Energy and Sustainability Statement

Former Builders Yard, Jack Straw's Lane, Oxford

PR8160
Date: 03/12/2020

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Notice

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Executive summary

ERS Consultants Ltd has been appointed to prepare an Energy & Sustainability Statement for the site located at the Former Builders Yard, Jack Straw's Lane, Oxford.

The proposal is for the redevelopment of existing light industrial unit to provide 4x 3-bed dwellings and 4x 4-bed dwellings provision of private amenity space i.e. car parking. This report will be focusing on the new build dwellings that are being proposed and look at implementing careful design and sustainable measures; so that the project creates attractive new residential units which will address current housing need within the Oxford city area.

Proposed schedules of accommodation are as follows:

- 4x3-bed semi-detached dwelling houses
- 4x4-bed semi-detached dwelling houses

Total combined floor area for habitable dwellings: 1054.76m²
(Drawings can be found in the appendix of this report)

This energy and sustainability report outlines the key measures to be incorporated in the design, in regards to sustainability, carbon emissions, renewable energy and environmental impact of the considered development in accordance and with guidance from the following documents and policies:

- Oxford local plan 2036 (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2019

In line with Oxford's Local plan Policy RE1, the development would need to achieve a 40% reduction in regulated CO_2 emissions against a Building Regulations (Part L 2013) compliant scheme.

In addition to passive design and energy efficiency measures, this energy and sustainability statement will demonstrate that the additional solar panels and a heat pump system provides an increased carbon emissions reduction compared to energy efficiency and passive measures alone.

A dynamic energy simulation has been undertaken to establish the energy consumption and carbon emissions of the proposed building.

The methodology used to determine the expected operational CO_2 emissions for the development is in accordance with the Oxford Local Plan's three-step Energy Hierarchy and the CO_2 savings achieved for each step are outlined below:

Baseline – (CO2 emissions Part L 2013 of the Building Regulation)

Initially in the energy assessment must be established that the regulated CO_2 emissions of the development comply with the Part L 2013 of the Building Regulations using the approved compliance software SAP. Baseline regulated CO2 emissions 24,777kgCO_2/year for the proposed dwelling houses.

Be Lean – Use less energy

The second step addresses reduction in energy demand, through the adoption of passive and active design measures with emphasis on a fabric first approach.

Emphasis will be put on the buildings fabric performance in order to reduce energy consumption, as less heating and cooling will be lost through the high performance fabric hence reducing the demand. Fabric first measures include levels of insulation beyond Building Regulation 2013 requirements which will help in achieving low air tightness levels.

With the addition of the lean fabric improvements the energy regulated CO_2 emissions are shown to reduce by 12.23% (21,747kgCO_2/year) for the proposed dwelling houses.

Be Clean – Supply energy efficiently

The space conditioning and hot water system network at Former Builders Yard, Jack Straw's Lane, will consist of high efficiency air source heat pumps in the houses. The heating system will be providing heating throughout each dwelling via radiators or underfloor heating.

A suitable analysis will be taken into account to see if this development can fit in with local heat networks, and provide guidance on this, during this stage of the report.

The hot water will be provided by storage cylinders with low hot water storage losses; these are fueled by heat pumps.

Additional measures to reduce energy will include low energy lighting without comprising the luminance as well as energy saving controls for heating and hot water.

With the addition of the clean energy regulated CO_2 emissions are shown to reduce by 35.84% (15,897kgCO_2/year) for the dwelling houses.

Be Green – Use renewable energy

The renewable technologies and feasibility studies carried out for the development identified Photovoltaic Panels (2.00kWp), as a suitable technology for the development. The incorporation of renewable technologies will further reduce CO_2 emissions on site by a further 42.12% (14,341kgCO_2/year) for the dwelling houses.

Solar photovoltaic panels are only to be installed on plots that fall short on the required reduction, these dwellings are identified as Plots 1, 2, 7 and 8.

The proposed dwellings individually each achieve a reduction of over 40%, thus meaning this proposed development using the proposed specification in this report completes the **40% Carbon Emissions Reduction** against Part L1A, 2013 Building Regulations, in accordance with the Oxford Local Plan's Policy RE1.

Energy & carbon demand summary

Table 1 Energy and Carbon Reductions for Houses

	Energy Consumption (kWh/Year)	Energy Consumption Savings (%)	CO_2 Emissions (kg CO_2/Year)	CO_2 Emissions Savings (%)
Baseline	71,509		24,777	
Be Lean	41,903	41.40%	21,747	12.23%
Be Clean	30,629	57.17%	15,897	35.84%
Be Green	27,632	61.36%	14,341	42.12%
Total Reduction		**61.36%**		**41.88%**

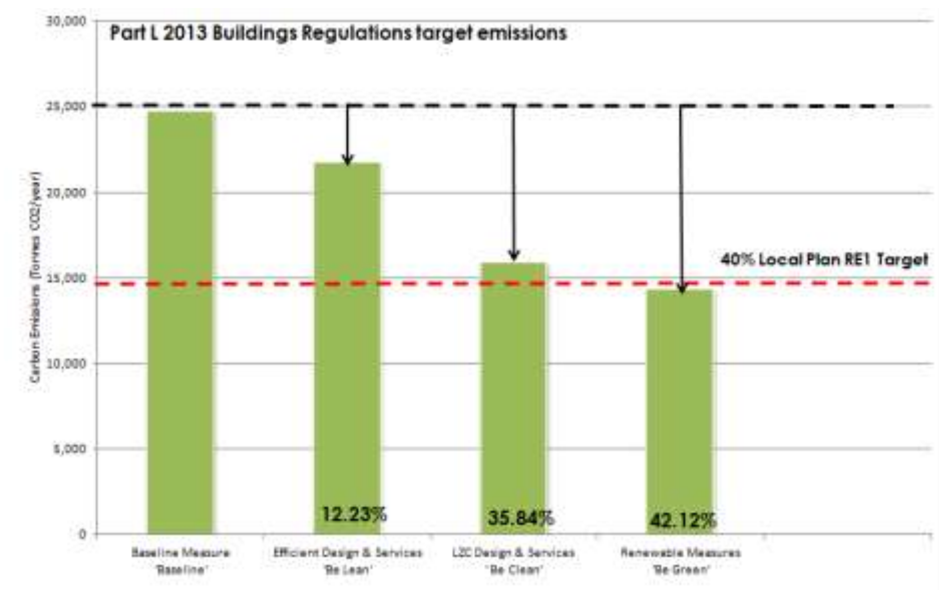


Fig.1 CO_2 Reduction

Table 1, the provisional baseline annual energy consumption of the houses has been estimated to be 71,509KWh/yr and the resulting annual carbon dioxide emissions are 24,713kg CO_2/yr.

The incorporation of energy saving measures and renewable energy sources, following the Oxford local plan guidance, the site would reduce the energy requirement and CO_2 emissions to 27,675kWh/year and 14,363kgCO_2/year respectively.

The total reduction with "Be Clean" and "Be Green" measures would result in a total of 41.88% reduction that is in comparison to the Part L 2013 Building regulations baseline as shown in Figure 1, achieving the required target.

Table 2. Proposed Specifications

Proposed Specifications			
Fabric	U-Value (W/m2K)	Walls	0.18 (External Wall) 150mm Dritherm 32 in cavity
		Floors	0.16
		Roof	0.12(Roof insulated at ceiling) 0.18(Pitched Roofs) 0.18 (Flat Roofs)
		Windows/ Glazed Openings	1.40 Double glazed units, Low-E Soft Coat; Thermally broken lintels
		Doors	1.60 (Solid and Composite)
Air permeability	Q (m3/m2h)	5.00	
Space Heating-Houses	Air –source heat pump	Efficiency	293.5 COP/EER Mitsubishi Ecodan 11.2kW PUHZ-W112VAA-Model used for design stage calculations; 35Degrees; Heat pump must be checked with assessor prior to any purchase, to ensure compliance is met.
Controls	Time and Temperature Zone Control		
Water Heating	300litre Hot water cylinder to be installed on all houses;		
Thermal Bridging	Enhanced construction details have been used possible and all linear junctions have been individually calculated.		
Lighting Systems	Lighting type	LED Lighting, throughout the dwelling;	
Renewables	Photovoltaic Panels	Total 2.00kWp 8x250 watt panels installed recommended; 0.50kWp installed on each 3-bed houses facing a southern or western orientation if possible; Plots 1, 2, 7 and 8.	

Introduction

Site & proposal

The site is located at the site that is the Former Builders Yard, Jack Straw's Lane, Oxford; this is a site that is located in the area of New Marston and Headington.

The total development measures internally, approximately 1054.76m^2 in area and will consist of 4x 3-bed dwellings and 4x 4-bed dwellings, this application will be focusing on the new build units.

The approximate site location of the proposed development is shown in the site plan figure.2 and is highlighted in red.

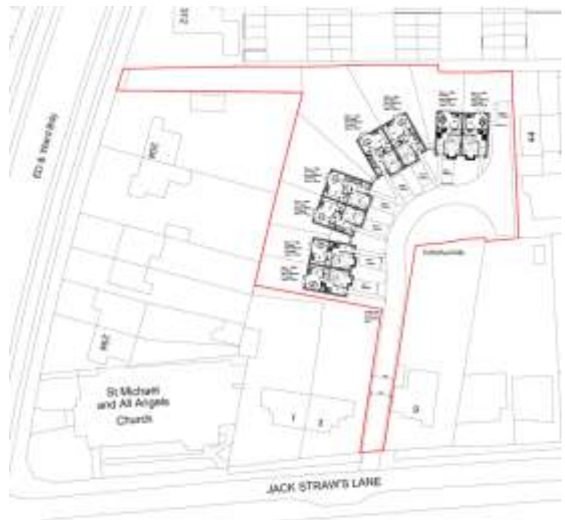


Fig.2 Site Plan

Policy context

This energy and sustainability statement will seek to respond to the energy policies that apply to this development. The most relevant applicable energy policies in the context of the proposed development are presented below.

- Oxford local plan 2036 (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2019

All the aforementioned polices focus on zero carbon targets for residential developments with a minimum 40 per cent on site reduction beyond Part L 2013.

Calculation methodology

The sections below present the methodology followed in determining carbon emissions reduction savings for the proposed scheme.

The methodology employed by the energy and sustainability statement is in line with the GLA's Guidance on preparing energy assessments.

The baseline CO_2 emissions are first established, i.e. the emissions of a scheme that is compliant with Part L 2013 of the Building Regulations.

The approved software used to model and calculate the energy performance and carbon emissions is Design SAP 2012 version 4.14r16 by Elmhurst Energy Systems Ltd.

The TER which is used as the baseline figure for the carbon reductions for each non-domestic element is multiplied by its floor area to establish the total emissions. Similarly the DER is calculated in the same method to determine the energy performance and CO_2 emissions of the proposed scheme for each of the steps of the Energy Hierarchy.

Baseline:

The dwelling's baseline uses the same heating system as per the designed counterpart, therefore in this exercise the baseline model, also uses a air source heat pump and hot water cylinder.

Be Lean: use less energy

The demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the dwelling fabric u-values, thermal bridging, air tightness and glazing have been improved to a high standard;

Be Clean: supply energy efficiently

As much of the remaining energy demand is supplied as efficiently as possible a high efficient air source heat pump is the recommended improvement, with suitable heating controls is highly recommended.

Be Green: use renewable energy

Renewable technologies are incorporated to offset part of the carbon emissions of the development. The uptake of renewable technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The 42.12% improvement for the houses against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall; savings through off-site measures should be achieved.

The Conclusions section summarizes the energy strategy and associated carbon savings for the proposed development.

The carbon emissions factors used in all calculations in this document are those used for Part L of the Building Regulations. The relevant factors are reproduced in Table 3 below.

Table 3 Carbon Emission Factors for selected fuel type

Fuel	CO_2 emission factor ($kgCO_2$/kWh)
Mains Gas	0.216 kgCo2/kWh
Bulk LPG	0.241 kgCo2/kWh
Heating Oil	0.298 kgCo2/kWh
Wood Pellets	0.039 kgCo2/kWh
Grid Electricity	0.519 kgCo2/kWh

* Table extracted from the document SAP 2012 version 9.92 (October 2013),
Table 12: Fuel prices, emission factors and primary energy factors, Page 225.
This can be found in the appendix of the report.

The emission factors and primary energy factors in Table 12 are for a 3-year projection 2013-2015. Factors for a 15-year projection, which may be relevant to consideration of longer term impacts, are given on www.bre.co.uk/sap2012

Be Lean – Use less energy

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, and lighting.

Measures will also be put in place to reduce the risk of overheating, the regulated carbon saving achieved in this step of the Energy Hierarchy is 12.23% when compared against the baseline level for houses.

Passive design measures

Building materials

The key issues to be addressed in the selection of materials and equipment are:

- Use of materials and equipment from sustainable sources
- Minimization of in-use environmental impacts
- Minimization of embodied environmental impacts
- Use of materials and equipment with high recycled content

Enhanced U-values

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-Values provide better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2013 targets and notional building specifications, to reduce the demand for space conditioning (heating and/or cooling).
Table 4 demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

Table 4 Proposed fabric U-Values

Domestic (U-Values in W/m²k)		
Element	**Part L 2013 Building Regulation**	**Proposed**
Wall	0.30	0.18 (External Wall)
Floor	0.25	0.16 (Houses)
Roof	0.20	0.12 (Roof insulated at ceiling) 0.18(Pitched Roofs) 0.18 (Flat Roofs)
Windows	1.60	1.40
Doors	1.80	1.60

Air tightness improvement

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2013 minimum standards for air tightness by targeting air permeability rates of **$5.00m^3/m^2.h$ at 50Pa**.

Reducing the need for artificial lighting

The development has been designed to maximise daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

All of the habitable areas will benefit from large areas of glazing to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.

Waste

A site waste management plan that provides details of waste minimisation, sorting, reuse and recycling procedures is required for all levels in the planning guidance. Sustainable waste management should follow the hierarchy described in *BS 5906: Waste management in buildings. Code of practice*. This outlines the following principles in decreasing order of desirability:

- Reduce waste
- Re-use materials and equipment (and facilitate future reuse)
- Recycle waste (and facilitate recycling)
- Compost biodegradable waste
- Recover energy from waste (and facilitate energy recovery from waste)
- Disposal

Active design measures

High efficacy & low energy lighting

Where artificial lighting will be needed it will low energy lighting without compensating for luminance, and will accommodate LED.

Water

Proposals for new residential development are to meet the higher water efficiency standard within Building Regulations Part G2 of water consumption target of 110 litres per person per day. The Building Regulations regulation requirement, 110 litres/ person is recommended for a new development within the Oxford area. This can be achieved by applying various water efficiency and reclamation / recycling measures.

Appendix G of this report shows a model water calculation has been provided as a guide on how this dwelling should achieve this standard.

Water Efficiency Measures

The following measures can be used to reduce the quantity of water demand to satisfy end users:

- Dual or low flush WCs
- Spray or aerating taps
- Water efficient appliances
- Low flow showers
- Smaller size bath

Water Reclamation / Recycling Measures

- Rainwater collection

Water collected from roofs or hard surfaces such as car parks can be harvested for storage and use for non-potable uses such as watering gardens and WC flushing.

Controls and Monitoring

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate;
- Heating and cooling systems controls will comprise time and temperature controls, both centrally for the whole building, and locally for each space;
- Smart metering to be installed on all new dwellings for adequate monitoring;

Overheating Risk analysis

The potential risk of overheating was assessed via the Part L Building Regulation compliance tool SAP. All domestic areas have been found to pass Criterion 3 'Limiting Solar Gains' of Part L. The SAP output(s) for all domestic areas can be found in Appendix F – SAP Results.

Be Lean CO_2 emissions & savings

Table 1 Breakdown of energy consumption and CO_2 emissions for the baseline and the proposed schemes after 'Lean' measures are implemented.

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by 12.23% (21,747kgCO_2/year) compared to the baseline for the houses.

Be Clean – Supply energy efficiently

By means of installing a high efficient air source heat pump and improving the heating controls, the regulated CO_2 emissions are shown to reduce by 35.84% (15,897kgCO_2/year) for the dwelling houses compared to the baseline.

Low Carbon Energy Sources (CHP/District Heating Schemes)

District Heating Scheme

Policy RE1 the City Council will encourage the development of city wide heat networks. If a heat network exists in close proximity to a scheme it is expected to connect to it and this will count towards the development's carbon reduction requirements.

A district heating option has been considered as one of the first LZC technologies options as an opportunity of using waste heat which would be otherwise rejected into the atmosphere, this option is usually applied for large scale developments. Investigation was carried out to identify existing district heating schemes in local area of the development.

A study has been completed into the availability of existing heat networks in the vicinity of the development, using the "Final Report for Heat Networks for Oxford" by BRE. This document looks at the feasibility of heat network. This report has been referenced as there are currently no existing heat networks in the proximity of this proposed development, despite being Headington being a viable location for a proposed heat network.

Fig.3 Overview of project areas for heat network

The proposed development site at the Former Builders Yard, Jack Straw's Lane, is not in a close proximity of an existing heat network making this an unviable solution to improve the heating system in the dwelling at time of this application.

Considering the size of the development, this is not an economically viable solution, however, since there may be potential extensions of the network in the future, we advise measures to be taken for the future connection to the district heating network. Should it become realistic and feasible to do so.

Combined Heat and Power (CHP)

The presence of a year-round base hot water generation heat load in residential units is favourable to CHP. To date, there are readily available micro gas fired CHP units (such as EC power) on the market. At this stage gas fired CHP will be provisionally incorporated into the development's LZC strategy, however, the carbon reductions due to CHP are extremely sensitive to the system design, unit selection and running time.
CHP (Combined Heat & Power) is a great technology to use, however the system itself needs to run on a 24 hour basis. The heat generated would be exceeding the demand and needs for this site, and would require to have an outlet area which can profit from this excess, however this development does not have a space that benefit from this, therefore this option has considered not feasible for this development.

Be Green – Use renewable energy

Renewable technologies feasibility study

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were considered.

This section provides an overview of the technologies considered, a brief assessment of their feasibility, a proposed mixture of suitable technologies.

The proposed development will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance.

A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO_2 savings achieved;
- Site constraints;
- Financial benefit
- Any potential visual impacts

Demand profiles

The balance of technologies chosen will depend on the development's energy demand patterns.

Keeping in mind that the space heating energy demand changes according to the season. While hot water energy demand will provide a significant base load throughout the year.

Electrical demand is likely to be moderate throughout the year. Lighting loads will be highest during the evening but will continue at reduced levels throughout the night and during the day.

Feasibility

At this early stage in the design, it is possible only to outline the likely feasibility of specific technologies. Further descriptions of the LZC technologies below are included in Appendix A.

Table 5. Renewable and Low Zero Carbon Technologies

Renewable Technology	Comments	Lifetime (Years)	Maintenance	Impact on External Appearance	Site Feasibility	Adopted for Site
BIOMASS 	Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20	High	High	3	☐
PV 	PV panels would generate significant carbon savings, whilst having minimal impact on the appearance of the building and no adverse impact on the amenity of neighboring buildings.	25	Low	Med	9	☑
Solar Thermal 	Solar thermal array mounted on the roof would conflict with the savings made from the CHP unit	25	Low	Med	4	☐
GSHP 	The installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs.	20	Med	Low	5	☐
Wind 	Due to insufficient open area for installation of a stand-alone wind turbine and planning issues this option has not considered in this development.	25	Med	High	3	☐

Detailed assessment of Photovoltaic Panels

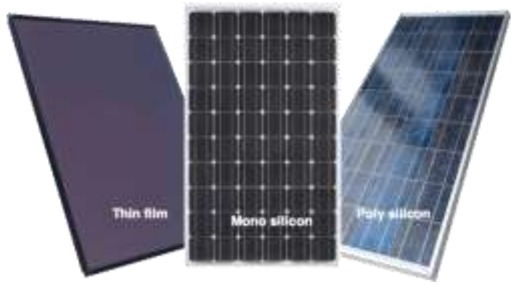


Fig 4. Photovoltaic Panels

Four types of solar cells are available on the market at present and these are mono-crystalline, polycrystalline, thin film and hybrid panels as seen in figure 4. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

1.00 kWp (Kilo Watt Peak) of PV panels can produce approximately 850 kWh/ year of electricity in this region, reducing the grid energy requirement and CO_2 emissions.

Photovoltaic Panel is considered a suitable technology for this development as the development provides an extent of roof space for the installation of PV panels. In addition to this the PV arrays are relatively easy to install when compared to other renewable systems and provide a significant amount of CO_2 savings.

The PV shall comprise 2.00kWp of horizontal roof mounted arrays; Table 6 summarizes the technical data for the proposed PV array. In total, the PV installation would produce a further regulated CO_2 savings of 6.28% for the houses.

Table 6. Proposed PV Specifications

Photovoltaic Panels	
Module Efficiency	15%
Panel Orientation	Facing all angles except North;
Tilt	30-40°
Array Area (approximately)	Each dwelling 4m^2
Total power to be installed	2.00 KWp
Energy Generation	1708.9128 KWh/yr
Total CO_2 savings	**886.9256 KgCO_2/yr**

Be Green CO_2 emissions & savings

The incorporation of renewable technologies will further reduce CO_2 emissions by a further 42.12% (14,341kgCO_2/year for the houses compared to the baseline).

Flood zone risk assessment for planning

The Environment Agency has developed a flood risk map for planning to identify the relative risk of flooding for proposed development planning locations. Flood zones assume that no defenses are present and so where these do exist, they are only indicative of the potential for flooding.

Fig.5 Environment Agency Flood Zone Interactive Map

The whole of the development lies within flood zone 1 of the Environment Agency's flood risk map as seen in figure. 5, the land located within flood zone 1 is at low risk of flooding having an associated annual probability of flooding of less than 1 in 1000 (0.1%).

Study approach

In accordance with Planning Practice Guidance for Flood Risk document, land within flood zone 1 is suitable for all uses. Assessment of this site has been based upon the Environment Agency's flood interactive map, the topographical site survey and the architect's proposed development layout.

Flood vulnerability

Based on the Environment Agencies flood map, the development site is located within Flood Zone 1 and in accordance with Planning Practice Guidance for Flood Risk neither a sequential or exception test is required.

Conclusion

Following the implementation of the three-step Energy Hierarchy, the regulated CO_2 savings for the site are estimated at 42.12% for the houses, against a Part L 2013 compliant scheme.

Overall, the proposed development has been designed to meet energy policies set out by the Oxford plan requirements, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

Table 7. Summarises the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset, in addition to this a total site average is calculated, this average meets the 40% Carbon reduction over a Part L1A 2013 baseline, requirements as set by Oxford's Local Plan RE1

Table 7. CO_2 emissions after each step of the Energy Hierarchy for the proposed development

	CO_2 Emissions (tonnes/yr)	CO_2 Emissions Savings per Step (%)
Baseline	24,777	
Be Lean	21,747	12.23%
Be Clean	15,897	35.84%
Be Green	14,341	42.12%
Total Site Reduction achieved		**42.12%**

Based on the results and outline figures, the proposed development to the Former Builders Yard in Jack Straw's Lane, will satisfy the relevant policies for sustainable design and construction requirements of energy consumption and carbon emissions.

The energy demand and carbon emissions, could be reduced by introducing a combination of energy efficiency measures and on-site renewable. Based on the calculations and results achieved when those measures were applied, the development achieved a total site reduction of 42.12% in CO2 emissions based on the 2013 Regulations (Figure 1).

The new dwellings will be designed with a high level of insulation and low air permeability to reduce heat loss as much as is practically possible, also the use of low energy lighting and A – Rated White goods are essential for the reduction of energy consumption.

Moreover, the control strategy throughout must be carefully designed to ensure the most economical operation of all equipment throughout the development.

To achieve the required reduction of carbon emissions, several options were considered, however the best option in regards to site location and the development size, was the combination of a highly efficient air source heat pumps for the provision of heating in the dwelling houses, with 2.00kWp of Photovoltaic panels installed for the complete site and proposed to be laid across the Roof of the dwellings that need this technology (approximate total of 8 panels). Hot water cylinders are to be installed in each dwelling where required.

The proposed development site to the Former Builders Yard in Jack Straw's Lane, is not in a close proximity of an existing heat network making this an unviable solution to improve the heating system in the dwelling at time of this application.

CHP (Combined Heat & Power) is a great system to use for a new development, however due to the low energy demands of the development and the lack of additional space required for this technology, it will not be a preferable solution, as the site does not have the demand and space to accommodate this technology.

The baseline annual energy consumption of the dwelling houses on this development has been calculated to be 71,509kWh/yr and 24,777KgCO_2/yr of CO2 emissions.
By incorporating on-site renewable/ LZC technologies the total CO2 emissions will be reduced to 14,341KgCO_2/yr, equivalent to 42.12% reduction over Part L 2013 requirements, the overall site reduction achieves reduction required as per the required local plan.

Different possible renewable energy options have been identified; bearing in mind that selection is a complex process which requires a more detailed estimation of energy demand patterns, therefore, further analysis will be undertaken as the design progresses.

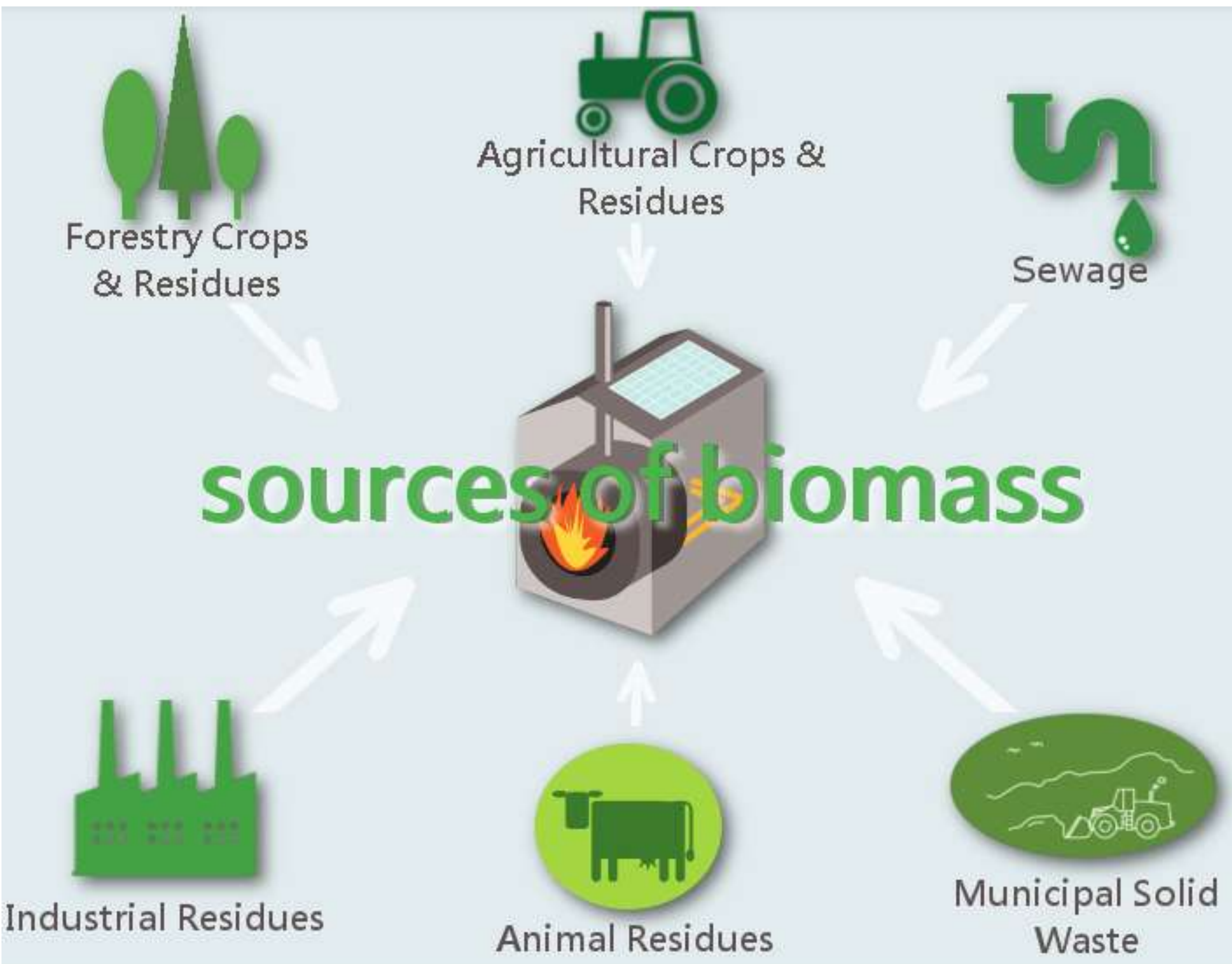
Post construction each dwelling is to have suitable post construction testing provided to ensure the dwellings satisfy the requirements of the this document and building regulation standards at the time of completion, this is to be provided as As-Built SAP worksheet, EPC and Air and Acoustic testing, in addition to this to enhance post construction monitoring the dwellings are to be installed with smart metering.

Appendix A - Low or Zero Carbon Energy Sources

Biomass As a fuel

Biomass is a renewable energy source, generated from burning wood, plants and other organic matter, such as manure or household waste. It releases CO2 when burned, but considerably less than fossil fuels. We consider biomass a renewable energy source, if the plants or other organic materials being burned are replaced.

Biomass is known for its versatility, given it can be used to generate heat, electricity, be used in combined heat and power units and be used as liquid fuel. In domestic settings, it tends to be found in the form of wood-fuelled heating systems.



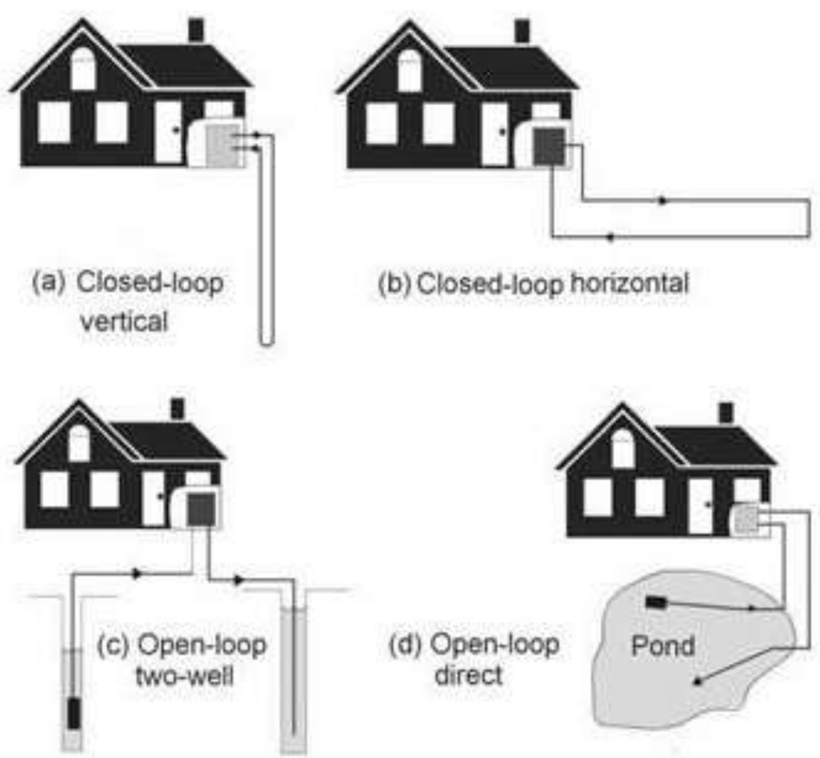
Geothermal Energy:

Geothermal energy technologies use the heat energy stored in ground; either for direct-use applications: such as using the grounds' heat to defrost a driveway or the indirect use with additional equipment such as a geothermal heat pump. Most commercial installations couple a heat pump with the ground to upgrade the low-grade heat from the ground or ground water to a higher grade heat, where it can be used for heating purposes.

The suitability of a ground source system depends heavily on the type of earth coupling heat exchange system used:

Ground source earth coupling options

The right choice of appropriate heat exchanger depends on several factors such as: size of space heating/hot water system, available site area for the heat exchangers, and local ground conditions. Due to the specialist nature of this technology we recommend that a specialist is employed to size the heat exchangers based on a desk-top study of the site's geological conditions – this normally being required in advance of any other contractor appointment.



Vertical Closed Loop System

A frequently used and simple ground source heat exchanger, for a small to medium size project, is a closed loop vertical system. The system comprises of vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethylene pipes with a U-shape connector at the base of the hole – effectively providing a flow down to the bottom of the hole and return back up to the surface. All the flow and return loops are connected together across the site - completing the entire heat exchange loop. Water is pumped around the loop and is then circulated around the heat pump to achieve the required heat exchange. The distance between boreholes is dependent on ground conditions but is typically a minimum of a 6mx6m grid, to prevent overlapping of the heat exchange process between loops.

Horizontal Closed Loop System

Horizontal closed loop heat exchangers are usually applied to small projects such as individual houses, which usually require a relatively low heat output. Consisting of horizontal trenches 1.5-2m deep, with either straight pipes or 'slinky' coiled pipes, these require significant excavation work and significant site area to achieve appreciable outputs as such are not normally suited to medium to large projects.

Vertical Open Boreholes System

A further option is a vertical open borehole system. The system involves the abstraction and discharge of natural ground water using boreholes; into which pumps are inserted, connected to collapsible pipework. Each borehole pump abstracts ground water, circulates it around the heat pump and then discharges the water back to the ground via an absorbing well, some distance from the original abstraction borehole. The system is capable of providing very high rates of heat exchange for a relatively small number of boreholes, which makes it very efficient in terms of site area required. However, this depends greatly on the availability of ground water, which in turn varies according to location. A major downside of this system is that the extraction of water from deep boreholes via pumps consumes a lot of energy, as the water has to be physically lifted to the surface by the pump – this in effect reduces the carbon emissions saved by this system as a whole.

Ground source heat exchange options in summary:

Vertical loop system - closed boreholes

- moderate heat capacity
- relatively low installation cost

Vertical open system - open boreholes

- high heat capacity
- high running energy
- high installation cost

Horizontal loop system – straight pipes

- low capacity,
- high installation cost
- extensive ground excavation work

Horizontal coiled loop system – 'slinky' pipes

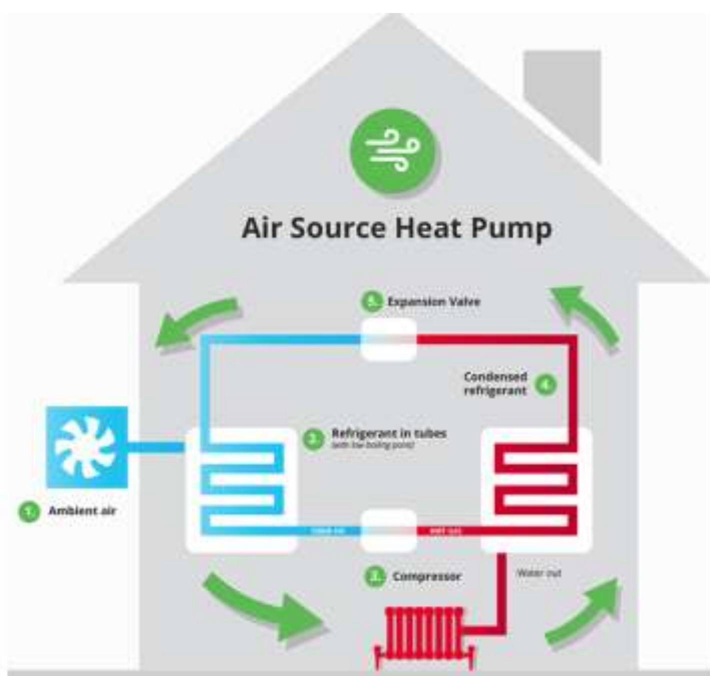
- good capacity
- low installation cost
- extensive ground excavation work

Air Source Heat Pumps

Heat pumps are basically refrigeration units which work in reverse – instead of cooling being produced and heat rejected, the unit produces heat and rejects cooling. Conventional heat pumps use air as the medium to reject this 'coolth' to atmosphere. Ground source units use the ground as a means of improving the unit efficiency because the ground is a constant 11-13 °C at depths of 50m down – this suits the heat pump much better during the coldest weather than the extremes of air temperature. Reversible heat pumps can also be used for cooling, however this is not being considered further for this project.

A heat pump consumes electrical power to drive the compressor and other ancillary elements. The ratio between total energy input and heat energy output of the heat pump is a measure of its efficiency – usually referred to as 'Coefficient of Performance' - COP. A ground source heat pump has a higher COP than an air cooled heat pump – this additional energy effectively being the grounds' natural contribution to the system.

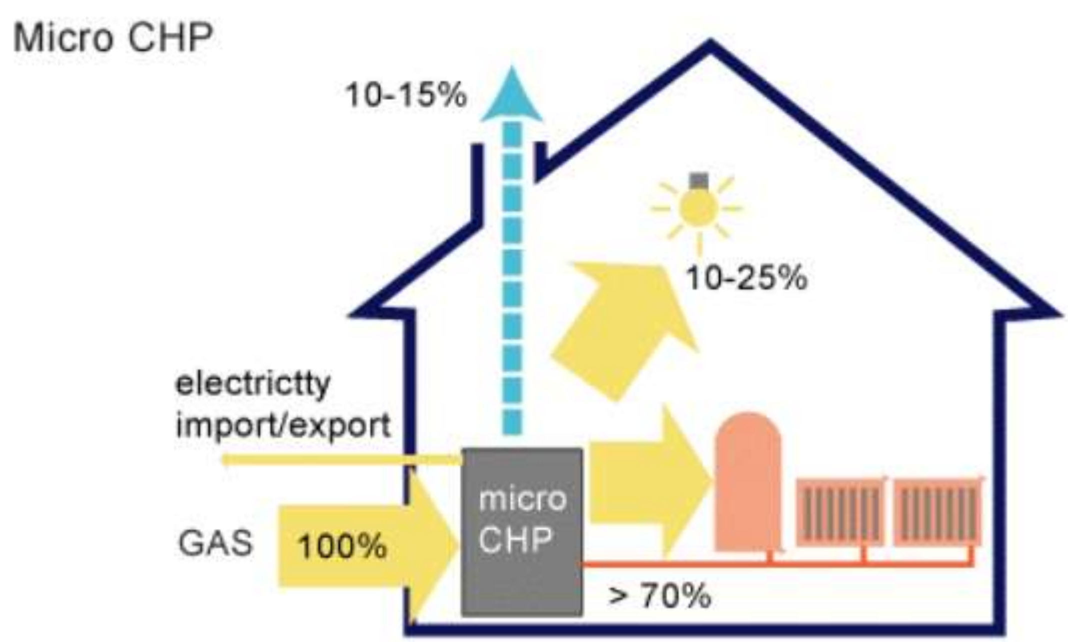
The heat produced by a heat pump is usually used to either provide space heating say to underfloor heating or radiators or the heat is used to generate domestic hot water via a storage vessel.



CHP

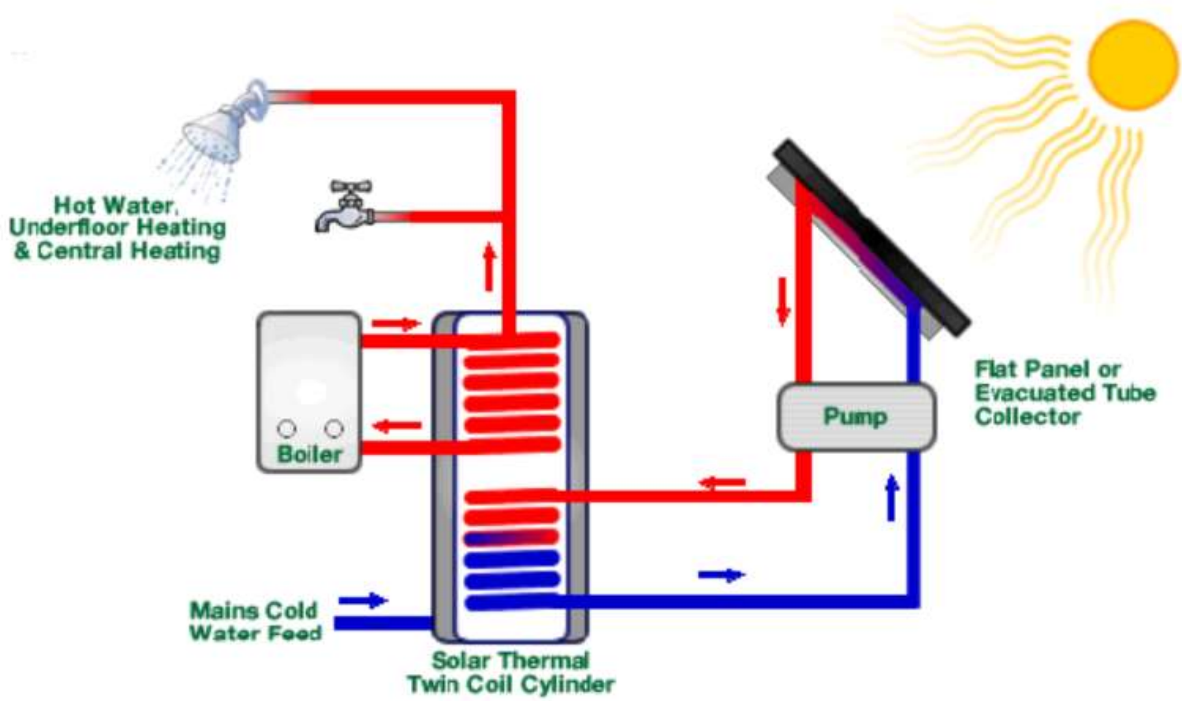
Combined heat and power (CHP) is a process involving simultaneous generation of heat and electricity, where the heat generated in the process in harnessed via heat recovery equipment. CHP at the large commercial size is now fairly common in premises which have a simultaneous demand for heating and electricity for long periods, such as hospitals, recreational centres and hotels. In addition, small CHP systems are now becoming available for individual houses, group residential units and small non-domestic premises. Compared with using centrally generated electricity supplied via the grid, CHP can offer a more efficient and economic method of supplying energy demand, if installed and operated appropriately, owing to the utilization of heat which is normally rejected to the atmosphere from central generating stations, and by reducing network distribution losses due to local generation and use.

Heat generated will be used for space and water heating, and additional heat storage may be used to lengthen use periods, to assist in warm-up and to improve overall energy efficiency. For overall good energy efficiency, as with all CHP, usage must be heat demand led. Thus, a sophisticated control system is required and users should be made aware of efficient operating practices.



Solar thermal collectors

Solar thermal collectors (flat plate or evacuated tubes) convert solar thermal energy into heat for hot water generation. These are usually located on a roof oriented south facing in an ideal slope of 45 degree. Solar collectors properly sized and designed provide approx 50% of annual hot water demand.



Photovoltaic

Photovoltaic modules convert sunlight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and fl at roofs, in façades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles.

Currently, a PV system will cost between £1500 and £2500 per kWp, and frequently part of this cost can be offset owing to the displacement of a conventional cladding material. Costs have fallen significantly since the first systems were installed (1980s) and are predicted to fall further still.

While single crystal silicon remains the most efficient flat plate technology (15–16% conversion efficiency); it also has the least potential for cost reduction. PV cells made from poly-crystalline silicon have become popular as they are less expensive to produce, although they have a slightly lower efficiency.

Thin film modules are constructed by depositing extremely thin layers of photosensitive materials on a low-cost backing such as glass, stainless steel or plastic. As much less semiconductor material is required as for crystalline silicon cells, material costs are potentially much lower. Efficiencies are much lower, around 4–5%, although this can be boosted to 8–10% by depositing two or three layers of thin film material. Thin film production also requires less handling as the films are produced as large, complete modules and not as individual cells that have to be mounted in frames and wired together. Hence, there is the potential for significant cost reductions with volume production.

Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form. The cost of the inverter and these 'Balance Of System' (BOS) components can approach 30% of the total cost of a PV system. Hence, simplification and cost reductions in these components over the coming years will also be necessary to make PV systems affordable.

Wind energy

Wind power is the most successful and fastest spreading renewable energy technology in the UK with a number of individual and group installations of varying size, capacity and location. Traditionally, turbines are installed in non-urban areas with a strong trend for large offshore wind farms. In parallel with the design and development of ever-bigger machines, which are deemed to be more efficient and cost-effective, it is being increasingly recognized that smaller devices installed at the point of use, i.e. urban settings, can play an important role in reducing carbon emissions if they become mainstream.

At present there is a wide range of available off-the-shelf wind products, many manufactured in the UK and EU with proven good performance and durability. The dominant type is horizontal axis wind turbines (HAWT), which are typically ground mounted. Vertical axis wind turbines (VAWT) have limited market presence and there is a trade-off between lower efficiency and potentially higher resistance to extreme conditions. Capacity ranges from 500W to more than 1.5MW, but, for practical purposes and in built-up areas in particular, machines of more than 1kW and below 500kW are likely to be considered.
Wind technology is also currently one of the most cost-effective renewable energy technologies, which is attributable to the large scale of installations reducing the unit output cost. Individual building or community wind projects, although smaller, have the advantage of feeding electricity directly into the building's electricity circuit, thus sparing costly distribution network development and avoiding distribution losses. The downside is the still high capital cost per kW installed for smaller turbines, plus location constraints, such as visual intrusion and noise. The wind regime in urban areas is also a concern owing to higher wind turbulence which reduces the potential electricity output.

In most cases, wind turbines are connected to the electricity grid and all generated energy is used regardless of the building demand fluctuations. The output largely depends on the wind speed and the correlation between the two is a cube function. This means that in short periods of above-average wind speeds the generation increases exponentially. As a result, it is difficult to make precise calculations of the annual output of a turbine, but average figures can provide useful guidance to designers and architects. In reasonably windy areas (average wind speed of 6m/s) the expected output from 1kW installed is about 2500kWh annually.

The cost per kW installed varies considerably by manufacturer and size of machine with an indicative bracket of £2,500–£5,000. With a lifespan of more than 20 years, wind turbines can save money if design and planning are carried out in a robust way.

Building-integrated wind turbines are starting to be a reality in the UK, but potential projects may face difficulties with obtaining planning permission. There are a few examples now of permitted development rights for certain rooftop turbines in some local councils. A number of horizontal axis devices specifically designed for building integration are now available commercially, having design and reliability parameters relevant to the urban context. Building-mounted vertical axis devices are under development. At present, turbines installed near buildings, as well as community installations for groups of buildings, should be regarded as the larger wind energy source related to buildings, when they contribute to the carbon emissions from these premises using 'private wire' networks. However, the contribution of several building-integrated turbines in a development is likely to become significant in the next few years.

Appendix B-Fuel prices and emission factors

Table 12: Fuel prices, emission factors and primary energy factors

Fuel	Standing charge, £ [a]	Unit price p/kWh	Emissions kg CO_2 per kWh [b]	Primary energy factor	Fuel code
Gas:					
mains gas	120	3.48	0.216	1.22	1
bulk LPG	70	7.60	0.241	1.09	2
bottled LPG		10.30	0.241	1.09	3
LPG subject to Special Condition 18 [c]	120	3.48	0.241	1.09	9
biogas (including anaerobic digestion)	70	7.60	0.098	1.10	7
Oil:					
heating oil		5.44	0.298	1.10	4
biodiesel from any biomass source [d]		7.64	0.123	1.06	71
biodiesel from vegetable oil only [e]		7.64	0.083	1.01	73
appliances able to use mineral oil or biodiesel		5.44	0.298	1.10	74
B30K [f]		6.10	0.245	1.09	75
bioethanol from any biomass source		47.0	0.140	1.08	76
Solid fuel: [g]					
house coal		3.67	0.394	1.00	11
anthracite		3.64	0.394	1.00	15
manufactured smokeless fuel		4.61	0.433	1.21	12
wood logs		4.23	0.019	1.04	20
wood pellets (in bags for secondary heating)		5.81	0.039	1.26	22
wood pellets (bulk supply for main heating)		5.26	0.039	1.26	23
wood chips		3.07	0.016	1.12	21
dual fuel appliance (mineral and wood)		3.99	0.226	1.02	10
Electricity: [a]					
standard tariff	54	13.19	0.519	3.07	30
7-hour tariff (high rate) [h]	24	15.29	0.519	3.07	32
7-hour tariff (low rate) [h]		5.50	0.519	3.07	31
10-hour tariff (high rate) [h]	23	14.68	0.519	3.07	34
10-hour tariff (low rate) [h]		7.50	0.519	3.07	33
18-hour tariff (high rate) [h]	40	13.67	0.519	3.07	38
18-hour tariff (low rate) [h]		7.41	0.519	3.07	40
24-hour heating tariff	70	6.61	0.519	3.07	35
electricity sold to grid		13.19 [i]	0.519	3.07	36
electricity displaced from grid			0.519 [i]	3.07 [i]	37
electricity, any tariff [j]					39
Community heating schemes: [k]	120 [l]				
heat from boilers – mains gas		4.24	0.216	1.22	51
heat from boilers – LPG		4.24	0.241	1.09	52
heat from boilers – oil		4.24	0.331 [m]	1.10	53
heat from boilers that can use mineral oil or biodiesel		4.24	0.331	1.10	56
heat from boilers using biodiesel from any biomass source		4.24	0.123	1.06	57
heat from boilers using biodiesel from vegetable oil only		4.24	0.083	1.01	58
heat from boilers – B30D [f]		4.24	0.269	1.09	55
heat from boilers – coal		4.24	0.380 [n]	1.00	54
heat from electric heat pump		4.24	0.519	3.07	41
heat from boilers – waste combustion		4.24	0.047	1.23	42
heat from boilers – biomass		4.24	0.031 [o]	1.01	43
heat from boilers – biogas (landfill or sewage gas)		4.24	0.098	1.10	44
waste heat from power station		2.97	0.058 [p]	1.34	45
geothermal heat source		2.97	0.041	1.24	46
heat from CHP		2.97	as above [q]	as above [q]	48
electricity generated by CHP			0.519 [i]	3.07 [i]	49
electricity for pumping in distribution network			0.519	3.07	50

Appendix C, D, E and E

This appendix contains the following reports used in producing the content of this Energy and Sustainability Statement.

*Appendix C-*Flood risk map for planning to show the location of the site with regards to the relevant flood zone areas.

Appendix D- heat map, which locates the proximity of existing and proposed heat networks in relation to the site proposed in this development.

Appendix E- Floor plan and elevations used to produce SAP Calculation for this development.

Appendix F- SAP calculation reports for the selected units that were used to base the calculations on for this report. The reports are for the final stage of the energy hierarchy (Be Green). The reports demonstrate how reduction has been achieved over the baseline figures.

Appendix G- Sample water efficiency calculations to demonstrate how the required target suggested could be achieved.

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
Jack St Lane	**452944/207479**	**30 Oct 2020 11:28**

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn’t include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
Jack St Lane

Location (easting/northing)
452944/207479

Scale
1:2500

Created
30 Oct 2020 11:28

Selected point

Flood zone 3

Flood zone 3: areas benefitting from flood defences

Flood zone 2

Flood zone 1

Flood defence

Main river

Flood storage area

0 20 40 60m

1 Introduction

1.1 National Aspirations

In 2008 the UK Climate Change Act was introduced as a legally-binding framework to reduce greenhouse gases (GHG) to at least 80% reduction on 1990 levels by 2050. In order to achieve this target, five interim Carbon Budgets have been drafted by the Committee on Climate Change, an independent advisor to the UK Government.

Although previous interim Carbon Budgets have been met as per last Climate Change Committee report, it was noted that the economic recession had a disproportionate impact and led to significantly lower emission from carbon-intense sectors. It was also ascertained that limited progress in deploying low-carbon heat in buildings and district heating (DH) infrastructure has been made (Committee on Climate Change, 2015). In order to tackle issues around DH, the Department for Energy and Climate Change (DECC) provides funding and strategical guidance through their Heat Networks Delivery Unit (HNDU).

1.2 Council background

Oxford City Council (OCC) has "a longstanding commitment to making Oxford more sustainable" and has received a series of awards (Oxford City Council, 2011). OCC has set a target for the authority's estates and operations of 5% per year carbon reduction by installed measures. Recognizing that its own carbon emissions were only about 1% of the city wide emissions, a target to influence these city wide emission was also adopted by the council. The target is to reduce carbon emissions by 40% by 2020 from a 2005/2006 c.1,000,000 tCO_2 baseline. To bring about this improvement OCC has taken a pro-active working approach including partnering, informing and encouraging local stakeholders with regards to renewable and low-carbon energy generation and related infrastructures.

The Council has adopted a Carbon Management Plan to reduce the council's carbon footprint and also founded the Low Carbon Oxford (LCO) Charter (developed through Oxford Strategic Partnership) to work with and influence others across the city. Organisations such as University of Oxford who sign the charter, agree to the reductions in CO_2 emissions against specific thresholds.

The charter stipulates a 3% year on year CO_2 reduction target including emissions from the built environment and transport sector. OCC has supplementary planning documents in place – the Natural Resource Impact Analysis Supplementary Planning Document (NRIA SPD) – which sets standards and requirements around energy efficiency, renewable and low carbon energy as well as water resources and building materials.

Due to their ongoing engagement, OCC has commissioned studies into District Heating (DH) networks in the past as part of the West End Area Action Plan, which sees the redevelopment of a whole area in the centre. The output from the initial study created interest from many key stakeholders such as the University of Oxford.

1.3 Local stakeholder

The University of Oxford (OU) has more than 22,000 students and a functional estate that covers about 600,000 m^2 distributed across more than 230 buildings. The University is one of the key employers of the town and together with Oxford Brookes University accounts for approximately 21,800 jobs or 19.6% of total employment in Oxford (Office for National Statistics, 2011).

Similarly to the council, OU recognises its environmental impact and strives for best practice in energy and carbon management, it has ambitious carbon emission reduction targets and focuses on providing sustainable buildings for the future as per the Environmental Sustainability Policy from 2014 (University of Oxford, 2014).

OU had commissioned an earlier initial feasibility study into a centre-wide DH network and continues his involvement in the following study.

1.4 Unique opportunity

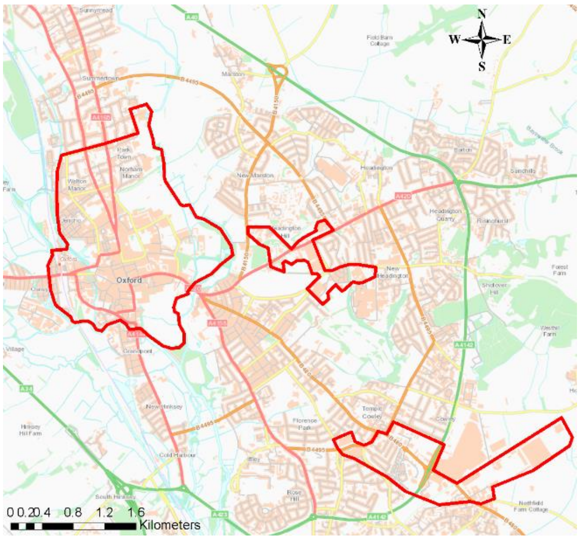


Figure 1: Overview of project areas, from left to the right: City Centre, Headington, Cowley

This study is a part of wider project considering heat network opportunities for the city centre (covering an area of 414 ha), Headington (51 ha) and Cowley (138 ha) as depicted in Figure 1.

Although DH systems have been deployed across Europe for a number of years and UK independent bodies have identified DH as a key enabling technology for decarbonising heat in high density areas (Committee on Climate Change, 2015), the overall development of DH infrastructures in the UK is slow (Hawkey & Webb, 2014). By way of comparison, it is estimated that 60% of heat supply in Finland is provided by heat networks, in the UK the figures is around 2%.

Since Oxford is a dense city with a significant proportion of historic and protected properties the implementation of DH is one of the few opportunities that could deliver significant reduction in energy costs and carbon emissions. It does not involve major transformation of the buildings it would serve yet provides an opportunity to implement cost-effective centralised plant that could, in the long term, be fuelled by low carbon technologies.

In addition, the implementation of DH projects are often affected by economical, ecological and political concerns that can be found in dense urban areas where DH schemes are being considered. As a consequence, it is important to take a broad, multi-stakeholder approach to first understand and then address the key constraints and challenges to identify solutions that could deliver the objectives of the stakeholders.

1.5 Scope

The joint team of BRE and Greenfield was commissioned to carry out a detailed heat network feasibility study for Oxford City Centre. The work has built on previous work by BRE / Greenfield (BRE/Greenfield, 2014) and an earlier initial feasibility study into a centre-wide network (Ove Arup & Partners Ltd, 2010). The scope of the work was as follows:

- Provide building level monthly and daily demand profiles for existing and future heat demands.
- Identification of connection issues, including preferred connection points, existing plant rooms, existing heat networks and other operation parameters
- Provide a flexible demand assessment tool that allows testing the impact of inclusion/exclusion of individual areas and buildings on the overall heat demand
- Identification of available energy sources and technologies with consideration for low carbon pathways
- Determine potential energy centre locations considering any environmental constraints
- Determine the preferred network route considering constraints in consultation with key stakeholders
- Conduct network analysis including pipe sizing
- Determine revenue from developer contributions and energy sales
- Carry out scheme optimisation and options appraisal
- Review local policies and provide a scheme development programme
- Carry out detailed financial modelling
- Assess risks and provide risk register
- Evaluate different business models
- Provide a GIS representation of the proposed system
- Assist the client and key stakeholders in dissemination of information related to the project

The work is carried out in accordance to CIBSE Heat Network Code of Practice (hereafter referred to as HNCP) and HNDU project criteria in order to provide a sound technical basis for complex decision-making around economic viability and implementation of DH schemes.

1.6 Parallel Heat Network studies

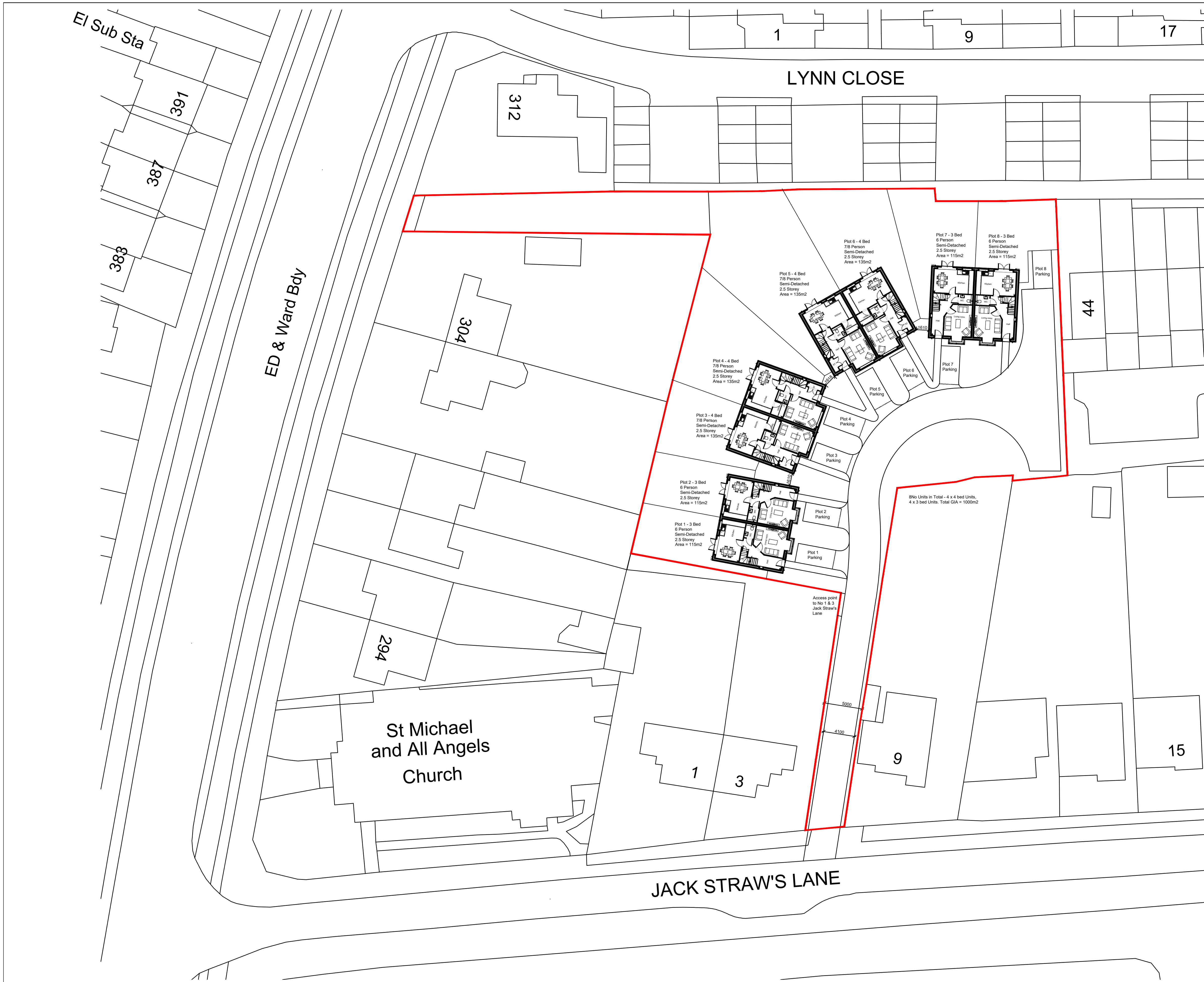
The work conducted for Headington and Cowley is presented in two separate reports, with variation on this above scope to align with the funding granted.

Headington

The Headington project area is characterised by clusters of high heat and electricity demand density including hospitals, university campuses, student villages and (boarding) schools that could be the anchor loads for a heat network development. A number of stakeholders have demonstrated strong interest in leading the development of district heating and/or being key consumers.

University of Oxford Hospitals NHS Foundation Trust is currently implementing a private district heating connection between two hospitals (John Radcliffe and Churchill). Others, such as Oxford Brookes University have ambitions to extend the use of district heating and/or already have experience using combined heat and power (CHP) technology.

The closest distance for a link between the potential DH scheme in Headington and the city centre would be between the anchor loads St. Catherine's College and Clive Booth Student Village. Although there are constraints in the area such as the river Cherwell and a conservation area, the distance is just over half a kilometre.



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CLIENT:

CANTAY ESTATES LTD

PROJECT:

Former Builders Yard,
Jack Straws Lane,
Oxford.

TITLE:

Proposed Site Layout

DRAWING No:	CLIENT JOB No:	ISSUE
MDL-1348-PA-01	---	-

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DRN:	AW	CHK:	XX	DATE: Oct 2020

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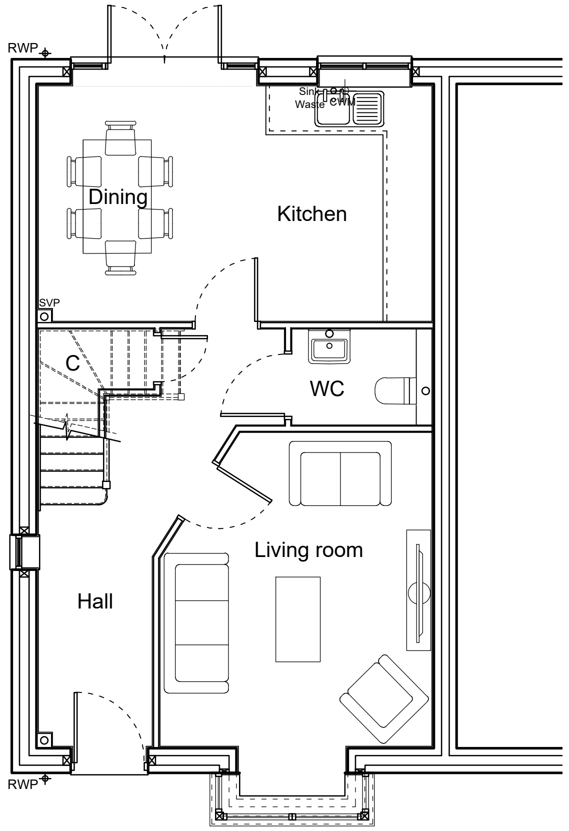
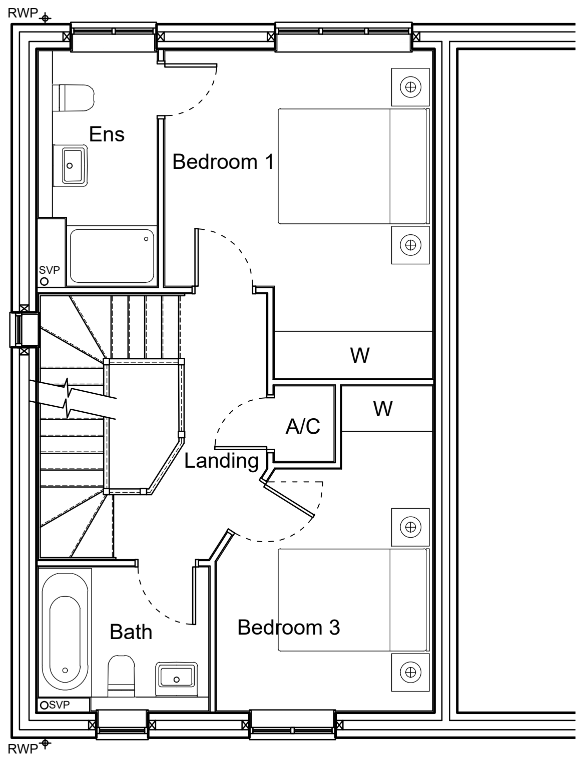
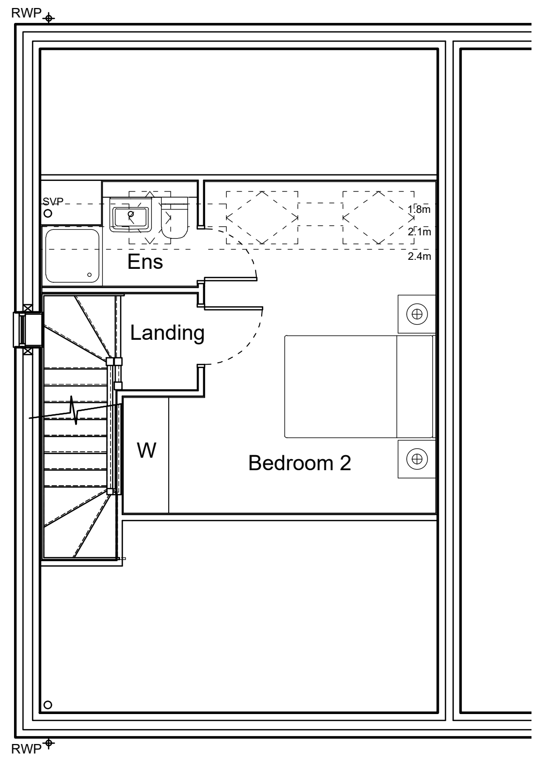


Ground Floor Plan
115m2 / 1235sq/ft



First Floor Plan



Second Floor Plan

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CLIENT:
CANTAY ESTATES LTD

PROJECT:
Former Builders Yard,
Jack Straws Lane,
Oxford.

TITLE: 3 Bed House Type
Floor Plans

DRAWING No:	CLIENT JOB No:	ISSUE
MDL-1348-PA-02	---	-

STATUS: Planning

SCALE: 1:100

DRN: AW | CHK: XX | DATE: Oct 2020

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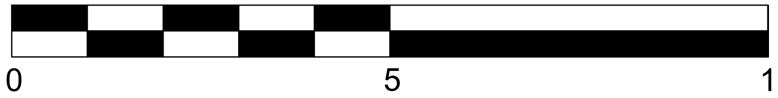

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Front Elevation

Left Hand Side Elevation

Right Hand Side Elevation

Rear Elevation

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CLIENT:
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PROJECT:
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Jack Straws Lane,
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TITLE: 3 Bed House Type Elevations

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MDL-1348-PA-03	---	-

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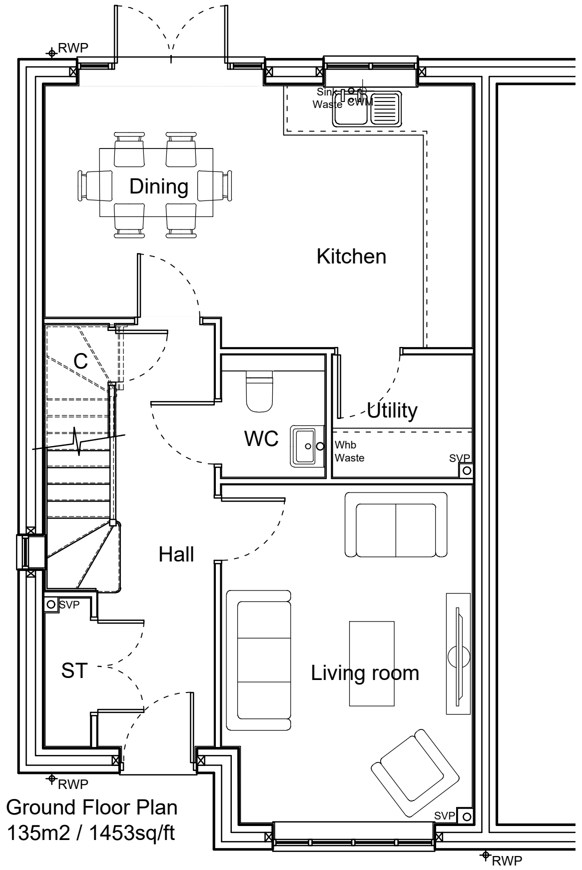
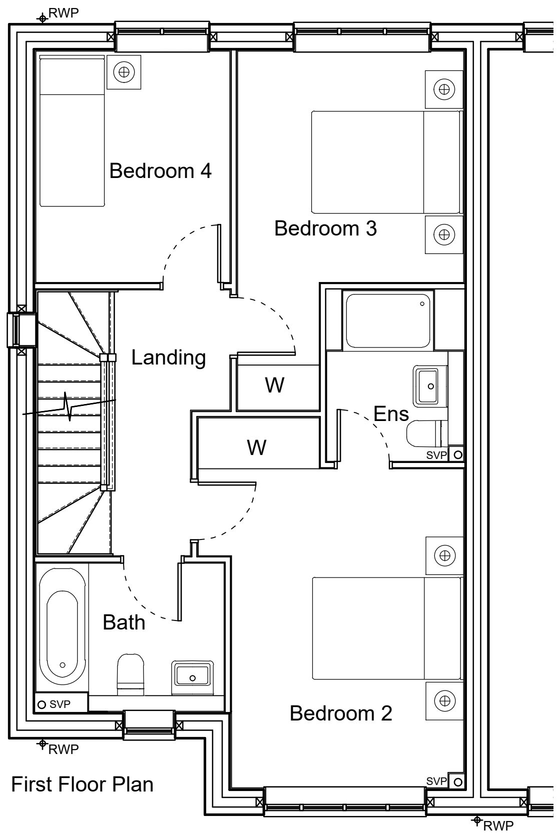
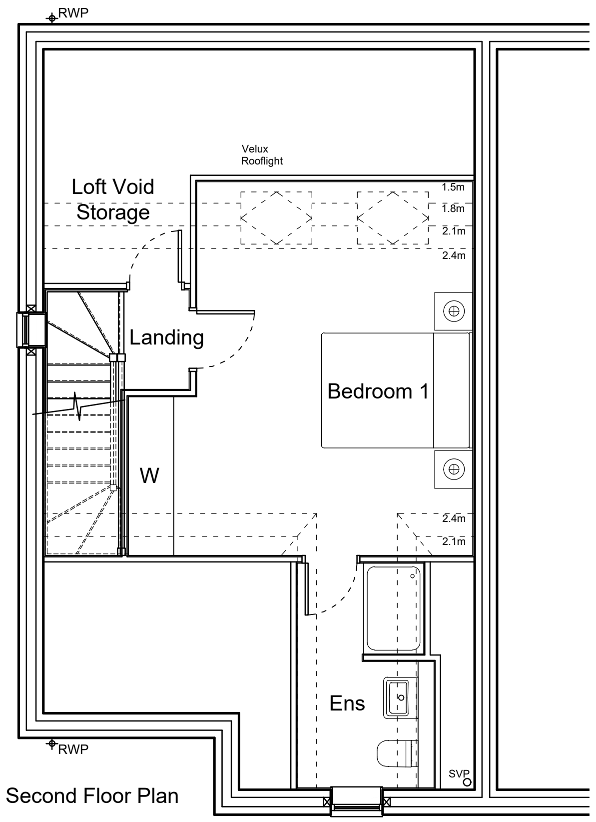


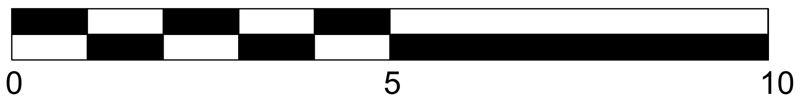
Ground Floor Plan
135m2 / 1453sq/ft



First Floor Plan



Second Floor Plan



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CLIENT:
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PROJECT:
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TITLE:
4 Bed House Type
Floor Plans

DRAWING No:	CLIENT JOB No:	ISSUE
MDL-1348-PA-04	---	-

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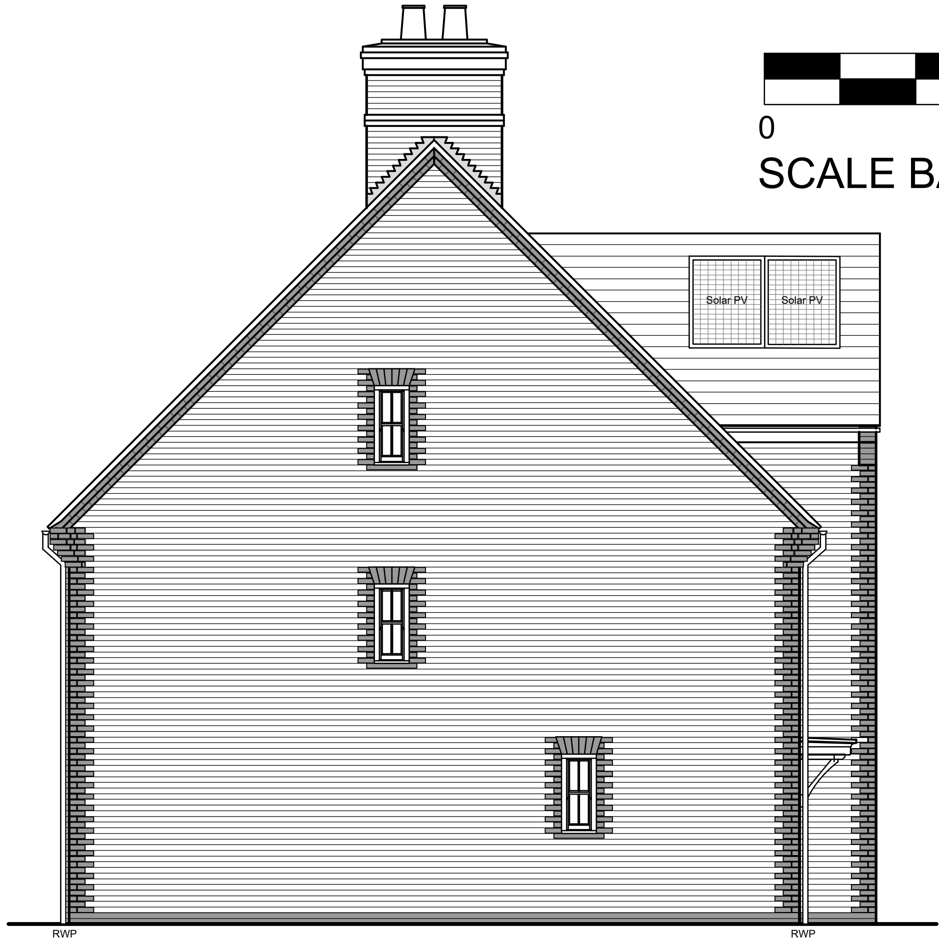
Front Elevation



Left Hand Side Elevation

Right Hand Side Elevation

Rear Elevation

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-	-	-	-

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PROJECT:

Former Builders Yard,
Jack Straws Lane,
Oxford.

TITLE: 4 Bed House Type Elevations

DRAWING No: MDL-1348-PA-05	CLIENT JOB No: ---	ISSUE: -	
STATUS: Planning		SCALE: 1:100	
DRN: AW	CHK: XX	DATE: Oct 2020	

SHEET SIZE - A3

50mm 100mm 150mm

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Property Reference	Jack Straws Lane-Plot 5	**Issued on Date**	03/12/2020
Assessment Reference	003-Be Green	**Prop Type Ref**	PR8160
Property	Plot 5, Jack Straws Lane, Oxford, OX3		

SAP Rating	86 B	**DER**	13.10	**TER**	22.12
Environmental	88 B	**% DER<TER**	40.77		
CO_2 Emissions (t/year)	1.68	**DFEE**	43.46	**TFEE**	50.89
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.61		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@erscltd.co.uk	**Assessor ID**	v571-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	22.12	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	13.10	$kgCO_2/m^2$	Pass
	-9.02 (-40.8%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	50.89	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	43.46	$kWh/m^2/yr$	
	-7.4 (-14.5%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.18 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.16 (max. 0.25)	0.16 (max. 0.70)	Pass
Roof	0.14 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.42 (max. 2.00)	1.60 (max. 3.30)	Pass

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	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Mitsubishi Ecodan 11.2 kW PUHZ-W112VAA	
Secondary heating system	None	

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

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 2.55 kWh/day Permitted by DBSCG 2.86	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Time and temperature zone control	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight	Pass

Based on:

Overshading	Average
Windows facing South East Windows facing South West Windows facing North West	7.12 m², No overhang 1.42 m², No overhang 10.55 m², No overhang
Air change rate	4.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	Pass

10 Key features

External wall U-value	0.13	W/m²K
Party wall U-value	0.00	W/m²K
Roof U-value	0.12	W/m²K
Thermal bridging y-value	0.033	W/m²K

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

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

Property Reference	Jack Straws Lane-Plot 5	Issued on Date	03/12/2020
Assessment Reference	003-Be Green	Prop Type Ref	PR8160
Property	Plot 5, Jack Straws Lane, Oxford, OX3		

SAP Rating	86 B	DER	13.10	TER	22.12
Environmental	88 B	% DER<TER	40.77		
CO_2 Emissions (t/year)	1.68	DFEE	43.46	TFEE	50.89
General Requirements Compliance	Pass	% DFEE<TFEE	14.61		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@ersctd.co.uk	Assessor ID	v571-0001
Client			

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

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

Semi-Detached House, total floor area 149 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
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1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.10 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.5 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)         OK
Party wall      0.00 (max. 0.20)         -                       OK
Floor           0.16 (max. 0.25)        0.16 (max. 0.70)         OK
Roof            0.14 (max. 0.20)        0.18 (max. 0.35)         OK
Openings        1.42 (max. 2.00)        1.60 (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 Ecodan 11.2 kW PUHZ-W112VAA



Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 2.55 kWh/day
Permitted by DBSCG 2.86                           OK
Primary pipework insulated:             Yes                                                  OK
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Time and temperature zone control                    OK


Hot water controls:                     Cylinderstat                                         OK
                                        Independent timer for DHW                            OK

----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                  OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                               OK
Based on:
Overshading:                            Average
Windows facing South East:              7.12 m², No overhang
Windows facing South West:              1.42 m², No overhang
Windows facing North West:              10.55 m², No overhang
Air change rate:                        4.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.12 W/m²K
Thermal bridging y-value                0.033 W/m²K



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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	52.7000 (1b)	x	2.5500 (2b)	=	134.3850 (1b) - (3b)
First floor	52.7000 (1c)	x	2.7000 (2c)	=	142.2900 (1c) - (3c)
Second floor	43.5500 (1d)	x	2.4100 (2d)	=	104.9555 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 148.9500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		381.6305 (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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.1572	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4072	(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) =	0.3461	(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	0.4413	0.4327	0.4240	0.3808	0.3721	0.3288	0.3288	0.3202	0.3461	0.3721	0.3894	0.4067	(22b)
Effective ac	0.5974	0.5936	0.5899	0.5725	0.5692	0.5541	0.5541	0.5513	0.5599	0.5692	0.5758	0.5827	(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	
Windows (Uw = 1.40)			19.0900	1.3258	25.3087			(27)
Door			2.1400	1.6000	3.4240			(26)
Rooflights (Uw = 1.40)			1.8600	1.3258	2.4659			(27a)
GF			52.7000	0.1600	8.4320			(28a)
EW	136.3000	21.2300	115.0700	0.1800	20.7126			(29a)
Stud Wall	23.8600		23.8600	0.1300	3.1018			(29a)
Roof ins. @ Rafters	21.8500	1.8600	19.9900	0.1800	3.5982			(30)
Roof (Cosrule2)	9.1500		9.1500	0.1300	1.1895			(30)
Roof @ Joists	30.0500		30.0500	0.1200	3.6060			(30)
Total net area of external elements Aum(A, m2)			273.9100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.8387			(33)
PW			71.3800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.1445	(36)
Total fabric heat loss	(33) + (36) =	80.9832	(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	75.2334	74.7571	74.2903	72.0977	71.6875	69.7778	69.7778	69.4242	70.5134	71.6875	72.5174	73.3850	(38)
Heat transfer coeff	156.2166	155.7404	155.2735	153.0810	152.6707	150.7611	150.7611	150.4074	151.4966	152.6707	153.5006	154.3682	(39)
Average = Sum(39)m / 12 =												153.0790	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0488	1.0456	1.0425	1.0277	1.0250	1.0122	1.0122	1.0098	1.0171	1.0250	1.0306	1.0364	(40)
HLP (average)												1.0277	(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	2.9325	(42)
Average daily hot water use (litres/day)	103.8478	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.2325	110.0786	105.9247	101.7708	97.6169	93.4630	93.4630	97.6169	101.7708	105.9247	110.0786	114.2325	(44)
Energy conte	169.4035	148.1614	152.8893	133.2926	127.8974	110.3658	102.2701	117.3564	118.7580	138.4011	151.0756	164.0583	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9296	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m													
	25.4105	22.2242	22.9334	19.9939	19.1846	16.5549	15.3405	17.6035	17.8137	20.7602	22.6613	24.6087	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss													
	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage													
	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(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													
	235.3949	207.7665	218.8807	197.1552	193.8888	174.2284	168.2615	183.3478	182.6207	204.3924	214.9382	230.0497	(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													
	235.3949	207.7665	218.8807	197.1552	193.8888	174.2284	168.2615	183.3478	182.6207	204.3924	214.9382	230.0497	(64)
Total per year (kWh/year) = Sum(64)m =												2410.9249	(64)
Heat gains from water heating, kWh/month													
	109.1198	96.9478	103.6288	95.4099	95.3190	87.7867	86.7979	91.8141	90.5771	98.8115	101.3227	107.3425	(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	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.3966	26.9979	21.9562	16.6223	12.4253	10.4900	11.3348	14.7334	19.7752	25.1091	29.3060	31.2414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	319.3783	322.6924	314.3409	296.5614	274.1181	253.0245	238.9327	235.6185	243.9701	261.7495	284.1929	305.2865	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	(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)													
	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	(71)
Water heating gains (Table 5)													
	146.6664	144.2675	139.2860	132.5137	128.1169	121.9260	116.6639	123.4061	125.8016	132.8111	140.7260	144.2775	(72)
Total internal gains													
	563.4293	560.9459	542.5712	512.6855	481.6484	452.4285	433.9194	440.7461	456.5349	486.6578	521.2130	547.7934	(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	
Southeast	7.1200	36.7938	0.6300	0.7000	0.7700	80.0621	(77)
Southwest	1.4200	36.7938	0.6300	0.7000	0.7700	15.9674	(79)
Northwest	10.5500	11.2829	0.6300	0.7000	0.7700	36.3787	(81)
Northwest	1.8600	16.3666	0.6300	0.7000	1.0000	12.0824	(82)

Solar gains	144.4905	262.4908	403.0885	573.8358	711.1821	736.2867	697.2607	590.0748	461.4243	301.9108	176.0364	121.7379	(83)
Total gains	707.9198	823.4367	945.6596	1086.5213	1192.8305	1188.7152	1131.1801	1030.8208	917.9591	788.5685	697.2494	669.5313	(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	66.2142	66.4166	66.6163	67.5705	67.7520	68.6102	68.6102	68.7715	68.2771	67.7520	67.3857	67.0070	
alpha	5.4143	5.4278	5.4411	5.5047	5.5168	5.5740	5.5740	5.5848	5.5518	5.5168	5.4924	5.4671	
util living area													
	0.9994	0.9984	0.9948	0.9774	0.9099	0.7477	0.5737	0.6455	0.8967	0.9893	0.9986	0.9995	(86)
Tweekday	18.7332	18.8869	19.1521	19.5230	19.8243	19.9760	19.9991	19.9982	19.9035	19.5163	19.0699	18.7228	
Tweekend	20.3754	20.4424	20.5590	20.7210	20.8635	20.9446	20.9640	20.9602	20.8987	20.7155	20.5188	20.3672	
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	20.0360	20.1375	20.3194	20.5643	20.7894	20.9149	20.9444	20.9386	20.8419	20.5609	20.2487	20.0234	(87)
Th 2	20.0429	20.0455	20.0481	20.0603	20.0626	20.0732	20.0732	20.0752	20.0691	20.0626	20.0580	20.0531	(88)
util rest of house													
	0.9992	0.9978	0.9929	0.9682	0.8738	0.6636	0.4595	0.5285	0.8409	0.9836	0.9979	0.9994	(89)
Tweekday	18.7332	18.8869	19.1521	19.5230	19.8243	19.9760	19.9991	19.9982	19.9035	19.5163	19.0699	18.7228	
Tweekend	18.7332	18.8869	19.1521	19.5230	19.8243	19.9760	19.9991	19.9982	19.9035	19.5163	19.0699	18.7228	
MIT 2	18.7332	18.8869	19.1521	19.5230	19.8243	19.9760	19.9991	19.9982	19.9035	19.5163	19.0699	18.7228	(90)
Living area fraction									fLA = Living area / (4) =			0.0990	(91)
MIT	18.8622	19.0108	19.2677	19.6261	19.9198	20.0690	20.0927	20.0913	19.9964	19.6197	19.1866	18.8516	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8622	19.0108	19.2677	19.6261	19.9198	20.0690	20.0927	20.0913	19.9964	19.6197	19.1866	18.8516	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9970	0.9906	0.9626	0.8672	0.6632	0.4620	0.5306	0.8356	0.9797	0.9971	0.9991	(94)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	707.0419	820.9333	936.7725	1045.8911	1034.4082	788.3774	522.5667	546.9789	767.0395	772.5880	695.2308	668.9243	(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	2274.8527	2197.6190	1982.4890	1641.9575	1254.9298	824.5141	526.5589	555.2047	893.2862	1377.0444	1855.2991	2261.7376	(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	1166.4513	925.1328	778.0131	429.1678	164.0680	0.0000	0.0000	0.0000	0.0000	449.7156	835.2492	1185.0531	(98)

Space heating		5932.8509	(98)
Space heating per m2	(98) / (4) =	39.8312	(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 %)	326.8335	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1815.2520	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1166.4513	925.1328	778.0131	429.1678	164.0680	0.0000	0.0000	0.0000	0.0000	449.7156	835.2492	1185.0531	(98)
Space heating efficiency (main heating system 1)	326.8335	326.8335	326.8335	326.8335	326.8335	0.0000	0.0000	0.0000	0.0000	326.8335	326.8335	326.8335	(210)
Space heating fuel (main heating system)	356.8947	283.0594	238.0457	131.3108	50.1993	0.0000	0.0000	0.0000	0.0000	137.5978	255.5581	362.5862	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	235.3949	207.7665	218.8807	197.1552	193.8888	174.2284	168.2615	183.3478	182.6207	204.3924	214.9382	230.0497	(64)
Efficiency of water heater												171.1200	(216)
(217)m	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	(217)
Fuel for water heating, kWh/month	137.5613	121.4157	127.9106	115.2146	113.3058	101.8165	98.3295	107.1458	106.7208	119.4439	125.6067	134.4376	(219)

Water heating fuel used	1408.9089	(219)
Annual totals kWh/year		
Space heating fuel - main system	1815.2520	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	536.8126	(232)
Total delivered energy for all uses	3760.9735	(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	1815.2520	0.5190	942.1158	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1408.9089	0.5190	731.2237	(264)
Space and water heating			1673.3395	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	536.8126	0.5190	278.6058	(268)
Total CO2, kg/year			1951.9452	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.1000	(273)

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

DER		13.1000	ZC1
Total Floor Area	TFA	148.9500	
Assumed number of occupants	N	2.9325	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.7061	ZC2
CO2 emissions from cooking, equation (L16)		1.2714	ZC3
Total CO2 emissions		27.0775	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		27.0775	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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	52.7000	(1b)	x	2.5500 (2b)	=	134.3850	(1b) - (3b)
First floor	52.7000	(1c)	x	2.7000 (2c)	=	142.2900	(1c) - (3c)
Second floor	43.5500	(1d)	x	2.4100 (2d)	=	104.9555	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 148.9500							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	381.6305	(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) =	0.1048	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3548	(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) =	0.3016	(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	0.3845	0.3770	0.3694	0.3318	0.3242	0.2865	0.2865	0.2790	0.3016	0.3242	0.3393	0.3544	(22b)
Effective ac	0.5739	0.5711	0.5682	0.5550	0.5526	0.5410	0.5410	0.5389	0.5455	0.5526	0.5576	0.5628	(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			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			19.0900	1.3258	25.3087			(27)
TER Room Window (Uw = 1.70)			1.8600	1.5918	2.9607			(27a)
GF			52.7000	0.1300	6.8510			(28a)
EW	136.3000	21.2300	115.0700	0.1800	20.7126			(29a)
Stud Wall	23.8600		23.8600	0.1800	4.2948			(29a)
Roof ins. @ Rafters	21.8500	1.8600	19.9900	0.1300	2.5987			(30)
Roof (Cosrule2)	9.1500		9.1500	0.1300	1.1895			(30)
Roof @ Joists	30.0500		30.0500	0.1300	3.9065			(30)
Total net area of external elements Aum(A, m2)			273.9100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		69.9625			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.0956	(36)
Total fabric heat loss	(33) + (36) =	83.0581	(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	72.2798	71.9182	71.5639	69.8993	69.5879	68.1381	68.1381	67.8696	68.6965	69.5879	70.2179	70.8766	(38)
Heat transfer coeff	155.3379	154.9763	154.6219	152.9574	152.6460	151.1962	151.1962	150.9277	151.7546	152.6460	153.2760	153.9346	(39)
Average = Sum(39)m / 12 =												152.9559	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0429	1.0405	1.0381	1.0269	1.0248	1.0151	1.0151	1.0133	1.0188	1.0248	1.0290	1.0335	(40)
HLP (average)												1.0269	(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	2.9325	(42)
Average daily hot water use (litres/day)	103.8478	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.2325	110.0786	105.9247	101.7708	97.6169	93.4630	93.4630	97.6169	101.7708	105.9247	110.0786	114.2325	(44)
Energy conte	169.4035	148.1614	152.8893	133.2926	127.8974	110.3658	102.2701	117.3564	118.7580	138.4011	151.0756	164.0583	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9296	(45)

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	25.4105	22.2242	22.9334	19.9939	19.1846	16.5549	15.3405	17.6035	17.8137	20.7602	22.6613	24.6087	(46)

Water storage loss:

Store volume	300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.1127	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.1409	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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	228.0324	201.1165	211.5181	190.0302	186.5262	167.1033	160.8989	175.9853	175.4956	197.0299	207.8131	222.6871	(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	228.0324	201.1165	211.5181	190.0302	186.5262	167.1033	160.8989	175.9853	175.4956	197.0299	207.8131	222.6871	(64)

Total per year (kWh/year) = Sum(64)m = 2324.2366 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	103.2297	91.6277	97.7387	89.7098	89.4289	82.0867	80.9079	85.9241	84.8771	92.9214	95.6227	101.4524	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	146.6269	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.3966	26.9979	21.9562	16.6223	12.4253	10.4900	11.3348	14.7334	19.7752	25.1091	29.3060	31.2414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	319.3783	322.6924	314.3409	296.5614	274.1181	253.0245	238.9327	235.6185	243.9701	261.7495	284.1929	305.2865	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	37.6627	(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)	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	-117.3015	(71)
Water heating gains (Table 5)	138.7496	136.3508	131.3693	124.5970	120.2002	114.0093	108.7471	115.4893	117.8849	124.8944	132.8093	136.3608	(72)
Total internal gains	558.5125	556.0292	537.6544	507.7688	476.7317	447.5118	429.0026	435.8293	451.6181	481.7410	516.2962	542.8767	(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	
Southeast	7.1200	36.7938	0.6300	0.7000	0.7700	80.0621	(77)
Southwest	1.4200	36.7938	0.6300	0.7000	0.7700	15.9674	(79)
Northwest	10.5500	11.2829	0.6300	0.7000	0.7700	36.3787	(81)
Northwest	1.8600	16.3666	0.6300	0.7000	1.0000	12.0824	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	144.4905	262.4908	403.0885	573.8358	711.1821	736.2867	697.2607	590.0748	461.4243	301.9108	176.0364	121.7379	(83)
Total gains	703.0031	818.5200	940.7429	1081.6046	1187.9138	1183.7985	1126.2634	1025.9041	913.0424	783.6518	692.3326	664.6146	(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	66.5887	66.7441	66.8970	67.6250	67.7630	68.4128	68.4128	68.5345	68.1610	67.7630	67.4845	67.1957	
alpha	5.4392	5.4496	5.4598	5.5083	5.5175	5.5609	5.5609	5.5690	5.5441	5.5175	5.4990	5.4797	
util living area	0.9994	0.9985	0.9949	0.9778	0.9111	0.7511	0.5773	0.6498	0.8988	0.9896	0.9986	0.9996	(86)
MIT	19.7836	19.9205	20.1594	20.4884	20.7824	20.9493	20.9903	20.9821	20.8537	20.4761	20.0721	19.7620	(87)
Th 2	20.0477	20.0498	20.0517	20.0610	20.0627	20.0708	20.0708	20.0723	20.0677	20.0627	20.0592	20.0555	(88)
util rest of house	0.9992	0.9979	0.9930	0.9687	0.8753	0.6670	0.4624	0.5321	0.8437	0.9840	0.9980	0.9994	(89)
MIT 2	18.4053	18.6071	18.9570	19.4381	19.8390	20.0353	20.0670	20.0643	19.9397	19.4264	18.8360	18.3794	(90)

Living area fraction fLA = Living area / (4) = 0.0990 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.5418	18.7371	19.0761	19.5421	19.9324	20.1258	20.1584	20.1552	20.0302	19.5304	18.9584	18.5163	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5418	18.7371	19.0761	19.5421	19.9324	20.1258	20.1584	20.1552	20.0302	19.5304	18.9584	18.5163	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9987	0.9967	0.9901	0.9620	0.8693	0.6725	0.4736	0.5432	0.8410	0.9794	0.9969	0.9990	(94)
Useful gains	702.0633	815.8554	931.4408	1040.5467	1032.6957	796.0681	533.3603	557.2588	767.8673	767.5085	690.2054	663.9627	(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	2212.2943	2144.4283	1944.5388	1627.7873	1256.6423	835.4763	538.0158	566.7648	899.9354	1363.1823	1817.6077	2203.7756	(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	1123.6119	892.8010	753.7449	422.8133	166.6162	0.0000	0.0000	0.0000	0.0000	443.1813	811.7296	1145.6208	(98)

Space heating	5760.1191	(98)
Space heating per m2 (98) / (4) =	38.6715	(99)

CALCULATION OF TARGET EMISSIONS 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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6160.5552	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1123.6119	892.8010	753.7449	422.8133	166.6162	0.0000	0.0000	0.0000	0.0000	443.1813	811.7296	1145.6208	(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)	1201.7240	954.8674	806.1443	452.2067	178.1992	0.0000	0.0000	0.0000	0.0000	473.9907	868.1600	1225.2629	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	228.0324	201.1165	211.5181	190.0302	186.5262	167.1033	160.8989	175.9853	175.4956	197.0299	207.8131	222.6871	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.4981	88.3227	87.9168	86.8875	84.5145	79.8000	79.8000	79.8000	79.8000	86.9135	88.0924	88.5673	(217)
Fuel for water heating, kWh/month	257.6693	227.7064	240.5889	218.7084	220.7033	209.4027	201.6277	220.5329	219.9193	226.6966	235.9036	251.4327	(219)

Water heating fuel used	2730.8918	(219)
Annual totals kWh/year		
Space heating fuel - main system	6160.5552	(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)	536.8126	(232)
Total delivered energy for all uses	9503.2596	(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	6160.5552	0.2160	1330.6799	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2730.8918	0.2160	589.8726	(264)
Space and water heating			1920.5525	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	536.8126	0.5190	278.6058	(268)
Total CO2, kg/m2/year			2238.0833	(272)
Emissions per m2 for space and water heating			12.8939	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.8705	(272b)
Emissions per m2 for pumps and fans			0.2613	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.8939 * 1.55) + 1.8705 + 0.2613, rounded to 2 d.p.			22.1200	(273)

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Property Reference	Jack Straws Lane-Plot 7	**Issued on Date**	03/12/2020
Assessment Reference	003-Be Green	**Prop Type Ref**	PR8160
Property	Plot 7, Jack Straws Lane, Oxford, OX3		

SAP Rating	86 B	**DER**	14.23	**TER**	25.27
Environmental	88 B	**% DER<TER**	43.69		
CO_2 Emissions (t/year)	1.35	**DFEE**	47.31	**TFEE**	56.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.77		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@erscltd.co.uk	**Assessor ID**	v571-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	25.27	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	14.23	$kgCO_2/m^2$	Pass
	-11.04 (-43.7%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.17	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	47.31	$kWh/m^2/yr$	
	-8.9 (-15.8%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.18 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.16 (max. 0.25)	0.16 (max. 0.70)	Pass
Roof	0.13 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.42 (max. 2.00)	1.60 (max. 3.30)	Pass

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	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Mitsubishi Ecodan 11.2 kW PUHZ-W112VAA	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 2.55 kWh/day Permitted by DBSCG 2.86	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Time and temperature zone control	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight	Pass

Based on:

Overshading	Average
Windows facing North	10.38 m², No overhang
Windows facing East	0.88 m², No overhang
Windows facing South	4.76 m², No overhang
Windows facing West	2.25 m², No overhang
Air change rate	4.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	Pass

10 Key features

External wall U-value	0.13	W/m²K
Party wall U-value	0.00	W/m²K
Roof U-value	0.12	W/m²K
Thermal bridging y-value	0.037	W/m²K
Photovoltaic array	0.50	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

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

Property Reference	Jack Straws Lane-Plot 7	**Issued on Date**	03/12/2020
Assessment Reference	003-Be Green	**Prop Type Ref**	PR8160
Property	Plot 7, Jack Straws Lane, Oxford, OX3		

SAP Rating	86 B	**DER**	14.23	**TER**	25.27
Environmental	88 B	**% DER<TER**	43.69		
CO_2 Emissions (t/year)	1.35	**DFEE**	47.31	**TFEE**	56.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.77		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@ersclt d.co.uk	**Assessor ID**	v571-0001
Client			

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

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

Semi-Detached House, total floor area 115 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) 25.27 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.23 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.3 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.17 (max. 0.30)       0.18 (max. 0.70)        OK
Party wall      0.00 (max. 0.20)        -                      OK
Floor           0.16 (max. 0.25)       0.16 (max. 0.70)        OK
Roof            0.13 (max. 0.20)       0.18 (max. 0.35)        OK
Openings        1.42 (max. 2.00)       1.60 (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 Ecodan 11.2 kW PUHZ-W112VAA



Secondary heating system:              None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      Nominal cylinder loss: 2.55 kWh/day
Permitted by DBSCG 2.86                          OK
Primary pipework insulated:            Yes                                               OK
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Time and temperature zone control                 OK


Hot water controls:                    Cylinderstat                                      OK
                                       Independent timer for DHW                         OK

----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):      Slight                                            OK
Based on:
Overshading:                           Average
Windows facing North:                  10.38 m², No overhang
Windows facing East:                   0.88 m², No overhang
Windows facing South:                  4.76 m², No overhang
Windows facing West:                   2.25 m², No overhang
Air change rate:                       4.00 ach
Blinds/curtains:                       None
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                  0.13 W/m²K
Party wall U-value                     0.00 W/m²K
Roof U-value                           0.12 W/m²K
Thermal bridging y-value               0.037 W/m²K
Photovoltaic array                     0.50 kW



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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	46.8400 (1b)	x	2.5500 (2b)	=	119.4420 (1b) - (3b)
First floor	44.3800 (1c)	x	2.7000 (2c)	=	119.8260 (1c) - (3c)
Second floor	23.5200 (1d)	x	2.6300 (2d)	=	61.8576 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 114.7400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	301.1256 (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							5 * 10 =	50.0000 (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) =	50.0000 / (5) =	0.1660 (8)
Pressure test		Yes
Measured/design AP50		5.0000
Infiltration rate		0.4160 (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) =	0.3536 (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	0.4509	0.4420	0.4332	0.3890	0.3802	0.3360	0.3360	0.3271	0.3536	0.3802	0.3978	0.4155	(22b)
Effective ac	0.6016	0.5977	0.5938	0.5757	0.5723	0.5564	0.5564	0.5535	0.5625	0.5723	0.5791	0.5863	(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	
Windows (Uw = 1.40)			18.2700	1.3258	24.2216			(27)
Door			2.1400	1.6000	3.4240			(26)
Rooflight (Uw = 1.40)			2.4100	1.3258	3.1951			(27a)
GF			46.8400	0.1600	7.4944			(28a)
EW	122.5100	20.4100	102.1000	0.1800	18.3780			(29a)
Stud Wall	21.8600		21.8600	0.1300	2.8418			(29a)
Room in Roof (cosrule)2	22.2500		22.2500	0.1300	2.8925			(30)
Roof Joists	20.1300		20.1300	0.1200	2.4156			(30)
Roof ins.@Rafters Including Ba	6.4200	2.4100	4.0100	0.1800	0.7218			(30)
Total net area of external elements Aum(A, m2)			240.0100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.5848			(33)
PW			64.1800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.9365 (36)
Total fabric heat loss	(33) + (36) =	74.5213 (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	59.7868	59.3946	59.0101	57.2042	56.8664	55.2935	55.2935	55.0023	55.8994	56.8664	57.5499	58.2645	(38)
Heat transfer coeff	134.3081	133.9159	133.5314	131.7255	131.3877	129.8148	129.8148	129.5236	130.4207	131.3877	132.0712	132.7857	(39)
Average = Sum(39)m / 12 =												131.7239	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1705	1.1671	1.1638	1.1480	1.1451	1.1314	1.1314	1.1288	1.1367	1.1451	1.1510	1.1573	(40)
HLP (average)												1.1480	(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	2.8405 (42)
Average daily hot water use (litres/day)	101.6614 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8275	107.7611	103.6946	99.6282	95.5617	91.4953	91.4953	95.5617	99.6282	103.6946	107.7611	111.8275	(44)
Energy conte	165.8370	145.0421	149.6705	130.4863	125.2047	108.0422	100.1170	114.8857	116.2578	135.4872	147.8949	160.6043	(45)
Energy content (annual)										Total = Sum(45)m =		1599.5296	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	24.8756	21.7563	22.4506	19.5730	18.7807	16.2063	15.0175	17.2329	17.4387	20.3231	22.1842	24.0906	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(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	231.8284	204.6472	215.6618	194.3490	191.1961	171.9048	166.1083	180.8770	180.1204	201.4786	211.7575	226.5957	(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	231.8284	204.6472	215.6618	194.3490	191.1961	171.9048	166.1083	180.8770	180.1204	201.4786	211.7575	226.5957	(64)
Total per year (kWh/year) = Sum(64)m =												2376.5249	(64)
Heat gains from water heating, kWh/month	107.9339	95.9106	102.5585	94.4768	94.4237	87.0141	86.0820	90.9926	89.7458	97.8426	100.2652	106.1940	(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	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.2342	22.4128	18.2273	13.7992	10.3151	8.7084	9.4098	12.2312	16.4166	20.8447	24.3288	25.9355	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.1979	281.0848	273.8101	258.3231	238.7735	220.3997	208.1249	205.2381	212.5128	227.9998	247.5493	265.9231	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	(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)	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	(71)
Water heating gains (Table 5)	145.0725	142.7241	137.8475	131.2178	126.9135	120.8529	115.7016	122.3019	124.6470	131.5089	139.2572	142.7339	(72)
Total internal gains	514.1117	511.8288	495.4920	468.9473	441.6094	415.5683	398.8435	405.3783	419.1836	445.9605	476.7425	500.1997	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.3800	10.6334	0.6300	0.7000	0.7700	33.7319	(74)
East	0.8800	19.6403	0.6300	0.7000	0.7700	5.2820	(76)
South	4.7600	46.7521	0.6300	0.7000	0.7700	68.0111	(78)
West	2.2500	19.6403	0.6300	0.7000	0.7700	13.5052	(80)
North	2.4100	15.2954	0.6300	0.7000	1.0000	14.6305	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.1608	239.8406	360.0023	509.7417	636.5407	662.7800	626.0086	525.3775	410.2118	273.0507	163.4889	114.7186	(83)
Total gains	649.2725	751.6694	855.4943	978.6890	1078.1501	1078.3483	1024.8520	930.7558	829.3953	719.0113	640.2314	614.9183	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.3267	59.5005	59.6718	60.4898	60.6454	61.3802	61.3802	61.5182	61.0950	60.6454	60.3315	60.0069	
alpha	4.9551	4.9667	4.9781	5.0327	5.0430	5.0920	5.0920	5.1012	5.0730	5.0430	5.0221	5.0005	
util living area	0.9985	0.9965	0.9904	0.9650	0.8821	0.7116	0.5444	0.6148	0.8674	0.9810	0.9967	0.9988	(86)
Tweekday	18.5618	18.7309	19.0157	19.4096	19.7208	19.8712	19.8942	19.8933	19.8007	19.4066	18.9263	18.5477	
Tweekend	20.3341	20.4080	20.5337	20.7073	20.8576	20.9402	20.9603	20.9562	20.8936	20.7026	20.4899	20.3242	
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	19.9723	20.0843	20.2803	20.5430	20.7802	20.9082	20.9387	20.9324	20.8339	20.5410	20.2034	19.9570	(87)
Th 2	19.9436	19.9464	19.9491	19.9618	19.9642	19.9753	19.9753	19.9773	19.9710	19.9642	19.9594	19.9543	(88)
util rest of house	0.9979	0.9953	0.9868	0.9513	0.8375	0.6203	0.4243	0.4906	0.8003	0.9712	0.9953	0.9985	(89)
Tweekday	18.5618	18.7309	19.0157	19.4096	19.7208	19.8712	19.8942	19.8933	19.8007	19.4066	18.9263	18.5477	
Tweekend	18.5618	18.7309	19.0157	19.4096	19.7208	19.8712	19.8942	19.8933	19.8007	19.4066	18.9263	18.5477	
MIT 2	18.5618	18.7309	19.0157	19.4096	19.7208	19.8712	19.8942	19.8933	19.8007	19.4066	18.9263	18.5477	(90)
Living area fraction									fLA = Living area / (4) =			0.1308	(91)
MIT	18.7463	18.9079	19.1811	19.5579	19.8594	20.0068	20.0308	20.0293	19.9359	19.5550	19.0934	18.7321	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7463	18.9079	19.1811	19.5579	19.8594	20.0068	20.0308	20.0293	19.9359	19.5550	19.0934	18.7321	(93)

8. Space heating requirement

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9936	0.9832	0.9444	0.8321	0.6234	0.4310	0.4973	0.7975	0.9658	0.9937	0.9978	(94)
Useful gains	647.3657	746.8515	841.1099	924.2873	897.1705	672.1982	441.7357	462.8289	661.4334	694.4258	636.1805	613.5408	(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	1940.2529	1875.8860	1693.3305	1403.9133	1072.0381	701.8855	445.3734	470.0756	761.1198	1176.5726	1583.9826	1929.6524	(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	961.9081	758.7112	634.0522	345.3307	130.1015	0.0000	0.0000	0.0000	0.0000	358.7172	682.4175	979.1871	(98)

Space heating 4850.4254 (98)
Space heating per m2 (98) / (4) = 42.2732 (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 %)	278.8038	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1739.7272	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	961.9081	758.7112	634.0522	345.3307	130.1015	0.0000	0.0000	0.0000	0.0000	358.7172	682.4175	979.1871	(98)
Space heating efficiency (main heating system 1)	278.8038	278.8038	278.8038	278.8038	278.8038	0.0000	0.0000	0.0000	0.0000	278.8038	278.8038	278.8038	(210)
Space heating fuel (main heating system)	345.0125	272.1309	227.4188	123.8616	46.6642	0.0000	0.0000	0.0000	0.0000	128.6630	244.7662	351.2101	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	231.8284	204.6472	215.6618	194.3490	191.1961	171.9048	166.1083	180.8770	180.1204	201.4786	211.7575	226.5957	(64)
Efficiency of water heater												171.1200	(216)
(217)m	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	171.1200	(217)
Fuel for water heating, kWh/month	135.4771	119.5928	126.0296	113.5747	111.7322	100.4586	97.0713	105.7019	105.2597	117.7411	123.7480	132.4192	(219)

Water heating fuel used	1388.8060	(219)
Annual totals kWh/year		
Space heating fuel - main system	1739.7272	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	445.6431	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 0.50 * 1068 * 1.00) = -427.2282	-427.2282	(233)
Total delivered energy for all uses	3146.9481	(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	1739.7272	0.5190	902.9184	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1388.8060	0.5190	720.7903	(264)
Space and water heating			1623.7087	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	445.6431	0.5190	231.2888	(268)
Energy saving/generation technologies				
PV Unit	-427.2282	0.5190	-221.7314	(269)
Total CO2, kg/year			1633.2661	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.2300	(273)

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

DER		14.2300	ZC1
Total Floor Area	TFA	114.7400	
Assumed number of occupants	N	2.8405	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.3676	ZC2
CO2 emissions from cooking, equation (L16)		1.6313	ZC3
Total CO2 emissions		30.2289	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.2289	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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



----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                        Area         Storey height              Volume
                                                                                        (m2)              (m)                    (m3)
Ground floor                                                                         46.8400 (1b)    x      2.5500 (2b)    =    119.4420 (1b) - (3b)
First floor                                                                          44.3800 (1c)    x      2.7000 (2c)    =    119.8260 (1c) - (3c)
Second floor                                                                         23.5200 (1d)    x      2.6300 (2d)    =     61.8576 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              114.7400                                                         (4)
Dwelling volume                                                                            (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    301.1256 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                               main              secondary              other              total         m3 per hour
                                                            heating                heating
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) =        0.1328 (8)
Pressure test                                                                                                                                    Yes
Measured/design AP50                                                                                                                          5.0000
Infiltration rate                                                                                                                             0.3828 (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)  =         0.3254 (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
                0.4149       0.4068       0.3986       0.3580       0.3498       0.3091       0.3091       0.3010       0.3254       0.3498       0.3661       0.3824 (22b)
Effective ac    0.5861       0.5827       0.5795       0.5641       0.5612       0.5478       0.5478       0.5453       0.5529       0.5612       0.5670       0.5731 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                          Gross         Openings          NetArea          U-value           A x U          K-value          A x K
                                                    m2               m2               m2            W/m2K             W/K           kJ/m2K           kJ/K
TER Opaque door                                                                   2.1400           1.0000          2.1400                                 (26)
TER Opening Type (Uw = 1.40)                                                     18.2700           1.3258         24.2216                                 (27)
TER Room Window (Uw = 1.70)                                                       2.4100           1.5918          3.8361                                 (27a)
GF                                                                               46.8400           0.1300          6.0892                                 (28a)
EW                                            122.5100          20.4100         102.1000           0.1800         18.3780                                 (29a)
Stud Wall                                      21.8600                           21.8600           0.1800          3.9348                                 (29a)
Room in Roof (cosrule)2                        22.2500                           22.2500           0.1300          2.8925                                 (30)
Roof Joists                                    20.1300                           20.1300           0.1300          2.6169                                 (30)
Roof ins.@Rafters Including Ba                  6.4200           2.4100           4.0100           0.1300          0.5213                                 (30)
Total net area of external elements Aum(A, m2)                                   240.0100                                                                 (31)
Fabric heat loss, W/K = Sum (A x U)                                         (26)...(30) + (32) =          64.6304                                         (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                             250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                     13.0611 (36)
Total fabric heat loss                                                                                                       (33) + (36) =     77.6915 (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          58.2386      57.9065      57.5810      56.0519      55.7658      54.4340      54.4340      54.1874      54.9470      55.7658      56.3445      56.9496 (38)
Heat transfer coeff
              135.9301     135.5980     135.2725     133.7434     133.4573     132.1256     132.1256     131.8790     132.6386     133.4573     134.0361     134.6411 (39)
Average = Sum(39)m / 12 =                                                                                                                     133.7421 (39)

                Jan          Feb          Mar          Apr          May          Jun          Jul          Aug          Sep          Oct          Nov          Dec
HLP             1.1847       1.1818       1.1789       1.1656       1.1631       1.1515       1.1515       1.1494       1.1560       1.1631       1.1682       1.1734 (40)
HLP (average)                                                                                                                                   1.1656 (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                                                                                                                               2.8405 (42)
Average daily hot water use (litres/day)                                                                                                      101.6614 (43)

                Jan          Feb          Mar          Apr          May          Jun          Jul          Aug          Sep          Oct          Nov          Dec
Daily hot water use
              111.8275     107.7611     103.6946      99.6282      95.5617      91.4953      91.4953      95.5617      99.6282     103.6946     107.7611     111.8275 (44)
Energy conte  165.8370     145.0421     149.6705     130.4863     125.2047     108.0422     100.1170     114.8857     116.2578     135.4872     147.8949     160.6043 (45)
Energy content (annual)                                                                                                    Total = Sum(45)m =     1599.5296 (45)
Distribution loss  (46)m = 0.15 x (45)m
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	24.8756	21.7563	22.4506	19.5730	18.7807	16.2063	15.0175	17.2329	17.4387	20.3231	22.1842	24.0906	(46)

Water storage loss:

Store volume	300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.1127	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.1409	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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	224.4658	197.9972	208.2993	187.2239	183.8336	164.7797	158.7458	173.5145	172.9953	194.1160	204.6325	219.2331	(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	224.4658	197.9972	208.2993	187.2239	183.8336	164.7797	158.7458	173.5145	172.9953	194.1160	204.6325	219.2331	(64)

Total per year (kWh/year) = Sum(64)m = 2289.8366 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	102.0439	90.5905	96.6685	88.7768	88.5336	81.3141	80.1919	85.1025	84.0458	91.9526	94.5651	100.3040	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	142.0240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.2342	22.4128	18.2273	13.7992	10.3151	8.7084	9.4098	12.2312	16.4166	20.8447	24.3288	25.9355	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.1979	281.0848	273.8101	258.3231	238.7735	220.3997	208.1249	205.2381	212.5128	227.9998	247.5493	265.9231	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	37.2024	(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)	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	-113.6192	(71)
Water heating gains (Table 5)	137.1557	134.8074	129.9308	123.3010	118.9968	112.9362	107.7849	114.3851	116.7302	123.5921	131.3404	134.8172	(72)
Total internal gains	509.1950	506.9121	490.5753	464.0305	436.6926	410.6516	393.9267	400.4616	414.2668	441.0438	471.8258	495.2830	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.3800	10.6334	0.6300	0.7000	0.7700	33.7319	(74)
East	0.8800	19.6403	0.6300	0.7000	0.7700	5.2820	(76)
South	4.7600	46.7521	0.6300	0.7000	0.7700	68.0111	(78)
West	2.2500	19.6403	0.6300	0.7000	0.7700	13.5052	(80)
North	2.4100	15.2954	0.6300	0.7000	1.0000	14.6305	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.1608	239.8406	360.0023	509.7417	636.5407	662.7800	626.0086	525.3775	410.2118	273.0507	163.4889	114.7186	(83)
Total gains	644.3558	746.7527	850.5776	973.7722	1073.2333	1073.4315	1019.9353	925.8390	824.4786	714.0945	635.3146	610.0015	(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	58.6188	58.7623	58.9037	59.5772	59.7049	60.3067	60.3067	60.4195	60.0735	59.7049	59.4471	59.1800	
alpha	4.9079	4.9175	4.9269	4.9718	4.9803	5.0204	5.0204	5.0280	5.0049	4.9803	4.9631	4.9453	
util living area	0.9985	0.9966	0.9907	0.9665	0.8871	0.7215	0.5549	0.6260	0.8738	0.9819	0.9968	0.9989	(86)
MIT	19.6769	19.8290	20.0891	20.4473	20.7639	20.9418	20.9874	20.9778	20.8407	20.4392	19.9967	19.6530	(87)
Th 2	19.9323	19.9346	19.9369	19.9476	19.9496	19.9590	19.9590	19.9607	19.9554	19.9496	19.9455	19.9413	(88)
util rest of house	0.9980	0.9954	0.9872	0.9532	0.8432	0.6293	0.4313	0.4988	0.8076	0.9725	0.9955	0.9985	(89)
MIT 2	18.1670	18.3907	18.7707	19.2909	19.7152	19.9200	19.9543	19.9514	19.8227	19.2878	18.6440	18.1384	(90)

Living area fraction fLA = Living area / (4) = 0.1308 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.3645	18.5788	18.9431	19.4422	19.8524	20.0537	20.0895	20.0857	19.9559	19.4385	18.8209	18.3365	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	18.3645	18.5788	18.9431	19.4422	19.8524	20.0537	20.0895	20.0857	19.9559	19.4385	18.8209	18.3365	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9932	0.9826	0.9448	0.8384	0.6385	0.4474	0.5150	0.8076	0.9659	0.9933	0.9976	(94)
Useful gains	642.2988	741.6428	835.7444	920.0493	899.8226	685.3523	456.3186	476.8317	665.8886	689.7422	631.0642	608.5084	(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	1911.7893	1854.8243	1683.2145	1409.9514	1087.9974	720.5736	461.0500	486.0656	776.7142	1179.5572	1571.0272	1903.3547	(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	944.5009	748.0580	630.5178	352.7296	140.0021	0.0000	0.0000	0.0000	0.0000	364.4224	676.7734	963.3656	(98)

Space heating		4820.3697	(98)
Space heating per m2	(98) / (4) =	42.0112	(99)

CALCULATION OF TARGET EMISSIONS 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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5155.4756	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	944.5009	748.0580	630.5178	352.7296	140.0021	0.0000	0.0000	0.0000	0.0000	364.4224	676.7734	963.3656	(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)	1010.1614	800.0620	674.3505	377.2509	149.7348	0.0000	0.0000	0.0000	0.0000	389.7565	723.8218	1030.3376	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	224.4658	197.9972	208.2993	187.2239	183.8336	164.7797	158.7458	173.5145	172.9953	194.1160	204.6325	219.2331	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.2284	88.0297	87.5837	86.4793	84.0987	79.8000	79.8000	79.8000	79.8000	86.4704	87.7678	88.3050	(217)
Fuel for water heating, kWh/month	254.4146	224.9209	237.8287	216.4955	218.5927	206.4909	198.9295	217.4367	216.7861	224.4883	233.1521	248.2681	(219)

Water heating fuel used	2697.8041	(219)
Annual totals kWh/year		
Space heating fuel - main system	5155.4756	(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)	445.6431	(232)
Total delivered energy for all uses	8373.9228	(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	5155.4756	0.2160	1113.5827	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2697.8041	0.2160	582.7257	(264)
Space and water heating			1696.3084	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	445.6431	0.5190	231.2888	(268)
Total CO2, kg/m2/year			1966.5222	(272)
Emissions per m2 for space and water heating			14.7839	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0158	(272b)
Emissions per m2 for pumps and fans			0.3392	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7839 * 1.55) + 2.0158 + 0.3392, rounded to 2 d.p.			25.2700	(273)

breglobal

Job no:	PRXXXX
Date:	XX/XX/XXXX
Assessor name:	Rajohn Ali
Registration no:	BRE400012
Development name:	Appendix G of Energy Statement

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 70% (maximum)

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:	Dwelling																			
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**																			
WC	Full flush volume	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	3	8.88		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)	6	11.06		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**																			
Bath	Capacity to overflow	155	17.05		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**																			
Washing Machine	Litres / kg	7	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**																			
Dishwasher	Litres / place setting	0.9	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		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		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		115.4		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**		**105.0**		**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		**110.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	17.K Compliance?		Yes		-		-		-		-		-		-		-		-		-