful gains   766.0760   829.0037   858.2181   833.4286   718.8035   515.3456   341.7983   357.9913   530.5857   671.6729   714.6800   737.9136 (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
              1390.1153  1357.1465  1240.7126  1047.1752   808.3178   540.0934   347.6068   366.5851   581.8291   879.4967  1150.2823  1370.9685 (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
               464.2853   354.9120   284.5760   153.8975    66.5986     0.0000     0.0000     0.0000     0.0000   154.6209   313.6336   470.9928 (98)
Space heating                                                                                                             2263.5167 (98)
Space heating per m2                                                                                      (98) / (4) =     20.6488 (99)


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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)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2498.3628	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	464.2853	354.9120	284.5760	153.8975	66.5986	0.0000	0.0000	0.0000	0.0000	154.6209	313.6336	470.9928	(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)													
	512.4562	391.7351	314.1015	169.8648	73.5084	0.0000	0.0000	0.0000	0.0000	170.6633	346.1739	519.8596	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
Efficiency of water heater												79.9000	(216)
(217)m	86.8808	86.5276	85.8272	84.4807	82.5571	79.9000	79.9000	79.9000	79.9000	84.3983	86.1281	86.9735	(217)
Fuel for water heating, kWh/month													
	251.0894	222.2667	235.4585	214.6124	215.3436	199.0095	191.3111	209.6743	209.2247	222.7495	230.5881	244.8444	(219)
Water heating fuel used												2646.1721	(219)
Annual totals kWh/year													
Space heating fuel - main system												2498.3628	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												136.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1029 * 1.00) =										-988.0192		-988.0192	(233)
Total delivered energy for all uses												4769.2806	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2498.3628	3.4800	86.9430	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2646.1721	3.4800	92.0868	(247)
Mechanical ventilation fans	61.5187	13.1900	8.1143	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	476.2462	13.1900	62.8169	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-988.0192	13.1900	-130.3197	(252)
Total energy cost			249.5338	(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] =	0.6778	(257)
SAP value		90.5444	
SAP rating (Section 12)		91	(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	2498.3628	0.2160	539.6464	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2646.1721	0.2160	571.5732	(264)
Space and water heating			1111.2195	(265)
Pumps and fans	136.5187	0.5190	70.8532	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-988.0192	0.5190	-512.7820	(269)
Total kg/year			916.4626	(272)
CO2 emissions per m2			8.3600	(273)
EI value			92.0576	
EI rating			92	(274)
EI band			A	

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 / 0.8361 = 4.162, stars = 4
Water heating environmental impact	0.216 / 0.8361 = 0.2583, 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	54.8100	(1b)	x 2.3500	(2b) =	128.8035	(1b) - (3b)
First floor	54.8100	(1c)	x 2.6500	(2c) =	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)
Average = Sum(39)m / 12 =												98.8509	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9018	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

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

Water storage loss:													
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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
								Total per year (kWh/year) = Sum(64)m =				2217.7597	(64)
Heat gains from water heating, kWh/month													
	97.4962	86.4933	92.1559	84.4410	84.0742	77.0270	75.7870	80.6655	79.7409	87.4708	90.1915	95.7677	(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	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	131.0433	128.7103	123.8655	117.2791	113.0030	106.9820	101.8643	108.4214	110.7512	117.5683	125.2660	128.7200	(72)
Total internal gains													
	716.8900	711.2165	684.6123	643.6779	601.6689	564.6405	543.5493	553.4470	577.5362	618.7013	664.1318	698.5933	(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	8.8500	13.3408	0.5700	0.0000	0.7700	51.8193	(75)
Southwest	5.8100	41.5040	0.5700	0.0000	0.7700	105.8356	(79)

Solar gains	157.6549	244.9514	385.6826	556.4015	668.4686	738.6606	696.2303	595.2476	468.5561	318.8096	190.4343	127.2979	(83)
Total gains	874.5450	956.1678	1070.2948	1200.0794	1270.1375	1303.3011	1239.7796	1148.6946	1046.0924	937.5109	854.5662	825.8911	(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	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area													
	0.9195	0.8955	0.8337	0.7257	0.5785	0.3933	0.2674	0.3038	0.5323	0.7617	0.8845	0.9302	(86)
MIT	19.6136	19.7946	20.1763	20.5611	20.8296	20.9622	20.9918	20.9877	20.9001	20.5636	20.0210	19.5320	(87)
Th 2	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house													
	0.9095	0.8828	0.8140	0.6949	0.5344	0.3373	0.2033	0.2358	0.4735	0.7274	0.8683	0.9213	(89)
MIT 2	18.3279	18.5842	19.1198	19.6420	19.9855	20.1354	20.1619	20.1592	20.0743	19.6580	18.9114	18.2121	(90)
Living area fraction										fLA = Living area / (4) =		0.1409	(91)
MIT	18.5090	18.7547	19.2686	19.7715	20.1044	20.2518	20.2788	20.2759	20.1906	19.7856	19.0677	18.3980	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3590	18.6047	19.1186	19.6215	19.9544	20.1018	20.1288	20.1259	20.0406	19.6356	18.9177	18.2480	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8818	0.8536	0.7852	0.6729	0.5226	0.3329	0.2004	0.2324	0.4642	0.7028	0.8386	0.8948	(94)
Useful gains	771.1768	816.2290	840.4483	807.5339	663.8343	433.8514	248.4664	266.9856	485.5765	658.8436	716.6568	739.0004	(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													
	1320.5450	1295.4113	1168.2793	980.7460	726.9900	445.0078	249.9699	269.4556	518.0407	823.9797	1098.9911	1319.4582	(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													
	408.7299	322.0105	243.9063	124.7127	46.9878	0.0000	0.0000	0.0000	0.0000	122.8613	275.2807	431.8606	(98)
Space heating												1976.3497	(98)
Space heating per m2											(98) / (4) =	18.0291	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 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)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2181.4014	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	408.7299	322.0105	243.9063	124.7127	46.9878	0.0000	0.0000	0.0000	0.0000	122.8613	275.2807	431.8606	(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)													
	451.1368	355.4200	269.2122	137.6519	51.8629	0.0000	0.0000	0.0000	0.0000	135.6085	303.8418	476.6673	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
Efficiency of water heater												79.9000	(216)
(217)m	86.5658	86.2795	85.4169	83.9401	81.9226	79.9000	79.9000	79.9000	79.9000	83.8121	85.7854	86.7628	(217)
Fuel for water heating, kWh/month													
	252.0028	222.9058	236.5896	215.9948	217.0115	199.0095	191.3111	209.6743	209.2247	224.3073	231.5092	245.4391	(219)
Water heating fuel used												2654.9798	(219)
Annual totals kWh/year													
Space heating fuel - main system												2181.4014	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												136.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1096 * 1.00) =											-1052.0028	-1052.0028	(233)
Total delivered energy for all uses												4397.1434	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2181.4014	3.6300	79.1849	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2654.9798	3.6300	96.3758	(247)
Mechanical ventilation fans	61.5187	19.4400	11.9592	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	476.2462	19.4400	92.5823	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1052.0028	19.4400	-204.5094	(252)
Total energy cost			185.1728	(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	2181.4014	0.2160	471.1827	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2654.9798	0.2160	573.4756	(264)
Space and water heating			1044.6584	(265)
Pumps and fans	136.5187	0.5190	70.8532	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-1052.0028	0.5190	-545.9895	(269)
Total kg/year			816.6939	(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	2181.4014	1.2200	2661.3098	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2654.9798	1.2200	3239.0754	(264)
Space and water heating			5900.3852	(265)
Pumps and fans	136.5187	3.0700	419.1125	(267)
Energy for lighting	476.2462	3.0700	1462.0758	(268)
Energy saving/generation technologies				
PV Unit	-1052.0028	3.0700	-3229.6487	(269)

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

Primary energy kWh/year	4551.9248 (272)
Primary energy kWh/m2/year	41.5246 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 91
Current environmental impact rating:	A 92

(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	+ 1.5	-£ 40	-271 kg (33.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£40	2.47 kg/m²	A 92	A 94
Total Savings	£40	2.47 kg/m²		

Potential energy efficiency rating:	A 92
Potential environmental impact rating:	A 94

Fuel prices for cost data on this page from database revision number 493 TEST (31 Mar 2022)
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	£119	£129	-£10
Mains gas	£271	£221	£50
Space heating	£201	£202	-£1
Water heating	£96	£55	£41
Lighting	£93	£93	£0
Generated (PV)	-£205	-£205	£0
Total cost of fuels	£185	£145	£40
Total cost of uses	£185	£145	£40
Delivered energy	40 kWh/m²	28 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.5 tonnes	0.3 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	42 kWh/m²	28 kWh/m²	14 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	54.8100	(1b)	x 2.3500	(2b) =	128.8035	(1b) - (3b)
First floor	54.8100	(1c)	x 2.6500	(2c) =	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	47.1118	46.6313	46.1509	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	100.7444	100.2639	99.7835	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 = 99.2041 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9190	0.9147	0.9103	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9050	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Water storage loss:

	Value	Ref
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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
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	207.3870	182.6021	189.9302	164.1383	154.2257	135.9876	129.0692	144.6719	151.3534	175.8396	188.1868	202.1884	(62)

	Value	Ref
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	1.1413	(H8)
Utilisation factor	0.5836	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	115.5000	(H13)
Daily hot water demand	100.9975	(H14)
Volume ratio Veff/V	1.1436	(H15)
Solar storage volume factor	1.0000	(H16)
Solar input	-930.7225	(H17)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Solar input	-26.9891	-45.0370	-76.7032	-102.7975	-126.9976	-124.8589	-123.2088	-107.6482	-84.3101	-57.5739	-32.0130	-22.5853	(63)
Output from w/h	180.3979	137.5650	113.2270	61.3408	27.2281	11.1287	5.8603	37.0238	67.0433	118.2658	156.1738	179.6031	(64)
Heat gains from water heating, kWh/month	88.8871	78.7173	82.4302	70.7067	65.2296	58.6102	56.7563	62.3792	67.0871	77.7451	81.8601	87.1586	(65)

Solar input (sum of months) = Sum(63)m = -930.7225 (63)

Total per year (kWh/year) = Sum(64)m = 1094.8576 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Metabolic gains (Table 5), Watts (66)m	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)	119.4719	117.1389	110.7933	98.2037	87.6742	81.4031	76.2854	83.8431	93.1766	104.4961	113.6946	117.1486	(72)
Total internal gains	705.3186	699.6450	671.5400	624.6025	576.3401	539.0616	517.9704	528.8686	559.9616	605.6290	652.5604	687.0219	(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	Ref
Northeast	8.8500	11.2829	0.5700	0.0000	0.7700	43.8259	(75)
Southwest	5.8100	36.7938	0.5700	0.0000	0.7700	93.8246	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Solar gains	137.6505	249.0270	379.3961	534.9012	658.2905	679.5510	644.3310	548.2989	432.6207	285.6534	167.5246	116.0848	(83)
Total gains	842.9691	948.6720	1050.9362	1159.5037	1234.6306	1218.6126	1162.3014	1077.1676	992.5823	891.2824	820.0850	803.1066	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
tau	30.2250	30.3698	30.5161	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0150	3.0247	3.0344	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area	0.9338	0.9064	0.8569	0.7649	0.6338	0.4829	0.3623	0.4041	0.5997	0.8042	0.9049	0.9407	(86)
MIT	19.4139	19.6613	20.0289	20.4486	20.7561	20.9212	20.9754	20.9653	20.8452	20.4449	19.8731	19.3859	(87)
Th 2	20.1514	20.1551	20.1588	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house	0.9255	0.8951	0.8399	0.7379	0.5939	0.4288	0.2977	0.3367	0.5451	0.7751	0.8916	0.9333	(89)
MIT 2	18.0321	18.3868	18.9085	19.4921	19.8953	20.0936	20.1491	20.1409	20.0131	19.5007	18.7024	18.0016	(90)
MIT	18.2267	18.5663	19.0663	19.6268	20.0165	20.2102	20.2655	20.2570	20.1303	19.6337	18.8673	18.1966	(92)
adjusted MIT	18.0767	18.4163	18.9163	19.4768	19.8665	20.0602	20.1155	20.1070	19.9803	19.4837	18.7173	18.0466	(93)

Living area fraction: fLA = Living area / (4) = 0.1409 (91)

Temperature adjustment -0.1500

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	0.8991	0.8661	0.8102	0.7131	0.5786	0.4216	0.2937	0.3317	0.5321	0.7477	0.8627	0.9083	(94)
Useful gains	757.8727	821.6773	851.4582	826.8003	714.3040	513.7760	341.3589	357.3389	528.2020	666.4026	707.4673	729.4728	(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	1387.9238	1355.1981	1238.9453	1045.5247	807.2656	539.7426	347.5077	366.4380	581.2760	878.1572	1148.3823	1368.7454	(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	468.7581	358.5260	288.2904	157.4816	69.1634	0.0000	0.0000	0.0000	0.0000	157.5454	317.4588	475.6189	(98)

Space heating 2292.8425 (98)
Space heating per m2 (98) / (4) = 20.9163 (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 %) 90.6000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2530.7313 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	468.7581	358.5260	288.2904	157.4816	69.1634	0.0000	0.0000	0.0000	0.0000	157.5454	317.4588	475.6189	(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)	517.3930	395.7240	318.2013	173.8208	76.3393	0.0000	0.0000	0.0000	0.0000	173.8912	350.3960	524.9656	(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	180.3979	137.5650	113.2270	61.3408	27.2281	11.1287	5.8603	37.0238	67.0433	118.2658	156.1738	179.6031	(64)
Efficiency of water heater												79.9000	(216)
(217)m	87.3493	87.3560	87.3031	87.3219	87.2977	79.9000	79.9000	79.9000	79.9000	85.6800	86.7685	87.3920	(217)
Fuel for water heating, kWh/month	206.5247	157.4763	129.6942	70.2468	31.1900	13.9283	7.3346	46.3376	83.9090	138.0319	179.9890	205.5144	(219)

Water heating fuel used 1270.1767 (219)
Annual totals kWh/year
Space heating fuel - main system 2530.7313 (211)
Space heating fuel - secondary 0.0000 (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) 61.5187 (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 186.5187 (231)
Electricity for lighting (calculated in Appendix L) 476.2462 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.20 * 1029 * 1.00) = -988.0192 -988.0192 (233)
Total delivered energy for all uses 3475.6537 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2530.7313	3.4800	88.0694	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1270.1767	3.4800	44.2022	(247)
Mechanical ventilation fans	61.5187	13.1900	8.1143	(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	476.2462	13.1900	62.8169	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-988.0192	13.1900	-130.3197	(252)
Total energy cost			209.3706	(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] = 0.5687 (257)
SAP value 92.0663
SAP rating (Section 12) 92 (258)
SAP band A

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	2530.7313	0.2160	546.6380	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1270.1767	0.2160	274.3582	(264)
Space and water heating			820.9961	(265)
Pumps and fans	186.5187	0.5190	96.8032	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-988.0192	0.5190	-512.7820	(269)
Total kg/year			652.1891	(272)
CO2 emissions per m2			5.9500	(273)
EI value			94.3479	
EI rating			94	(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	54.8100	(1b)	x 2.3500	(2b) =	128.8035	(1b) - (3b)
First floor	54.8100	(1c)	x 2.6500	(2c) =	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	274.0500	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 =	98.8509 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9018	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

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

Water storage loss:													
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													
	207.3870	182.6021	189.9302	164.1383	154.2257	135.9876	129.0692	144.6719	151.3534	175.8396	188.1868	202.1884	(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												1.2106	(H8)
Utilisation factor												0.5622	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												100.9975	(H14)
Volume ratio Veff/V												1.1436	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-951.0247	(H17)
Solar input	-29.9792	-42.8420	-75.0179	-102.3679	-123.2225	-129.6601	-127.1899	-111.7581	-87.6563	-62.0278	-35.2681	-24.0349	(63)
								Solar input (sum of months) = Sum(63)m =				-951.0247	(63)
Output from w/h													
	177.4078	139.7601	114.9123	61.7704	31.0033	6.3275	1.8792	32.9138	63.6970	113.8118	152.9187	178.1535	(64)
								Total per year (kWh/year) = Sum(64)m =				1074.5554	(64)
Heat gains from water heating, kWh/month													
	88.8871	78.7173	82.4302	70.7067	65.2296	58.6102	56.7563	62.3792	67.0871	77.7451	81.8601	87.1586	(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	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	119.4719	117.1389	110.7933	98.2037	87.6742	81.4031	76.2854	83.8431	93.1766	104.4961	113.6946	117.1486	(72)
Total internal gains													
	705.3186	699.6450	671.5400	624.6025	576.3401	539.0616	517.9704	528.8686	559.9616	605.6290	652.5604	687.0219	(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	0.5700	0.0000	0.7700	51.8193	(75)
Southwest	5.8100	41.5040	0.5700	0.0000	0.7700	105.8356	(79)

Solar gains	157.6549	244.9514	385.6826	556.4015	668.4686	738.6606	696.2303	595.2476	468.5561	318.8096	190.4343	127.2979	(83)
Total gains	862.9735	944.5964	1057.2226	1181.0040	1244.8088	1277.7222	1214.2007	1124.1163	1028.5177	924.4387	842.9947	814.3197	(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	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area													
	0.9218	0.8981	0.8374	0.7319	0.5870	0.4003	0.2728	0.3101	0.5394	0.7669	0.8876	0.9324	(86)
MIT	19.5983	19.7806	20.1639	20.5496	20.8224	20.9603	20.9914	20.9869	20.8964	20.5544	20.0076	19.5160	(87)
Th 2	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house													
	0.9120	0.8857	0.8180	0.7014	0.5429	0.3436	0.2075	0.2408	0.4802	0.7329	0.8718	0.9238	(89)
MIT 2	18.3062	18.5646	19.1030	19.6275	19.9776	20.1337	20.1616	20.1588	20.0707	19.6465	18.8928	18.1894	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	18.4882	18.7359	19.2524	19.7574	20.0966	20.2502	20.2785	20.2754	20.1870	19.7743	19.0499	18.3763	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3382	18.5859	19.1024	19.6074	19.9466	20.1002	20.1285	20.1254	20.0370	19.6243	18.8999	18.2263	(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	0.8846	0.8566	0.7891	0.6790	0.5306	0.3390	0.2045	0.2373	0.4706	0.7079	0.8422	0.8975	(94)
Useful gains	763.3903	809.1634	834.2266	801.8475	660.4502	433.1183	248.3488	266.7901	483.9956	654.3924	709.9499	730.8636	(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	1318.4917	1293.5538	1166.6760	979.3530	726.2131	444.8452	249.9421	269.4101	517.6805	822.8684	1097.2307	1317.3127	(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	412.9954	325.5103	247.3424	127.8040	48.9276	0.0000	0.0000	0.0000	0.0000	125.3461	278.8422	436.3181	(98)
Space heating												2003.0861	(98)
Space heating per m2											(98) / (4) =	18.2730	(99)

8c. Space cooling requirement

Not applicable

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

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 %)													90.6000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2210.9118	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	412.9954	325.5103	247.3424	127.8040	48.9276	0.0000	0.0000	0.0000	0.0000	125.3461	278.8422	436.3181	(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)	455.8449	359.2829	273.0048	141.0640	54.0040	0.0000	0.0000	0.0000	0.0000	138.3511	307.7728	481.5873	(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	177.4078	139.7601	114.9123	61.7704	31.0033	6.3275	1.8792	32.9138	63.6970	113.8118	152.9187	178.1535	(64)	
Efficiency of water heater												79.9000	(216)	
(217)m	87.0953	87.0964	86.9081	86.8119	86.1263	79.9000	79.9000	79.9000	79.9000	85.1720	86.4974	87.2138	(217)	
Fuel for water heating, kWh/month	203.6939	160.4660	132.2228	71.1542	35.9974	7.9193	2.3520	41.1937	79.7209	133.6258	176.7899	204.2721	(219)	
Water heating fuel used												1249.4082	(219)	
Annual totals kWh/year														
Space heating fuel - main system												2210.9118	(211)	
Space heating fuel - secondary												0.0000	(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)												61.5187	(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												186.5187	(231)	
Electricity for lighting (calculated in Appendix L)												476.2462	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 1.20 * 1096 * 1.00) =											-1052.0028	-1052.0028	(233)	
Total delivered energy for all uses												3071.0822	(238)	

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2210.9118	3.6300	80.2561	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1249.4082	3.6300	45.3535	(247)
Mechanical ventilation fans	61.5187	19.4400	11.9592	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	476.2462	19.4400	92.5823	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1052.0028	19.4400	-204.5094	(252)
Total energy cost			144.9418	(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	2210.9118	0.2160	477.5570	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1249.4082	0.2160	269.8722	(264)
Space and water heating			747.4291	(265)
Pumps and fans	186.5187	0.5190	96.8032	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)

Energy saving/generation technologies			
PV Unit	-1052.0028	0.5190	-545.9895 (269)
Total kg/year			545.4147 (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	2210.9118	1.2200	2697.3124	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1249.4082	1.2200	1524.2781	(264)
Space and water heating			4221.5905	(265)
Pumps and fans	186.5187	3.0700	572.6125	(267)
Energy for lighting	476.2462	3.0700	1462.0758	(268)
Energy saving/generation technologies				
PV Unit	-1052.0028	3.0700	-3229.6487	(269)
Primary energy kWh/year			3026.6302	(272)
Primary energy kWh/m2/year			27.6102	(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	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	723.49 (P1)
Transmission heat loss coefficient	53.63 (37)
Summer heat loss coefficient	777.12 (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	0.5700	0.0000	0.9000	448.7625
South West	5.8100	119.9223	0.5700	0.0000	0.9000	357.4322
total:						806.1946

	Jun	Jul	Aug	
Solar gains	860	806	701	(P4)
Internal gains	562	541	550	
Total summer gains	1421	1347	1251	(P5)
Summer gain/loss ratio	1.83	1.73	1.61	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.13	20.93	20.71	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

Property Reference	SECLISDEAN	**Issued on Date**	04/05/2022
Assessment Reference	ASHP	**Prop Type Ref**	Dean
Property	Plot 30, Greatham, Hampshire, GU22		

SAP Rating	94 A	**DER**	6.28	**TER**	23.81
Environmental	95 A	**% DER<TER**	73.62		
CO_2 Emissions (t/year)	0.51	**DFEE**	35.81	**TFEE**	49.90
General Requirements Compliance	Pass	**% DFEE<TFEE**	28.23		

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 4.14r19

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 110 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 23.81 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 6.28 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)35.8 kWh/m²/yrOK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.09 (max. 0.25)	0.09 (max. 0.70)	OK
Roof	0.08 (max. 0.20)	0.08 (max. 0.35)	OK
Openings	1.00 (max. 2.00)	1.00 (max. 3.30)	OK

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

---

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

---

4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi Electric Ecodan 5.0 kW PUZ-WM50VHA

Secondary heating system: None

---

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

---

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): Slight 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

---

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.09 W/m²K
Door U-value 1.00 W/m²K
Window U-value 1.00 W/m²K
Thermal bridging y-value 0.036 W/m²K
Photovoltaic array 1.20 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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss	(33) + (36) = 53.6326	(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	47.1118	46.6313	46.1509	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	100.7444	100.2639	99.7835	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 =	99.2041 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9190	0.9147	0.9103	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9050	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Water storage loss:
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
              218.1484   192.3221   202.0874   181.3062   177.7815   159.0086   152.8575   167.5298   167.1705   187.9968   198.6011   212.9498 (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
              218.1484   192.3221   202.0874   181.3062   177.7815   159.0086   152.8575   167.5298   167.1705   187.9968   198.6011   212.9498 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   2217.7597 (64)
Heat gains from water heating, kWh/month
               97.4962    86.4933    92.1559    84.4410    84.0742    77.0270    75.7870    80.6655    79.7409    87.4708    90.1915    95.7677 (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         140.6263   140.6263   140.6263   140.6263   140.6263   140.6263   140.6263   140.6263   140.6263   140.6263   140.6263   140.6263 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               26.9670    23.9519    19.4790    14.7468    11.0234     9.3064    10.0559    13.0711    17.5440    22.2761    25.9995    27.7165 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              271.0089   273.8212   266.7344   251.6477   232.6033   214.7043   202.7467   199.9345   207.0212   222.1080   241.1523   259.0513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               37.0626    37.0626    37.0626    37.0626    37.0626    37.0626    37.0626    37.0626    37.0626    37.0626    37.0626    37.0626 (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)
             -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010  -112.5010 (71)
Water heating gains (Table 5)
              131.0433   128.7103   123.8655   117.2791   113.0030   106.9820   101.8643   108.4214   110.7512   117.5683   125.2660   128.7200 (72)
Total internal gains
              494.2072   491.6712   475.2668   448.8615   421.8176   396.1806   379.8548   386.6149   400.5043   427.1403   457.6057   480.6757 (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            11.2829            0.5700           0.0000            0.7700           43.8259 (75)
Southwest                              5.8100            36.7938            0.5700           0.0000            0.7700           93.8246 (79)
-----------------------------------------------------------------------------------------------------------------------------------------

Solar gains   137.6505   249.0270   379.3961   534.9012   658.2905   679.5510   644.3310   548.2989   432.6207   285.6534   167.5246   116.0848 (83)
Total gains   631.8577   740.6982   854.6630   983.7627  1080.1081  1075.7316  1024.1857   934.9138   833.1249   712.7936   625.1303   596.7605 (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           30.2250    30.3698    30.5161    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040    30.8040
alpha          3.0150     3.0247     3.0344     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536     3.0536
util living area
               0.9668     0.9464     0.9059     0.8214     0.6897     0.5339     0.4062     0.4571     0.6736     0.8704     0.9487     0.9714 (86)

Tweekday      17.5852    17.9878    18.5982    19.3074    19.8156    20.0690    20.1424    20.1300    19.9477    19.2744    18.3284    17.5519
Tweekend      19.7728    19.9524    20.2271    20.5527    20.7990    20.9328    20.9782    20.9685    20.8607    20.5301    20.0997    19.7539
24 / 16           0          0          0          0          0          0          0          0          0          0          0          0
24 / 9            0          0          0          0          0          0          0          0          0          0          0          0
16 / 9            0          0          0          0          0          0          0          0          0          0          0          0
MIT           19.1060    19.3794    19.8072    20.3015    20.6898    20.8968    20.9664    20.9514    20.7825    20.2748    19.5943    19.0768 (87)
Th 2          20.1514    20.1551    20.1588    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660    20.1660 (88)
util rest of house
               0.9622     0.9392     0.8933     0.7979     0.6506     0.4769     0.3354     0.3834     0.6194     0.8477     0.9406     0.9675 (89)
Tweekday      17.5852    17.9878    18.5982    19.3074    19.8156    20.0690    20.1424    20.1300    19.9477    19.2744    18.3284    17.5519
Tweekend      17.5852    17.9878    18.5982    19.3074    19.8156    20.0690    20.1424    20.1300    19.9477    19.2744    18.3284    17.5519
MIT 2         17.5852    17.9878    18.5982    19.3074    19.8156    20.0690    20.1424    20.1300    19.9477    19.2744    18.3284    17.5519 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.1409 (91)
MIT           17.7994    18.1838    18.7684    19.4474    19.9387    20.1856    20.2585    20.2457    20.0652    19.4153    18.5067    17.7667 (92)
Temperature adjustment                                                                                                                 0.0000
adjusted MIT  17.7994    18.1838    18.7684    19.4474    19.9387    20.1856    20.2585    20.2457    20.0652    19.4153    18.5067    17.7667 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9444     0.9169     0.8674     0.7747     0.6391     0.4783     0.3435     0.3907     0.6123     0.8231     0.9190     0.9513 (94)
Useful gains  596.6993   679.1601   741.3706   762.1600   690.3084   514.5601   351.7593   365.3112   510.0904   586.6997   574.5062   567.7262 (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
             1359.9914  1331.8875  1224.1884  1042.6234   814.4064   552.1396   361.6456   380.1484   589.6690   871.4043  1127.5643  1341.0800 (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
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	567.8893	438.6328	359.2165	201.9336	92.3289	0.0000	0.0000	0.0000	0.0000	211.8202	398.2018	575.3752 (98)
Space heating												2845.3984 (98)
Space heating per m2											(98) / (4) =	25.9569 (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 %)	294.3676 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)
Space heating requirement	966.6141 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	567.8893	438.6328	359.2165	201.9336	92.3289	0.0000	0.0000	0.0000	0.0000	211.8202	398.2018	575.3752	(98)
Space heating efficiency (main heating system 1)													
	294.3676	294.3676	294.3676	294.3676	294.3676	0.0000	0.0000	0.0000	0.0000	294.3676	294.3676	294.3676	(210)
Space heating fuel (main heating system)													
	192.9184	149.0085	122.0299	68.5992	31.3652	0.0000	0.0000	0.0000	0.0000	71.9577	135.2737	195.4615	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month													
	79.7603	70.3176	73.8880	66.2899	65.0012	58.1374	55.8884	61.2529	61.1216	68.7362	72.6133	77.8596	(219)
Water heating fuel used												810.8662	(219)
Annual totals kWh/year													
Space heating fuel - main system												966.6141	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
Total electricity for the above, kWh/year												61.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1029 * 1.00) =										-988.0192		-988.0192	(233)
Total delivered energy for all uses												1327.2261	(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	966.6141	0.5190	501.6727	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	810.8662	0.5190	420.8396	(264)
Space and water heating			922.5123	(265)
Pumps and fans	61.5187	0.5190	31.9282	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-988.0192	0.5190	-512.7820	(269)
Total CO2, kg/year			688.8303	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			6.2800	(273)

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

DER		6.2800	ZC1
Total Floor Area	TFA	109.6200	
Assumed number of occupants	N	2.8125	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.6501	ZC2
CO2 emissions from cooking, equation (L16)		1.7013	ZC3
Total CO2 emissions		22.6314	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		22.6314	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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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) =	0.1460	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3960	(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) =	0.3366	(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	0.4291	0.4207	0.4123	0.3702	0.3618	0.3197	0.3197	0.3113	0.3366	0.3618	0.3786	0.3955	(22b)
Effective ac	0.5921	0.5885	0.5850	0.5685	0.5655	0.5511	0.5511	0.5485	0.5566	0.5655	0.5717	0.5782	(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			54.8100	0.1300	7.1253			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.1800	15.8976			(29a)
External Roof 1	54.8100		54.8100	0.1300	7.1253			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7038			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2595	(36)
Total fabric heat loss					(33) + (36) =		61.9633	(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	53.5449	53.2216	52.9047	51.4160	51.1375	49.8410	49.8410	49.6009	50.3404	51.1375	51.7010	52.2900	(38)
Heat transfer coeff	115.5082	115.1849	114.8680	113.3793	113.1008	111.8043	111.8043	111.5642	112.3037	113.1008	113.6643	114.2533	(39)
Average = Sum(39)m / 12 =												113.3780	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0537	1.0508	1.0479	1.0343	1.0318	1.0199	1.0199	1.0177	1.0245	1.0318	1.0369	1.0423	(40)
HLP (average)												1.0343	(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												2.8125	(42)
Average daily hot water use (litres/day)												100.9975	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(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													
	216.5006	190.8337	200.4396	179.7115	176.1337	157.4139	151.2097	165.8820	165.5759	186.3490	197.0064	211.3020	(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													
	216.5006	190.8337	200.4396	179.7115	176.1337	157.4139	151.2097	165.8820	165.5759	186.3490	197.0064	211.3020	(64)
								Total per year (kWh/year) = Sum(64)m =				2198.3581	(64)
Heat gains from water heating, kWh/month													
	96.1780	85.3026	90.8377	83.1652	82.7560	75.7513	74.4688	79.3473	78.4651	86.1526	88.9158	94.4495	(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	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.1813	23.2540	18.9114	14.3172	10.7022	9.0353	9.7629	12.6903	17.0328	21.6271	25.2420	26.9090	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.0089	273.8212	266.7344	251.6477	232.6033	214.7043	202.7467	199.9345	207.0212	222.1080	241.1523	259.0513	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	129.2715	126.9384	122.0937	115.5073	111.2312	105.2101	100.0924	106.6496	108.9794	115.7965	123.4941	126.9482	(72)
Total internal gains													
	494.6496	492.2015	475.9274	449.6600	422.7246	397.1376	380.7899	387.4622	401.2212	427.7194	458.0763	481.0963	(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	590.4978	665.6029	740.1070	822.1202	881.1026	870.3197	829.4478	769.2514	702.4619	626.6243	574.7264	561.9280	(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	65.9044	66.0894	66.2717	67.1419	67.3072	68.0877	68.0877	68.2343	67.7849	67.3072	66.9736	66.6283	
alpha	5.3936	5.4060	5.4181	5.4761	5.4871	5.5392	5.5392	5.5490	5.5190	5.4871	5.4649	5.4419	
util living area													
	0.9988	0.9975	0.9931	0.9748	0.9101	0.7537	0.5793	0.6419	0.8849	0.9850	0.9975	0.9991	(86)
MIT	19.8322	19.9612	20.1876	20.5007	20.7811	20.9477	20.9899	20.9829	20.8656	20.5105	20.1194	19.8132	(87)
Th 2	20.0388	20.0412	20.0436	20.0549	20.0570	20.0668	20.0668	20.0686	20.0630	20.0570	20.0527	20.0483	(88)
util rest of house													
	0.9984	0.9966	0.9906	0.9647	0.8739	0.6695	0.4636	0.5244	0.8257	0.9773	0.9964	0.9988	(89)
MIT 2	18.4699	18.6602	18.9918	19.4503	19.8323	20.0301	20.0628	20.0610	19.9478	19.4706	18.9001	18.4490	(90)
Living area fraction										fLA = Living area / (4) =		0.1409	(91)
MIT	18.6618	18.8434	19.1603	19.5983	19.9660	20.1594	20.1934	20.1909	20.0771	19.6171	19.0719	18.6412	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6618	18.8434	19.1603	19.5983	19.9660	20.1594	20.1934	20.1909	20.0771	19.6171	19.0719	18.6412	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9950	0.9872	0.9583	0.8698	0.6786	0.4798	0.5407	0.8267	0.9722	0.9948	0.9981	(94)
Useful gains	589.0486	662.2588	730.6275	787.8768	766.3488	590.6060	397.9881	415.8997	580.7423	609.1952	571.7263	560.8721	(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													
	1658.9019	1606.0745	1454.2582	1212.9657	934.8867	621.5596	401.7572	422.9267	671.2500	1019.8390	1360.7736	1649.9530	(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													
	795.9709	634.2442	538.3812	306.0640	125.3922	0.0000	0.0000	0.0000	0.0000	305.5190	568.1140	810.2762	(98)
Space heating												4083.9616	(98)
Space heating per m2											(98) / (4) =	37.2556	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4367.8734	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	795.9709	634.2442	538.3812	306.0640	125.3922	0.0000	0.0000	0.0000	0.0000	305.5190	568.1140	810.2762	(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)													
	851.3057	678.3360	575.8088	327.3412	134.1093	0.0000	0.0000	0.0000	0.0000	326.7583	607.6086	866.6055	(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													
	216.5006	190.8337	200.4396	179.7115	176.1337	157.4139	151.2097	165.8820	165.5759	186.3490	197.0064	211.3020	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9775	87.7778	87.3234	86.2230	83.9265	79.8000	79.8000	79.8000	79.8000	86.1249	87.4798	88.0578	(217)
Fuel for water heating, kWh/month													
	246.0863	217.4056	229.5370	208.4265	209.8666	197.2606	189.4859	207.8722	207.4886	216.3706	225.2022	239.9583	(219)
Water heating fuel used												2594.9603	(219)
Annual totals kWh/year													
Space heating fuel - main system												4367.8734	(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)												462.3700	(232)
Total delivered energy for all uses												7500.2038	(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	4367.8734	0.2160	943.4607	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2594.9603	0.2160	560.5114	(264)
Space and water heating			1503.9721	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	462.3700	0.5190	239.9700	(268)
Total CO2, kg/m2/year			1782.8671	(272)
Emissions per m2 for space and water heating			13.7199	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.1891	(272b)
Emissions per m2 for pumps and fans			0.3551	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.7199 * 1.55) + 2.1891 + 0.3551, rounded to 2 d.p.			23.8100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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) =	0.1460	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3960	(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) =	0.3366	(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	0.4291	0.4207	0.4123	0.3702	0.3618	0.3197	0.3197	0.3113	0.3366	0.3618	0.3786	0.3955	(22b)
Effective ac	0.5921	0.5885	0.5850	0.5685	0.5655	0.5511	0.5511	0.5485	0.5566	0.5655	0.5717	0.5782	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.7852	(36)
Total fabric heat loss					(33) + (36) =		53.6326	(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	53.5449	53.2216	52.9047	51.4160	51.1375	49.8410	49.8410	49.6009	50.3404	51.1375	51.7010	52.2900	(38)
Heat transfer coeff	107.1775	106.8542	106.5373	105.0487	104.7701	103.4736	103.4736	103.2335	103.9730	104.7701	105.3336	105.9226	(39)
Average = Sum(39)m / 12 =												105.0473	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9777	0.9748	0.9719	0.9583	0.9558	0.9439	0.9439	0.9417	0.9485	0.9558	0.9609	0.9663	(40)
HLP (average)												0.9583	(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												2.8125	(42)
Average daily hot water use (litres/day)												100.9975	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(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

	35.0102	30.6202	31.5973	27.5473	26.4323	22.8090	21.1359	24.2538	24.5434	28.6030	31.2224	33.9055 (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	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	(66)

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

	26.9670	23.9519	19.4790	14.7468	11.0234	9.3064	10.0559	13.0711	17.5440	22.2761	25.9995	27.7165	(67)

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

	271.0089	273.8212	266.7344	251.6477	232.6033	214.7043	202.7467	199.9345	207.0212	222.1080	241.1523	259.0513	(68)

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

	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	(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)

	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)

Water heating gains (Table 5)

	47.0568	45.5657	42.4694	38.2601	35.5272	31.6792	28.4085	32.5992	34.0881	38.4449	43.3645	45.5719	(72)

Total internal gains

	410.2206	408.5266	393.8707	369.8425	344.3419	320.8779	306.3990	310.7926	323.8412	348.0169	375.7042	397.5277	(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	0.5700	0.0000	0.7700	43.8259	(75)
Southwest	5.8100	36.7938	0.5700	0.0000	0.7700	93.8246	(79)

Solar gains	137.6505	249.0270	379.3961	534.9012	658.2905	679.5510	644.3310	548.2989	432.6207	285.6534	167.5246	116.0848	(83)
Total gains	547.8711	657.5536	773.2669	904.7437	1002.6323	1000.4289	950.7300	859.0915	756.4619	633.6703	543.2288	513.6124	(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	28.4108	28.4968	28.5815	28.9866	29.0636	29.4278	29.4278	29.4962	29.2864	29.0636	28.9082	28.7474	
alpha	2.8941	2.8998	2.9054	2.9324	2.9376	2.9619	2.9619	2.9664	2.9524	2.9376	2.9272	2.9165	
util living area	0.9772	0.9611	0.9283	0.8558	0.7353	0.5800	0.4491	0.5057	0.7269	0.9034	0.9648	0.9809	(86)
MIT	18.8257	19.1115	19.5636	20.1326	20.5856	20.8562	20.9503	20.9290	20.7064	20.0964	19.3605	18.7795	(87)
Th 2	20.1019	20.1044	20.1068	20.1182	20.1204	20.1303	20.1303	20.1322	20.1265	20.1204	20.1160	20.1115	(88)
util rest of house	0.9739	0.9555	0.9178	0.8345	0.6965	0.5194	0.3700	0.4246	0.6730	0.8844	0.9587	0.9781	(89)
MIT 2	18.0913	18.3756	18.8216	19.3789	19.7991	20.0381	20.1066	20.0961	19.9206	19.3567	18.6332	18.0523	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	18.1947	18.4792	18.9261	19.4851	19.9099	20.1533	20.2254	20.2134	20.0313	19.4609	18.7357	18.1548	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1947	18.4792	18.9261	19.4851	19.9099	20.1533	20.2254	20.2134	20.0313	19.4609	18.7357	18.1548	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9643	0.9423	0.9006	0.8168	0.6864	0.5211	0.3790	0.4326	0.6665	0.8671	0.9464	0.9696	(94)
Useful gains	528.3012	619.5944	696.4223	738.9820	688.1924	521.3642	360.3047	371.6040	504.1660	549.4349	514.0937	498.0057	(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	1489.2008	1450.9972	1323.8402	1111.9486	860.1532	574.6183	375.1327	393.6696	616.6945	928.3597	1225.6254	1478.1242	(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	714.9092	558.7027	466.7989	268.5359	127.9389	0.0000	0.0000	0.0000	0.0000	281.9201	512.3028	729.2082	(98)
Space heating												3660.3167	(98)
Space heating per m2											(98) / (4) =	33.3910	(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	972.6518	765.7046	784.5746	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8396	0.8887	0.8612	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	816.6139	680.5174	675.6588	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1280.6181	1220.2076	1115.4936	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	334.0830	401.5296	327.2371	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1062.8497	(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   83.5208  100.3824   81.8093    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        265.7124 (107)
Space cooling per m2                                                                                                   2.4239 (108)
Energy for space heating                                                                                              33.3910 (99)
Energy for space cooling                                                                                               2.4239 (108)
Total                                                                                                                 35.8149 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                              35.8 (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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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) =	0.1460	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3960	(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) =	0.3366	(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	0.4291	0.4207	0.4123	0.3702	0.3618	0.3197	0.3197	0.3113	0.3366	0.3618	0.3786	0.3955	(22b)
Effective ac	0.5921	0.5885	0.5850	0.5685	0.5655	0.5511	0.5511	0.5485	0.5566	0.5655	0.5717	0.5782	(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			54.8100	0.1300	7.1253			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.1800	15.8976			(29a)
External Roof 1	54.8100		54.8100	0.1300	7.1253			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7038			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2595	(36)
Total fabric heat loss					(33) + (36) =		61.9633	(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	53.5449	53.2216	52.9047	51.4160	51.1375	49.8410	49.8410	49.6009	50.3404	51.1375	51.7010	52.2900	(38)
Heat transfer coeff	115.5082	115.1849	114.8680	113.3793	113.1008	111.8043	111.8043	111.5642	112.3037	113.1008	113.6643	114.2533	(39)
Average = Sum(39)m / 12 =												113.3780	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0537	1.0508	1.0479	1.0343	1.0318	1.0199	1.0199	1.0177	1.0245	1.0318	1.0369	1.0423	(40)
HLP (average)												1.0343	(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												2.8125	(42)
Average daily hot water use (litres/day)												100.9975	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(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													
	35.0102	30.6202	31.5973	27.5473	26.4323	22.8090	21.1359	24.2538	24.5434	28.6030	31.2224	33.9055	(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	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	140.6263	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.1813	23.2540	18.9114	14.3172	10.7022	9.0353	9.7629	12.6903	17.0328	21.6271	25.2420	26.9090	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.0089	273.8212	266.7344	251.6477	232.6033	214.7043	202.7467	199.9345	207.0212	222.1080	241.1523	259.0513	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	37.0626	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	47.0568	45.5657	42.4694	38.2601	35.5272	31.6792	28.4085	32.5992	34.0881	38.4449	43.3645	45.5719	(72)
Total internal gains													
	409.4349	407.8288	393.3032	369.4128	344.0207	320.6067	306.1060	310.4118	323.3300	347.3678	374.9467	396.7201	(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	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	505.2831	581.2302	657.4827	741.8730	802.3987	793.7888	754.7638	692.2009	624.5706	546.2728	491.5967	477.5518	(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	65.9044	66.0894	66.2717	67.1419	67.3072	68.0877	68.0877	68.2343	67.7849	67.3072	66.9736	66.6283	
alpha	5.3936	5.4060	5.4181	5.4761	5.4871	5.5392	5.5392	5.5490	5.5190	5.4871	5.4649	5.4419	
util living area													
	0.9995	0.9987	0.9961	0.9839	0.9351	0.7999	0.6292	0.6990	0.9218	0.9920	0.9988	0.9996	(86)
MIT	19.7582	19.8884	20.1177	20.4381	20.7360	20.9293	20.9851	20.9742	20.8254	20.4446	20.0475	19.7398	(87)
Th 2	20.0388	20.0412	20.0436	20.0549	20.0570	20.0668	20.0668	20.0686	20.0630	20.0570	20.0527	20.0483	(88)
util rest of house													
	0.9993	0.9982	0.9945	0.9770	0.9060	0.7192	0.5072	0.5778	0.8745	0.9876	0.9983	0.9995	(89)
MIT 2	18.8938	19.0258	19.2563	19.5823	19.8659	20.0314	20.0626	20.0604	19.9547	19.5928	19.1941	18.8830	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	19.0155	19.1473	19.3777	19.7029	19.9885	20.1578	20.1925	20.1891	20.0774	19.7128	19.3143	19.0037	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0155	19.1473	19.3777	19.7029	19.9885	20.1578	20.1925	20.1891	20.0774	19.7128	19.3143	19.0037	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9976	0.9931	0.9737	0.9034	0.7280	0.5245	0.5947	0.8754	0.9853	0.9978	0.9993	(94)
Useful gains	504.7716	579.8557	652.9435	722.3297	724.9206	577.8415	395.8567	411.6226	546.7543	538.2603	490.5046	477.2000	(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													
	1699.7671	1641.0724	1479.2315	1224.8217	937.4313	621.3888	401.6583	422.7257	671.2790	1030.6620	1388.3329	1691.3695	(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													
	889.0766	713.1376	614.7583	361.7942	158.1080	0.0000	0.0000	0.0000	0.0000	366.3469	646.4364	903.3421	(98)
Space heating												4653.0002	(98)
Space heating per m2											(98) / (4) =	42.4466	(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	1050.9603	827.3517	847.8878	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8421	0.9122	0.8796	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	884.9866	754.7256	745.8195	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1038.7298	990.7663	919.9197	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	110.6951	175.6143	129.5306	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												415.8399	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
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   27.6738   43.9036   32.3826    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          103.9600 (107)
Space cooling per m2                                                                                                     0.9484 (108)
Energy for space heating                                                                                                42.4466 (99)
Energy for space cooling                                                                                                 0.9484 (108)
Total                                                                                                                   43.3950 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                     49.9 (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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 = 98.8509 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9018	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Water storage loss:
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

	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498 (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

	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498 (64)

Total per year (kWh/year) = Sum(64)m = 2217.7597 (64)
RHI water heating demand 2218 (64)
Heat gains from water heating, kWh/month

	97.4962	86.4933	92.1559	84.4410	84.0742	77.0270	75.7870	80.6655	79.7409	87.4708	90.1915	95.7677 (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	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)

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

	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913 (67)

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

	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437 (68)

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

	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877 (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)

	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010 (71)

Water heating gains (Table 5)

	131.0433	128.7103	123.8655	117.2791	113.0030	106.9820	101.8643	108.4214	110.7512	117.5683	125.2660	128.7200 (72)
Total internal gains												
	713.8900	708.2165	681.6123	640.6779	598.6689	561.6405	540.5493	550.4470	574.5362	615.7013	661.1318	695.5933 (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	0.5700	0.0000	0.7700	51.8193	(75)
Southwest	5.8100	41.5040	0.5700	0.0000	0.7700	105.8356	(79)

Solar gains	157.6549	244.9514	385.6826	556.4015	668.4686	738.6606	696.2303	595.2476	468.5561	318.8096	190.4343	127.2979 (83)
Total gains	871.5450	953.1678	1067.2948	1197.0794	1267.1375	1300.3011	1236.7796	1145.6946	1043.0924	934.5109	851.5662	822.8911 (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	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area													
	0.9201	0.8961	0.8346	0.7266	0.5795	0.3941	0.2680	0.3045	0.5335	0.7629	0.8853	0.9308	(86)
Tweekday	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	
Tweekend	20.1012	20.2184	20.4657	20.7151	20.8893	20.9754	20.9947	20.9920	20.9350	20.7165	20.3649	20.0483	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.6128	19.7910	20.1754	20.5551	20.8291	20.9622	20.9918	20.9876	20.8986	20.5625	20.0083	19.5312	(87)
Th 2	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house													
	0.9101	0.8835	0.8149	0.6959	0.5354	0.3380	0.2038	0.2364	0.4746	0.7286	0.8692	0.9219	(89)
Tweekday	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	
Tweekend	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	
MIT 2	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	(90)
Living area fraction										fLA = Living area / (4) =		0.1409	(91)
MIT	18.5040	18.7499	19.2652	19.7687	20.1036	20.2517	20.2787	20.2758	20.1899	19.7832	19.0618	18.3928	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5040	18.7499	19.2652	19.7687	20.1036	20.2517	20.2787	20.2758	20.1899	19.7832	19.0618	18.3928	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8852	0.8576	0.7905	0.6800	0.5320	0.3439	0.2126	0.2455	0.4764	0.7111	0.8435	0.8979	(94)
Useful gains	771.4806	817.4004	843.7405	814.0646	674.0732	447.2029	262.9106	281.2374	496.9332	664.5495	718.2563	738.9027	(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													
	1334.8863	1309.7593	1182.7676	995.2995	741.7331	459.8206	264.7946	284.2783	532.7949	838.5687	1113.2357	1333.7782	(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)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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Space heating kWh
              419.1738   330.8652   252.2361   130.4892    50.3390     0.0000     0.0000     0.0000     0.0000   129.4703   284.3852   442.5873 (98)
Space heating                                                                                                                      2039.5461 (98)
RHI space heating demand                                                                                                              2040 (98)
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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	54.8100 (1b)	x	2.3500 (2b)	=	128.8035	(1b) - (3b)
First floor	54.8100 (1c)	x	2.6500 (2c)	=	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	47.1118	46.6313	46.1509	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	100.7444	100.2639	99.7835	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 = 99.2041 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9190	0.9147	0.9103	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9050	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water storage loss:

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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
									Total per year (kWh/year) = Sum(64)m =			2217.7597	(64)
Heat gains from water heating, kWh/month													
	97.4962	86.4933	92.1559	84.4410	84.0742	77.0270	75.7870	80.6655	79.7409	87.4708	90.1915	95.7677	(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	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	131.0433	128.7103	123.8655	117.2791	113.0030	106.9820	101.8643	108.4214	110.7512	117.5683	125.2660	128.7200	(72)
Total internal gains													
	713.8900	708.2165	681.6123	640.6779	598.6689	561.6405	540.5493	550.4470	574.5362	615.7013	661.1318	695.5933	(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	0.5700	0.0000	0.7700	43.8259	(75)
Southwest	5.8100	36.7938	0.5700	0.0000	0.7700	93.8246	(79)

Solar gains	137.6505	249.0270	379.3961	534.9012	658.2905	679.5510	644.3310	548.2989	432.6207	285.6534	167.5246	116.0848	(83)
Total gains	851.5406	957.2434	1061.0084	1175.5792	1256.9594	1241.1915	1184.8803	1098.7459	1007.1569	901.3546	828.6565	811.6781	(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	30.2250	30.3698	30.5161	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0150	3.0247	3.0344	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area													
	0.9322	0.9046	0.8543	0.7598	0.6262	0.4756	0.3560	0.3970	0.5935	0.8004	0.9027	0.9392	(86)
Tweekday	18.0489	18.4018	18.9227	19.5066	19.9049	20.0967	20.1499	20.1421	20.0178	19.5115	18.7173	18.0190	
Tweekend	19.9823	20.1415	20.3789	20.6508	20.8476	20.9512	20.9849	20.9786	20.9028	20.6466	20.2784	19.9644	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.4294	19.6720	20.0415	20.4548	20.7648	20.9250	20.9766	20.9670	20.8482	20.4545	19.8733	19.4017	(87)
Th 2	20.1514	20.1551	20.1588	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house													
	0.9238	0.8931	0.8371	0.7326	0.5862	0.4219	0.2923	0.3305	0.5390	0.7711	0.8892	0.9316	(89)
Tweekday	18.0489	18.4018	18.9227	19.5066	19.9049	20.0967	20.1499	20.1421	20.0178	19.5115	18.7173	18.0190	
Tweekend	18.0489	18.4018	18.9227	19.5066	19.9049	20.0967	20.1499	20.1421	20.0178	19.5115	18.7173	18.0190	
MIT 2	18.0489	18.4018	18.9227	19.5066	19.9049	20.0967	20.1499	20.1421	20.0178	19.5115	18.7173	18.0190	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	18.2433	18.5807	19.0803	19.6402	20.0260	20.2134	20.2664	20.2583	20.1348	19.6443	18.8801	18.2138	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2433	18.5807	19.0803	19.6402	20.0260	20.2134	20.2664	20.2583	20.1348	19.6443	18.8801	18.2138	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8995	0.8669	0.8114	0.7137	0.5792	0.4251	0.3001	0.3380	0.5369	0.7502	0.8636	0.9086	(94)
Useful gains	765.9216	829.8726	860.8607	838.9967	727.9787	527.5871	355.6117	371.4190	540.7258	676.2204	715.6386	737.4810	(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													
	1404.7116	1371.6829	1255.3076	1061.6755	823.0310	554.8885	362.4240	381.3964	596.5443	894.0370	1164.4730	1385.2724	(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													

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	475.2597	364.0965	293.4685	160.3287	70.7189	0.0000	0.0000	0.0000	0.0000	162.0555	323.1608	481.9568 (98)
Space heating												2331.0454 (98)
Space heating per m2											(98) / (4) =	21.2648 (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 %)													294.3676 (206)
Efficiency of secondary/supplementary heating system, %													100.0000 (208)
Space heating requirement													791.8826 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	475.2597	364.0965	293.4685	160.3287	70.7189	0.0000	0.0000	0.0000	0.0000	162.0555	323.1608	481.9568	(98)
Space heating efficiency (main heating system 1)													
	294.3676	294.3676	294.3676	294.3676	294.3676	0.0000	0.0000	0.0000	0.0000	294.3676	294.3676	294.3676	(210)
Space heating fuel (main heating system)													
	161.4511	123.6877	99.6946	54.4655	24.0240	0.0000	0.0000	0.0000	0.0000	55.0521	109.7814	163.7262	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month													
	79.7603	70.3176	73.8880	66.2899	65.0012	58.1374	55.8884	61.2529	61.1216	68.7362	72.6133	77.8596	(219)
Water heating fuel used												810.8662	(219)
Annual totals kWh/year													
Space heating fuel - main system												791.8826	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
Total electricity for the above, kWh/year												61.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1029 * 1.00) =										-988.0192		-988.0192	(233)
Total delivered energy for all uses												1152.4945	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	791.8826	13.1900	104.4493	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	810.8662	13.1900	106.9533	(247)
Mechanical ventilation fans	61.5187	13.1900	8.1143	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	476.2462	13.1900	62.8169	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-988.0192	13.1900	-130.3197	(252)
Total energy cost			152.0140	(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] =		0.4129 (257)
SAP value			94.2397
SAP rating (Section 12)			94 (258)
SAP band			A

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	791.8826	0.5190	410.9871	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	810.8662	0.5190	420.8396	(264)
Space and water heating			831.8266	(265)
Pumps and fans	61.5187	0.5190	31.9282	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-988.0192	0.5190	-512.7820	(269)
Total kg/year			598.1447	(272)
CO2 emissions per m2			5.4600	(273)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI value	94.8162
EI rating	95 (274)
EI band	A

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 2.9437 = 4.481, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.9437 = 0.1763, stars = 5
Water heating energy efficiency	13.19 / 2.7351 = 4.823, stars = 4
Water heating environmental impact	0.519 / 2.7351 = 0.1898, stars = 5

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	54.8100	(1b)	x 2.3500	(2b) =	128.8035	(1b) - (3b)
First floor	54.8100	(1c)	x 2.6500	(2c) =	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)
Average = Sum(39)m / 12 =												98.8509	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9018	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

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

Water storage loss:

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)

Total per year (kWh/year) = Sum(64)m = 2217.7597 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	97.4962	86.4933	92.1559	84.4410	84.0742	77.0270	75.7870	80.6655	79.7409	87.4708	90.1915	95.7677	(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	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)	131.0433	128.7103	123.8655	117.2791	113.0030	106.9820	101.8643	108.4214	110.7512	117.5683	125.2660	128.7200	(72)
Total internal gains	713.8900	708.2165	681.6123	640.6779	598.6689	561.6405	540.5493	550.4470	574.5362	615.7013	661.1318	695.5933	(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	8.8500	13.3408	0.5700	0.0000	0.7700	51.8193	(75)
Southwest	5.8100	41.5040	0.5700	0.0000	0.7700	105.8356	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	157.6549	244.9514	385.6826	556.4015	668.4686	738.6606	696.2303	595.2476	468.5561	318.8096	190.4343	127.2979	(83)
Total gains	871.5450	953.1678	1067.2948	1197.0794	1267.1375	1300.3011	1236.7796	1145.6946	1043.0924	934.5109	851.5662	822.8911	(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	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area	0.9201	0.8961	0.8346	0.7266	0.5795	0.3941	0.2680	0.3045	0.5335	0.7629	0.8853	0.9308	(86)
Tweekday	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	
Tweekend	20.1012	20.2184	20.4657	20.7151	20.8893	20.9754	20.9947	20.9920	20.9350	20.7165	20.3649	20.0483	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.6128	19.7910	20.1754	20.5551	20.8291	20.9622	20.9918	20.9876	20.8986	20.5625	20.0083	19.5312	(87)
Th 2	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house	0.9101	0.8835	0.8149	0.6959	0.5354	0.3380	0.2038	0.2364	0.4746	0.7286	0.8692	0.9219	(89)
Tweekday	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	
Tweekend	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	
MIT 2	18.3223	18.5792	19.1159	19.6398	19.9846	20.1352	20.1618	20.1591	20.0737	19.6554	18.9066	18.2062	(90)

Living area fraction fLA = Living area / (4) = 0.1409 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.5040	18.7499	19.2652	19.7687	20.1036	20.2517	20.2787	20.2758	20.1899	19.7832	19.0618	18.3928	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	18.5040	18.7499	19.2652	19.7687	20.1036	20.2517	20.2787	20.2758	20.1899	19.7832	19.0618	18.3928	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8852	0.8576	0.7905	0.6800	0.5320	0.3439	0.2126	0.2455	0.4764	0.7111	0.8435	0.8979	(94)
Useful gains	771.4806	817.4004	843.7405	814.0646	674.0732	447.2029	262.9106	281.2374	496.9332	664.5495	718.2563	738.9027	(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	1334.8863	1309.7593	1182.7676	995.2995	741.7331	459.8206	264.7946	284.2783	532.7949	838.5687	1113.2357	1333.7782	(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

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

	419.1738	330.8652	252.2361	130.4892	50.3390	0.0000	0.0000	0.0000	0.0000	129.4703	284.3852	442.5873 (98)
Space heating												2039.5461 (98)
Space heating per m2											(98) / (4) =	18.6056 (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 %)												293.6297	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												694.5980	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	419.1738	330.8652	252.2361	130.4892	50.3390	0.0000	0.0000	0.0000	0.0000	129.4703	284.3852	442.5873	(98)
Space heating efficiency (main heating system 1)													
	293.6297	293.6297	293.6297	293.6297	293.6297	0.0000	0.0000	0.0000	0.0000	293.6297	293.6297	293.6297	(210)
Space heating fuel (main heating system)													
	142.7559	112.6811	85.9028	44.4400	17.1437	0.0000	0.0000	0.0000	0.0000	44.0930	96.8516	150.7297	(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													
	218.1484	192.3221	202.0874	181.3062	177.7815	159.0086	152.8575	167.5298	167.1705	187.9968	198.6011	212.9498	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month													
	79.7603	70.3176	73.8880	66.2899	65.0012	58.1374	55.8884	61.2529	61.1216	68.7362	72.6133	77.8596	(219)
Water heating fuel used												810.8662	(219)
Annual totals kWh/year													
Space heating fuel - main system												694.5980	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
Total electricity for the above, kWh/year												61.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1096 * 1.00) =										-1052.0028		-1052.0028	(233)
Total delivered energy for all uses												991.2263	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	694.5980	19.4400	135.0298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	810.8662	19.4400	157.6324	(247)
Mechanical ventilation fans	61.5187	19.4400	11.9592	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	476.2462	19.4400	92.5823	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1052.0028	19.4400	-204.5094	(252)
Total energy cost			192.6944	(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	694.5980	0.5190	360.4964	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	810.8662	0.5190	420.8396	(264)
Space and water heating			781.3359	(265)
Pumps and fans	61.5187	0.5190	31.9282	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-1052.0028	0.5190	-545.9895	(269)
Total kg/year			514.4465	(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	694.5980	3.0700	2132.4158	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	810.8662	3.0700	2489.3594	(264)
Space and water heating			4621.7752	(265)

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

Pumps and fans	61.5187	3.0700	188.8625 (267)
Energy for lighting	476.2462	3.0700	1462.0758 (268)
Energy saving/generation technologies			
PV Unit	-1052.0028	3.0700	-3229.6487 (269)
Primary energy kWh/year			3043.0649 (272)
Primary energy kWh/m2/year			27.7601 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 94
Current environmental impact rating: A 95

(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	+ 1.5	-£ 58	-156 kg (30.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£58	1.42 kg/m²	A 96	A 96
Total Savings	£58	1.42 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 493 TEST (31 Mar 2022)
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	£397	£339	£58
Space heating	£147	£147	-£0
Water heating	£158	£99	£59
Lighting	£93	£93	£0
Generated (PV)	-£205	-£205	£0
Total cost of fuels	£192	£134	£58
Total cost of uses	£193	£134	£59
Delivered energy	9 kWh/m²	6 kWh/m²	3 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	1 kg/m²
Primary energy	28 kWh/m²	19 kWh/m²	8 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	54.8100	(1b)	x 2.3500	(2b) =	128.8035	(1b) - (3b)
First floor	54.8100	(1c)	x 2.6500	(2c) =	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		274.0500	(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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	47.1118	46.6313	46.1509	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	100.7444	100.2639	99.7835	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 = 99.2041 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9190	0.9147	0.9103	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9050	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Water storage loss:													
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	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													
	218.1484	192.3221	200.6917	174.5526	164.9872	146.4019	139.8306	155.4333	161.7677	186.6011	198.6011	212.9498	(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												1.1413	(H8)
Utilisation factor												0.5836	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.9975	(H14)
Volume ratio Veff/V												0.7426	(H15)
Solar storage volume factor												0.9405	(H16)
Solar input												-875.3245	(H17)
Solar input	-25.3827	-42.3564	-72.1378	-96.6788	-119.4385	-117.4271	-115.8752	-101.2408	-79.2918	-54.1470	-30.1075	-21.2410	(63)
									Solar input (sum of months) = Sum(63)m =			-875.3245	(63)
Output from w/h													
	192.7657	149.9657	128.5539	77.8738	45.5486	28.9748	23.9553	54.1926	82.4758	132.4541	168.4936	191.7089	(64)
									Total per year (kWh/year) = Sum(64)m =			1276.9628	(64)
Heat gains from water heating, kWh/month													
	97.4962	86.4933	91.0394	79.0381	73.8388	66.9416	65.3655	70.9884	75.4186	86.3542	90.1915	95.7677	(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	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	131.0433	128.7103	122.3647	109.7751	99.2457	92.9745	87.8568	95.4145	104.7480	116.0675	125.2660	128.7200	(72)
Total internal gains													
	713.8900	708.2165	680.1115	633.1739	584.9116	547.6330	526.5418	537.4401	568.5330	614.2005	661.1318	695.5933	(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	0.5700	0.0000	0.7700	43.8259	(75)
Southwest	5.8100	36.7938	0.5700	0.0000	0.7700	93.8246	(79)

Solar gains	137.6505	249.0270	379.3961	534.9012	658.2905	679.5510	644.3310	548.2989	432.6207	285.6534	167.5246	116.0848	(83)
Total gains	851.5406	957.2434	1059.5076	1168.0752	1243.2020	1227.1840	1170.8728	1085.7390	1001.1537	899.8538	828.6565	811.6781	(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	30.2250	30.3698	30.5161	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0150	3.0247	3.0344	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area													
	0.9322	0.9046	0.8546	0.7622	0.6309	0.4801	0.3599	0.4012	0.5960	0.8010	0.9027	0.9392	(86)
Tweekday	18.0489	18.4018	18.9206	19.4999	19.8990	20.0948	20.1494	20.1414	20.0159	19.5099	18.7173	18.0190	
Tweekend	19.9823	20.1415	20.3780	20.6474	20.8444	20.9499	20.9844	20.9780	20.9016	20.6458	20.2784	19.9644	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.4294	19.6720	20.0400	20.4495	20.7598	20.9230	20.9759	20.9660	20.8464	20.4533	19.8733	19.4017	(87)
Th 2	20.1514	20.1551	20.1588	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house													
	0.9238	0.8931	0.8375	0.7351	0.5909	0.4261	0.2956	0.3342	0.5415	0.7717	0.8892	0.9316	(89)
Tweekday	18.0489	18.4018	18.9206	19.4999	19.8990	20.0948	20.1494	20.1414	20.0159	19.5099	18.7173	18.0190	
Tweekend	18.0489	18.4018	18.9206	19.4999	19.8990	20.0948	20.1494	20.1414	20.0159	19.5099	18.7173	18.0190	
MIT 2	18.0489	18.4018	18.9206	19.4999	19.8990	20.0948	20.1494	20.1414	20.0159	19.5099	18.7173	18.0190	(90)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Living area fraction											fLA = Living area / (4) =	0.1409	(91)
MIT	18.2433	18.5807	19.0783	19.6336	20.0202	20.2115	20.2658	20.2575	20.1329	19.6428	18.8801	18.2138	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2433	18.5807	19.0783	19.6336	20.0202	20.2115	20.2658	20.2575	20.1329	19.6428	18.8801	18.2138	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8995	0.8669	0.8118	0.7160	0.5835	0.4292	0.3035	0.3417	0.5393	0.7508	0.8636	0.9086	(94)
Useful gains	765.9216	829.8726	860.0764	836.3426	725.4571	526.6747	355.3441	371.0386	539.8723	675.6038	715.6386	737.4810	(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	1404.7116	1371.6829	1255.1054	1061.0283	822.4628	554.6979	362.3702	381.3193	596.3566	893.8840	1164.4730	1385.2724	(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	475.2597	364.0965	293.9016	161.7737	72.1722	0.0000	0.0000	0.0000	0.0000	162.4005	323.1608	481.9568	(98)
Space heating												2334.7217	(98)
Space heating per m2											(98) / (4) =	21.2983	(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 %)												294.3676	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												793.1315	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	475.2597	364.0965	293.9016	161.7737	72.1722	0.0000	0.0000	0.0000	0.0000	162.4005	323.1608	481.9568	(98)
Space heating efficiency (main heating system 1)	294.3676	294.3676	294.3676	294.3676	294.3676	0.0000	0.0000	0.0000	0.0000	294.3676	294.3676	294.3676	(210)
Space heating fuel (main heating system)	161.4511	123.6877	99.8417	54.9563	24.5177	0.0000	0.0000	0.0000	0.0000	55.1693	109.7814	163.7262	(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	192.7657	149.9657	128.5539	77.8738	45.5486	28.9748	23.9553	54.1926	82.4758	132.4541	168.4936	191.7089	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	70.4798	54.8311	47.0024	28.4725	16.6537	10.5939	8.7586	19.8141	30.1551	48.4284	61.6053	70.0934	(219)
Water heating fuel used												466.8883	(219)
Annual totals kWh/year													
Space heating fuel - main system												793.1315	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												111.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1029 * 1.00) =										-988.0192		-988.0192	(233)
Total delivered energy for all uses												859.7654	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	793.1315	13.1900	104.6140	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	466.8883	13.1900	61.5826	(247)
Mechanical ventilation fans	61.5187	13.1900	8.1143	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	476.2462	13.1900	62.8169	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-988.0192	13.1900	-130.3197	(252)
Total energy cost			113.4031	(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] =	0.3080	(257)
SAP value		95.7028	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP rating (Section 12)	96 (258)
SAP band	A

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	793.1315	0.5190	411.6352	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	466.8883	0.5190	242.3150	(264)
Space and water heating			653.9502	(265)
Pumps and fans	111.5187	0.5190	57.8782	(267)
Energy for lighting	476.2462	0.5190	247.1718	(268)
Energy saving/generation technologies				
PV Unit	-988.0192	0.5190	-512.7820	(269)
Total kg/year			446.2183	(272)
CO2 emissions per m2			4.0700	(273)
EI value			96.1329	
EI rating			96	(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	54.8100	(1b)	x 2.3500	(2b) =	128.8035	(1b) - (3b)
First floor	54.8100	(1c)	x 2.6500	(2c) =	145.2465	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.6200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	274.0500	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 = 1.00)			14.6600	0.9615	14.0962			(27)
Heat Loss Floor 1			54.8100	0.0900	4.9329			(28a)
External Wall 1	105.1000	16.7800	88.3200	0.2300	20.3136			(29a)
External Roof 1	54.8100		54.8100	0.0800	4.3848			(30)
Total net area of external elements Aum(A, m2)			214.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8475			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.7852	(36)
Total fabric heat loss (33) + (36) =	53.6326	(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	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	45.2183	(38)
Heat transfer coeff	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	98.8509	(39)

Average = Sum(39)m / 12 =	98.8509 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	0.9018	(40)
HLP (average)												0.9018	(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	2.8125 (42)
Average daily hot water use (litres/day)	100.9975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.0972	107.0573	103.0174	98.9775	94.9376	90.8977	90.8977	94.9376	98.9775	103.0174	107.0573	111.0972	(44)
Energy conte	164.7540	144.0949	148.6930	129.6342	124.3871	107.3366	99.4631	114.1354	115.4985	134.6024	146.9291	159.5554	(45)
Energy content (annual)										Total = Sum(45)m =		1589.0837	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7131	21.6142	22.3040	19.4451	18.6581	16.1005	14.9195	17.1203	17.3248	20.1904	22.0394	23.9333	(46)

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

Water storage loss:													
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	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													
	218.1484	192.3221	200.6917	174.5526	164.9872	146.4019	139.8306	155.4333	161.7677	186.6011	198.6011	212.9498	(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												1.2106	(H8)
Utilisation factor												0.5622	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.9975	(H14)
Volume ratio Veff/V												0.7426	(H15)
Solar storage volume factor												0.9405	(H16)
Solar input												-894.4183	(H17)
Solar input	-28.1948	-40.2919	-70.5527	-96.2748	-115.8881	-121.9425	-119.6194	-105.1061	-82.4389	-58.3358	-33.1689	-22.6044	(63)
											Solar input (sum of months) = Sum(63)m =	-894.4183	(63)
Output from w/h													
	189.9536	152.0301	130.1389	78.2778	49.0991	24.4594	20.2112	50.3272	79.3287	128.2653	165.4322	190.3455	(64)
											Total per year (kWh/year) = Sum(64)m =	1257.8690	(64)
Heat gains from water heating, kWh/month													
	97.4962	86.4933	91.0394	79.0381	73.8388	66.9416	65.3655	70.9884	75.4186	86.3542	90.1915	95.7677	(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	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	168.7515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.4176	59.8797	48.6974	36.8671	27.5586	23.2661	25.1399	32.6777	43.8600	55.6903	64.9989	69.2913	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	404.4909	408.6883	398.1111	375.5935	347.1691	320.4542	302.6070	298.4096	308.9868	331.5044	359.9288	386.6437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	54.6877	(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)													
	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	-112.5010	(71)
Water heating gains (Table 5)													
	131.0433	128.7103	122.3647	109.7751	99.2457	92.9745	87.8568	95.4145	104.7480	116.0675	125.2660	128.7200	(72)
Total internal gains													
	713.8900	708.2165	680.1115	633.1739	584.9116	547.6330	526.5418	537.4401	568.5330	614.2005	661.1318	695.5933	(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	0.5700	0.0000	0.7700	51.8193	(75)
Southwest	5.8100	41.5040	0.5700	0.0000	0.7700	105.8356	(79)

Solar gains	157.6549	244.9514	385.6826	556.4015	668.4686	738.6606	696.2303	595.2476	468.5561	318.8096	190.4343	127.2979	(83)
Total gains	871.5450	953.1678	1065.7940	1189.5754	1253.3802	1286.2936	1222.7721	1132.6877	1037.0892	933.0101	851.5662	822.8911	(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	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	30.8040	
alpha	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	3.0536	
util living area													
	0.9201	0.8961	0.8350	0.7291	0.5841	0.3980	0.2710	0.3078	0.5359	0.7635	0.8853	0.9308	(86)
Tweekday	18.3223	18.5792	19.1140	19.6341	19.9803	20.1343	20.1617	20.1589	20.0725	19.6541	18.9066	18.2062	
Tweekend	20.1012	20.2184	20.4648	20.7122	20.8868	20.9747	20.9945	20.9917	20.9342	20.7158	20.3649	20.0483	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.6128	19.7910	20.1740	20.5506	20.8253	20.9612	20.9916	20.9872	20.8973	20.5615	20.0083	19.5312	(87)
Th 2	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	20.1660	(88)
util rest of house													
	0.9101	0.8835	0.8154	0.6985	0.5400	0.3415	0.2061	0.2390	0.4769	0.7293	0.8692	0.9219	(89)
Tweekday	18.3223	18.5792	19.1140	19.6341	19.9803	20.1343	20.1617	20.1589	20.0725	19.6541	18.9066	18.2062	
Tweekend	18.3223	18.5792	19.1140	19.6341	19.9803	20.1343	20.1617	20.1589	20.0725	19.6541	18.9066	18.2062	
MIT 2	18.3223	18.5792	19.1140	19.6341	19.9803	20.1343	20.1617	20.1589	20.0725	19.6541	18.9066	18.2062	(90)

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

Living area fraction										fLA = Living area / (4) =		0.1409	(91)
MIT	18.5040	18.7499	19.2633	19.7632	20.0993	20.2508	20.2786	20.2756	20.1886	19.7819	19.0618	18.3928	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5040	18.7499	19.2633	19.7632	20.0993	20.2508	20.2786	20.2756	20.1886	19.7819	19.0618	18.3928	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8852	0.8576	0.7910	0.6824	0.5363	0.3473	0.2150	0.2482	0.4786	0.7117	0.8435	0.8979	(94)
Useful gains	771.4806	817.4004	843.0174	811.7807	672.1642	446.7682	262.8352	281.1181	496.3609	664.0267	718.2563	738.9027	(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	1334.8863	1309.7593	1182.5842	994.7535	741.3138	459.7323	264.7796	284.2544	532.6726	838.4418	1113.2357	1333.7782	(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	419.1738	330.8652	252.6377	131.7404	51.4473	0.0000	0.0000	0.0000	0.0000	129.7648	284.3852	442.5873	(98)
Space heating												2042.6017	(98)
Space heating per m2											(98) / (4) =	18.6335	(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 %)	293.6297	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	695.6386	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	419.1738	330.8652	252.6377	131.7404	51.4473	0.0000	0.0000	0.0000	0.0000	129.7648	284.3852	442.5873	(98)
Space heating efficiency (main heating system 1)	293.6297	293.6297	293.6297	293.6297	293.6297	0.0000	0.0000	0.0000	0.0000	293.6297	293.6297	293.6297	(210)
Space heating fuel (main heating system)	142.7559	112.6811	86.0395	44.8662	17.5212	0.0000	0.0000	0.0000	0.0000	44.1934	96.8516	150.7297	(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	189.9536	152.0301	130.1389	78.2778	49.0991	24.4594	20.2112	50.3272	79.3287	128.2653	165.4322	190.3455	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	69.4516	55.5859	47.5819	28.6202	17.9518	8.9429	7.3897	18.4008	29.0045	46.8969	60.4860	69.5949	(219)
Water heating fuel used												459.9071	(219)
Annual totals kWh/year													
Space heating fuel - main system												695.6386	(211)
Space heating fuel - secondary												0.0000	(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)												61.5187	(230a)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												111.5187	(231)
Electricity for lighting (calculated in Appendix L)												476.2462	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1096 * 1.00) =										-1052.0028		-1052.0028	(233)
Total delivered energy for all uses												691.3079	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	695.6386	19.4400	135.2321	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	459.9071	19.4400	89.4059	(247)
Mechanical ventilation fans	61.5187	19.4400	11.9592	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	476.2462	19.4400	92.5823	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1052.0028	19.4400	-204.5094	(252)
Total energy cost			134.3902	(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	695.6386	0.5190	361.0364	(261)

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

Space heating - secondary		0.0000	0.5190	0.0000 (263)
Water heating (other fuel)		459.9071	0.5190	238.6918 (264)
Space and water heating				599.7282 (265)
Pumps and fans		111.5187	0.5190	57.8782 (267)
Energy for lighting		476.2462	0.5190	247.1718 (268)
Energy saving/generation technologies				
PV Unit		-1052.0028	0.5190	-545.9895 (269)
Total kg/year				358.7888 (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	695.6386	3.0700	2135.6106	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	459.9071	3.0700	1411.9149	(264)
Space and water heating			3547.5255	(265)
Pumps and fans	111.5187	3.0700	342.3625	(267)
Energy for lighting	476.2462	3.0700	1462.0758	(268)
Energy saving/generation technologies				
PV Unit	-1052.0028	3.0700	-3229.6487	(269)
Primary energy kWh/year			2122.3151	(272)
Primary energy kWh/m2/year			19.3607	(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	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	723.49 (P1)
Transmission heat loss coefficient	53.63 (37)
Summer heat loss coefficient	777.12 (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	0.5700	0.0000	0.9000	448.7625
South West	5.8100	119.9223	0.5700	0.0000	0.9000	357.4322
total:						806.1946

	Jun	Jul	Aug	
Solar gains	860	806	701	(P4)
Internal gains	562	541	550	
Total summer gains	1421	1347	1251	(P5)
Summer gain/loss ratio	1.83	1.73	1.61	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.13	20.93	20.71	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

COVE HOMES

Job no:	3693
Date:	24/05/2022
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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