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J C Beachey

On-Construction Energy Performance Certificates
Code for Sustainable Homes Rating
SAP, DER/TER Rating
Renewable Energy Statements
Water Calculations (for Part G)

Climate Change and Sustainability Report for Proposed Development

Two Houses
Adjacent 1 Wolseley Road,

Bishopston, Bristol

BS7 8EL

This report has been prepared by J C Beachey in respect of the Bristol Development Framework Core Strategy Policies:

BCS13 Climate Change

BCS14 Sustainable Energy

BCS15 Sustainable Design & Construction

BCS16 Flood Risk & Water Management

Report date: 30th September, 2019 *Author: J C Beachey*

Climate Change and Sustainability Report for Proposed Development

Two Houses
Adjacent 1 Wolseley Road,

Bishopston, Bristol

BS7 8EL

Report Inclusion: Two dwelling houses each of three storeys.

Report Exclusion: None.

This report has been prepared by J C Beachey in respect of the Bristol Development Framework Core Strategy Policies:

BCS13 Climate Change

Development should contribute to both mitigating and adapting to climate change, and to meeting targets to reduce carbon dioxide emissions.

Development should mitigate climate change through measures including:

- ***High standards of energy efficiency including optimal levels of thermal insulation, passive ventilation and cooling, passive solar design, and the efficient use of natural resources in new buildings.***
- ***The use of decentralised, renewable and low-carbon energy supply systems.***
- ***Patterns of development which encourage walking, cycling and the use of public transport instead of journeys by private car.***

Development should adapt to climate change through measures including:

- ***Site layouts and approaches to design and construction which provide resilience to climate change.***
- ***Measures to conserve water supplies and minimise the risk and impact of flooding.***
- ***The use of green infrastructure to minimise and mitigate the heating of the urban environment.***
- ***Avoiding responses to climate impacts which lead to increases in energy use and carbon dioxide emissions.***

These measures should be integrated into the design of new development.

New development should demonstrate through Sustainability Statements how it would contribute to mitigating and adapting to climate change and to meeting targets to reduce carbon dioxide emissions by means of the above measures.

BCS14 Sustainable Energy

Proposals for the utilisation, distribution and development of renewable and low-carbon sources of energy, including large-scale freestanding installations, will be encouraged. In assessing such proposals the environmental and economic benefits of the proposed development will be afforded significant weight, alongside considerations of public health and safety and impacts on biodiversity, landscape character, the historic environment and the residential amenity of the surrounding area.

Development in Bristol should include measures to reduce carbon dioxide emissions from energy use in accordance with the following energy hierarchy:

1. Minimising energy requirements;
2. Incorporating renewable energy sources;
3. Incorporating low-carbon energy sources.
Consistent with stage two of the above energy hierarchy, development will be expected to provide sufficient renewable energy generation to reduce carbon dioxide emissions from residual energy use in the buildings by at least 20%. An exception will only be made in the case where a development is appropriate and necessary but where it is demonstrated that meeting the required standard would not be feasible or viable.

The use of combined heat and power (CHP), combined cooling, heat and power (CCHP) and district heating will be encouraged. Within Heat Priority Areas, major development will be expected to incorporate, where feasible, infrastructure for district heating, and will be expected to connect to existing systems where available.

New development will be expected to demonstrate that the heating and cooling systems have been selected according to the following heat hierarchy:

1. Connection to existing CHP/CCHP distribution networks

2. Site-wide renewable CHP/CCHP

3. Site-wide gas-fired CHP/CCHP

4. Site-wide renewable community heating/cooling

5. Site-wide gas-fired community heating/cooling

6. Individual building renewable heating

BCS15 Sustainable Design & Construction

Sustainable design and construction will be integral to new development in Bristol. In delivering sustainable design and construction, development should address the following key issues:

- ***Maximising energy efficiency and integrating the use of renewable and low-carbon energy;***
- ***Waste and recycling during construction and in operation;***
- ***Conserving water resources and minimising vulnerability to flooding;***
- ***The type, life cycle and source of materials to be used;***
- ***Flexibility and adaptability, allowing future modification of use or layout, facilitating future refurbishment and retrofitting;***
- ***Opportunities to incorporate measures which enhance the biodiversity value of development, such as green roofs.***

New development will be required to demonstrate as part of the Sustainability Statement submitted with the planning application how the above issues have been addressed. For major development and development for health or education uses, the Sustainability Statement should include a BREEAM and/or Code for Sustainable Homes assessment. Additionally, in the case of a super-major development, a BREEAM for Communities assessment will be required.

All new development will be required to provide satisfactory arrangements for the storage of refuse and recyclable materials as an integral part of its design. Major developments should include communal facilities for waste collection and recycling where appropriate.

New homes and workplaces should include the provision of high-speed broadband access and enable provision of Next Generation broadband.

BCS16 Flood Risk & Water Management

Development in Bristol will follow a sequential approach to flood risk management, giving priority to the development of sites with the lowest risk of flooding. The development of sites with a sequentially greater risk of flooding will be considered where essential for regeneration or where necessary to meet the development requirements of the city.

Development in areas at risk of flooding will be expected to:

- ***be resilient to flooding through design and layout, and/or***
- ***incorporate sensitively designed mitigation measures, which may take the form of on-site flood defence works and/or a contribution towards or a commitment to undertake such off-site measures as may be necessary, in order to ensure that the development remains safe from flooding over its lifetime.***

All development will also be expected to incorporate water management measures to reduce surface water run-off and ensure that it does not increase flood risks elsewhere. This should include the use of sustainable drainage systems (SUDS).

Proportionality of the Scale of Development

This is to be regarded as a **small scale development** within the scope of BCS13. It is a development of two dwellings to replace a commercial garage.

There is minor scope to improve the structure/services over and above the requirements of Part L1A Building Regulations (England) 2013 edition (2016 amendments).

Sustainable Design and Construction

Waste and recycling

The dwellings will have external storage bins for general waste and re-cyclable waste. Small internal waste bins (within kitchen units) could also be provided dependant on LA waste strategy at the time of construction.

The development of the site would not require a Site Waste Management Plan although construction waste disposal must be strictly regulated and minimised.

Water Efficiency

It is a requirement that water use (potable and recycled) must comply with the requirements of Approved Document Part G - Sanitation, Hot Water Safety and water efficiency. A Planning condition ***may*** require reduction of water usage below the requirement of Part G.

A maximum potable water usage of **110 litres per person per day** is now required. This can be achieved through the use of low water use WCs, flow restrictors or flow restricted taps, low water flow shower and reduced overflow height bath, together with low water use white goods. At construction completion, the water use will be certified for Building Control.

Water Management – Rainwater Runoff

The site consists of an existing garage. There will be *reduced* rainwater run-off.

SuDS techniques for the proposed development will reduce and delay the discharge of rainfall run-off to watercourses and public sewers. SuDS.in the form of rainwater soakaways will be provided. Small grassed/green areas will be provided

Materials

Construction drawings and specification have yet to be prepared for the scheme, but early indications indicate that the constructed elements all fall within the banding A or A+ of the BRE Green Guide. An exception might be the ground floor slabs with a rating of B. Recycled hardcore should be used wherever possible.

Flexibility and Adaptability

The dwellings will have adequate open living areas. An area could be used as a Home Office.

Access to Fast Broadband

Fast Broadband will be available (Bristol City Council Broadband Connectivity Practice Note 2018) > 30Mb/sec via landline (cable or fibre optic). A postcode search revealed adequate internet speed and connection (document below).

BS7 8EL Availability

FTTH/FTTP	✓
Ultrafast Broadband (>=100 Mbps)	✓
Superfast Broadband (>24 Mbps)	✓
Fibre (eg FTTC/VDSL2/FTTH/Cable/G.Fast)	✓
Wireless	⊘
LLU	✓
ADSL2+	✓
ADSL	✓

Biodiversidy

Green lawn and traditional garden planting is proposed.

Appropriate Low or Zero Energy Generating Technologies

1. **Photo Voltaic Panels**

   PV panels will be installed. They will provide an appropriate means of providing carbon reduction.

2. **Solar Thermal**

   Solar thermal could be considered. This could be a retrofitted feature (climate change)

3. **Air source Heat Pumps**

   Air to water heat pumps mounted externally may require aesthetic considerations. The reduction in carbon emissions are good, but plant considerations in small internal areas would need careful consideration. These could be a retrofitted feature (climate change)

4. **Biomass**

   There is little option for biomass main heating, considering fuel storage, emissions in a built-up area, living patterns and considerable space requirement for hopper based systems. A small wood-burning stove could however be considered. Under the Clean Air Act 1993 Bristol is covered by a smoke control order.

5. **Ground Source Heat Pumps**

   The only option for the site would be bore holes, but the cost would preclude effective installation.

6. **Combined Heat and Power**

   Please note that CHP is not feasible for this scheme as there are no commercially available units small enough for economical use. The living pattern and development scale would preclude economical use. The Stirling engines of such a system may produce inter-dwelling noise, plus the need for regular oil changes and maintenance.

7. **District Heating**

District heating is not viable for this residential development. There is no known district heating system that could be linked to this development.

Energy Strategies

Calculations were carried out on the dwellings using SAP2012 methodology.

Both Houses The Baseline construction was calculated to achieve Building Regulation (Approved Document Part L1A England) compliance. The parameters used were as follows:

Heated by Mains Gas

Wall assumed masonry cavity wall	U-value = 0.18
Wall party walls	U-value = 0.00
Roofs	U-value = 0.13
Floor (ground bearing slab)	U-value = 0.11
Windows	U-value = 1.3
Roof Windows	U-value = 1.3 (measured vertically)
External Door	U-value = 1.00
Infiltration	**5.5** m^3/m^2/hr at 50 Pascals as designed
Ventilation	Purge Ventilation – openable windows. Intermittent ventilation – extract fans in wet areas
Lighting	100% low energy
Heating (space & water)	Mains Gas condensing combi boiler
Heat emitters	Radiators
Heating Controls	Time & Temperature zone control *with* delayed start stats.
Photovoltaic panels	**0.25 kW/peak**

Both Houses The Enhanced construction The parameters used were as follows

Heated by Mains Gas, additional Photo Voltaics

Wall assumed masonry cavity wall	U-value = 0.18
Wall party walls	U-value = 0.00
Roof	U-value = 0.13
Floor (ground bearing slab)	U-value = 0.11
Windows	U-value = 1.3
Roof Windows	U-value = 1.3 (measured vertically)
External Door	U-value = 1.00
Infiltration	**5.5** m^3/m^2/hr at 50 Pascals as designed
Ventilation	Purge Ventilation – openable windows. Intermittent ventilation – extract fans in wet areas
Lighting	100% low energy
Heating (space & water)	Mains Gas condensing combi boiler
Heat emitters	Radiators
Heating Controls	Time & Temperature zone control *with* delayed start stats.
Photovoltaic panels	**1.25 kW/peak**

Summary Table: **Left Hand House** - A baseline of Mains Gas heating. Please note this calculation was produced using the methodology of SAP2012 by an approved assessor (J C Beachey)

L H House	Energy Demand (kWh pa)	Energy saving achieved (%)	Regulated CO_2 emissions (kg pa)	Saving achieved on residual CO_2 emissions (%)
Building Regulation Part L compliance	7,340		1,708	
Proposed scheme after energy efficiency measures	7,340		1,708	
Proposed scheme after on-site renewables	6,476	11.77%	1,260	26.23%
Total savings on residual emissions	864		448	**26.23%**

Detailed Measures **Left Hand House**

Baseline Energy Demand

Baseline Energy demand (kWh pa)	7,340
Regulated emissions (kg pa)	1,708

Energy Demand with Renewables

Energy Demand with Renewables (kWh pa)	6,476
Regulated emissions with Renewables (kg pa)	1,260

CO_2 reduction is: 26.23%

Summary Table: **Right Hand House** - A baseline of Mains Gas heating. Please note this calculation was produced using the methodology of SAP2012 by an approved assessor (J C Beachey)

RH House	Energy Demand (kWh pa)	Energy saving achieved (%)	Regulated CO_2 emissions (kg pa)	Saving achieved on residual CO_2 emissions (%)
Building Regulation Part L compliance	8,023		1,863	
Proposed scheme after energy efficiency measures	8,023		1,863	
Proposed scheme after on-site renewables	7,159	10.77%	1,415	24.05%
Total savings on residual emissions	864		448	**24.05%**

Detailed Measures Right Hand House

Baseline Energy Demand

Baseline Energy demand (kWh pa)	8,023
Regulated emissions (kg pa)	1,863

Energy Demand with Renewables

Energy Demand with Renewables (kWh pa)	7,159
Regulated emissions with Renewables (kg pa)	1,415

CO_2 reduction is: 24.05%

Heating Considerations

The heating is to be by mains gas. Air to air or air to water electric heatpump heating could be a future consideration with the possibility of solar water heating (climate change).

Energy Efficiency

Advanced heating controls will aid energy reduction, and are recommended by the report author. Constructional elements will conform to, or better the requirements of Part L1A England. Although electric heat pumps could be used, the CO_2 emissions (by generation) are higher than for mains gas (SAP 2012 parameters, although SAP 10 for Part L1A 2020 indicate more favourable parameters). This could be offset by the area of photo voltaic array.

There are no baseline parameters by which to judge compact design and configuration.

Air Tightness

As the envelope of the dwellings is increasingly insulated, the mass of air to be heated within the dwellings remains a constant factor. With a relatively well insulated dwelling, the air change rate becomes a major factor in energy loss. The airtightness of the building envelope is therefore a vital consideration. However, an infiltration rate of $5m^3/m^2/hr$ or less is not recommended unless whole dwelling mechanical ventilation is achieved. It is not envisaged that whole dwelling mechanical ventilation will be utilised.

Although the *design* infiltration rate is relatively low ($5.5\ m^3/m^2/h$), reduction in infiltration will have a marked effect on emissions. Care must be taken in actively limiting infiltration in design and construction. It can be assumed that the overall rate of emissions will be lower than the calculated rate used for the purpose of this exercise.

Whole Dwelling Mechanical Ventilation with Heat Recovery

Unless very low infiltration rate can be achieved, it would be likely that the electricity running costs would outweigh the savings of the heat recovery. In practice, it is found that the constant running of mechanical ventilation systems (even in unoccupied time, considering presumed lifestyle) can be uneconomical.

Climate Change

Solar water heating could be incorporated plus additional PV arrays. A wet heating system could utilise air source heat pumps in future. Enhanced heating controls could be utilised. Adequate ventilation is provided to cope with increasing annual temperatures. Blinds could be fitted to the rooflights. Adequate rainwater disposal will be provided. There is **no** current flood risk (rivers, estuaries & reservoirs) in this area although no climate change flood risk calculations have been carried out.

The dwellings are in an urban area. Shops and industry are fairly close by. Regular transport links and adequate cycling facilities should mitigate journeys by private car.

The dwellings are effectively sheltered and should not be affected to any great extent by climate change. Summertime overheating is not currently predicted (SAP calculation).

Other Energy Related/Health Factors

Adequate natural daylighting is to be provided.

Natural ventilation is encouraged by the use of openable windows, although external noise and security have to be considered. (SAP 10)

Responsive heating controls (low hysteresis) should be provided. The use of delayed start or weather compensated controls is recommended (this would further enhance reduction of emissions).

External lighting will be LED and daylight controlled.

Approved Document Part L1A requires a minimum of 75% low-energy lighting (see the Domestic Building Services Compliance Guide).
This development will have 100% low-energy lighting.

On-Site Renewables

It is recommended that solar photovoltaic panels be installed. These can be mounted at 30deg on the flat roof facing due South.

Allowable Solutions

The CO_2 reduction is greater than the required 20%. Photo voltaic panels of cumulative 1.25 kW/peak are required to each house. It is possible that this figure may be greater, dependent on the make/efficiency of the panels. Strict attention to air-tightness in construction and the use of responsive heating controls will further reduce emissions.

Mining: Mining maps have been checked. The dwelling is just outside the coalfield consultation area. There is no apparent past mining activity (mine entries) in the vicinity of the development.

Radon: The dwelling is in an area with a 1-3% building chance of a Radon level above the trigger point of 200Bq^{-3}. Radon protection (membrane) should be provided (to be discussed with Building Control). This is a relatively low risk.

Flood Risk: There is no flood risk from rivers, estuaries or sea, surface water or from reservoirs.

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
BS7 8EL	**358960/175125**	**27 Sep 2019 13:20**

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

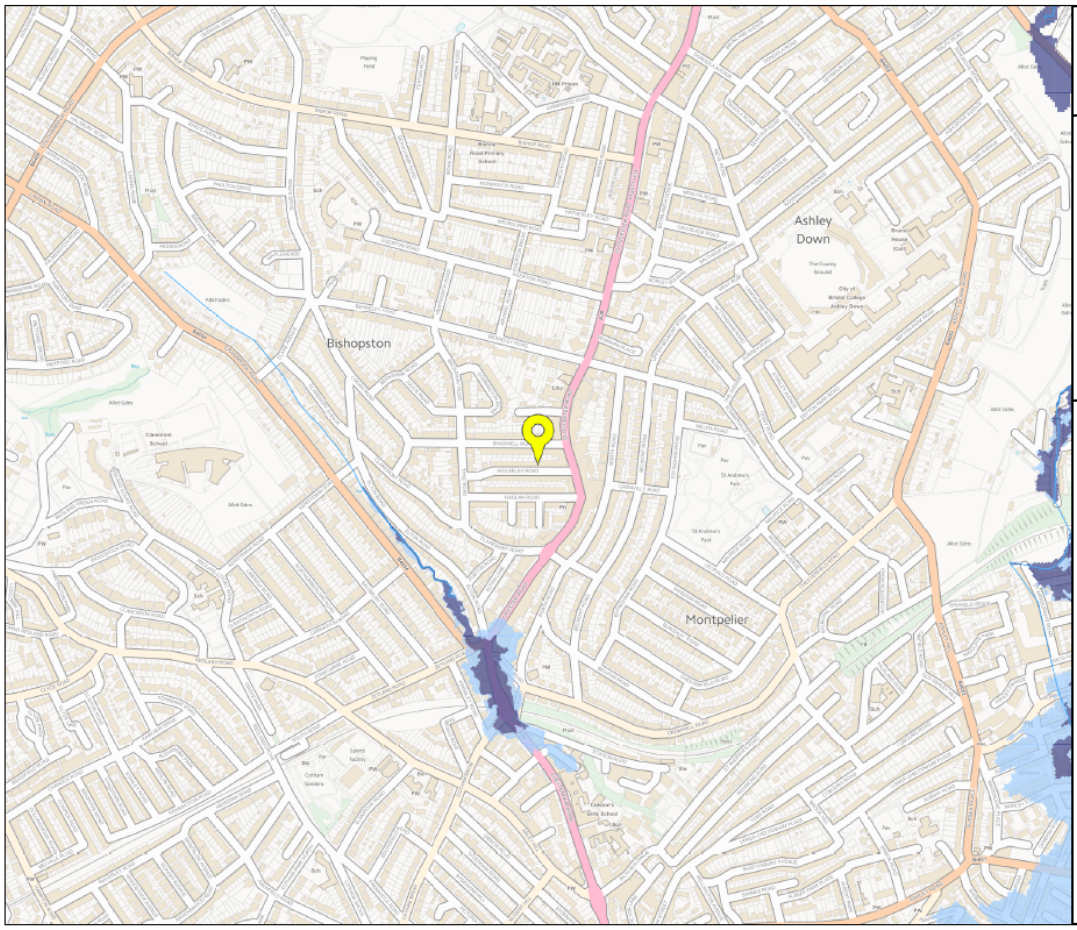
This means:

- 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
BS7 8EL

Location (easting/northing)
358960/175125

Scale
1:10000

Created
27 Sep 2019 13:20

- 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

0 100 200 300m

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

LH House Baseline

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 %)												89.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4435.8266	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	809.3307	625.0002	502.5351	252.2950	77.9561	0.0000	0.0000	0.0000	0.0000	277.4678	570.8912	832.4095	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	909.3603	702.2475	564.6462	283.4776	87.5912	0.0000	0.0000	0.0000	0.0000	311.7615	641.4508	935.2916	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	220.2465	194.0874	203.7435	182.5164	177.5203	156.3500	149.7952	166.9865	167.9918	189.2652	200.2872	214.9049	(64)
Efficiency of water heater												89.0000	(216)
(217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(217)
Fuel for water heating, kWh/month													
	247.4679	218.0757	228.9253	205.0746	199.4610	175.6741	168.3092	187.6253	188.7548	212.6575	225.0418	241.4661	(219)
Water heating fuel used												2498.5335	(219)
Annual totals kWh/year													
Space heating fuel - main system												4435.8266	(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)												546.3470	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.25 * 1080 * 1.00) =										-215.9049		-215.9049	(233)
Total delivered energy for all uses												7339.8021	(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	4435.8266	0.2160	958.1385	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2498.5335	0.2160	539.6832	(264)
Space and water heating			1497.8218	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	546.3470	0.5190	283.5541	(268)
Energy saving/generation technologies				
PV Unit	-215.9049	0.5190	-112.0547	(269)
Total CO2, kg/year			1708.2462	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.6100	(273)

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

DER		11.6100	ZC1
Total Floor Area	TFA	147.0900	
Assumed number of occupants	N	2.9295	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.7846	ZC2
CO2 emissions from cooking, equation (L16)		1.2870	ZC3
Total CO2 emissions		25.6816	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.6816	ZC8

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

ENHANCED LEFT HAND HOUSE CALCULATION (see sect. 12a)

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 %)												89.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4435.8266	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	809.3307	625.0002	502.5351	252.2950	77.9561	0.0000	0.0000	0.0000	0.0000	277.4678	570.8912	832.4095	(98)
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Water heating requirement													
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Water heating													
Water heating requirement													
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Electricity for lighting (calculated in Appendix L)												546.3470	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.25 * 1080 * 1.00) =										-215.9049		-215.9049	(233)
Total delivered energy for all uses												7339.8021	(238)

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

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Space and water heating			1497.8218	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	546.3470	0.5190	283.5541	(268)
Energy saving/generation technologies				
PV Unit	-215.9049	0.5190	-112.0547	(269)
Total CO2, kg/year			1708.2462	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.6100	(273)

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Total CO2 emissions		25.6816	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.6816	ZC8

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

RH House Baseline

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

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Fraction of space heat from main system(s)												1.0000	(202)
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Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5090.0345	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	907.6952	709.9313	585.0348	311.2865	108.3542	0.0000	0.0000	0.0000	0.0000	330.8878	646.7542	930.1869	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	1019.8822	797.6756	657.3424	349.7601	121.7463	0.0000	0.0000	0.0000	0.0000	371.7841	726.6901	1045.1538	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	220.7524	194.5299	204.2002	182.9145	178.0509	156.8173	150.2429	167.4856	168.3465	189.6786	200.7384	215.3948	(64)
Efficiency of water heater												89.0000	(216)
(217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(217)
Fuel for water heating, kWh/month													
	248.0364	218.5729	229.4384	205.5219	200.0571	176.1992	168.8122	188.1861	189.1534	213.1220	225.5488	242.0167	(219)
Water heating fuel used												2504.6650	(219)
Annual totals kWh/year													
Space heating fuel - main system												5090.0345	(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)												569.2361	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.25 * 1080 * 1.00) =										-215.9049		-215.9049	(233)
Total delivered energy for all uses												8023.0306	(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	5090.0345	0.2160	1099.4474	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2504.6650	0.2160	541.0076	(264)
Space and water heating			1640.4551	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	569.2361	0.5190	295.4335	(268)
Energy saving/generation technologies				
PV Unit	-215.9049	0.5190	-112.0547	(269)
Total CO2, kg/year			1862.7590	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.9700	(273)

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

DER		11.9700	ZC1
Total Floor Area	TFA	155.5900	
Assumed number of occupants	N	2.9426	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.4366	ZC2
CO2 emissions from cooking, equation (L16)		1.2187	ZC3
Total CO2 emissions		25.6253	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.6253	ZC8

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

RH House Enhanced

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 %)												89.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5090.0345	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	907.6952	709.9313	585.0348	311.2865	108.3542	0.0000	0.0000	0.0000	0.0000	330.8878	646.7542	930.1869	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	1019.8822	797.6756	657.3424	349.7601	121.7463	0.0000	0.0000	0.0000	0.0000	371.7841	726.6901	1045.1538	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	220.7524	194.5299	204.2002	182.9145	178.0509	156.8173	150.2429	167.4856	168.3465	189.6786	200.7384	215.3948	(64)
Efficiency of water heater												89.0000	(216)
(217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(217)
Fuel for water heating, kWh/month													
	248.0364	218.5729	229.4384	205.5219	200.0571	176.1992	168.8122	188.1861	189.1534	213.1220	225.5488	242.0167	(219)
Water heating fuel used												2504.6650	(219)
Annual totals kWh/year													
Space heating fuel - main system												5090.0345	(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)												569.2361	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.25 * 1080 * 1.00) =										-1079.5246		-1079.5246	(233)
Total delivered energy for all uses												7159.4109	(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	5090.0345	0.2160	1099.4474	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2504.6650	0.2160	541.0076	(264)
Space and water heating			1640.4551	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	569.2361	0.5190	295.4335	(268)
Energy saving/generation technologies				
PV Unit	-1079.5246	0.5190	-560.2733	(269)
Total CO2, kg/year			1414.5403	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.0900	(273)

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

DER		9.0900	ZC1
Total Floor Area	TFA	155.5900	
Assumed number of occupants	N	2.9426	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.4366	ZC2
CO2 emissions from cooking, equation (L16)		1.2187	ZC3
Total CO2 emissions		22.7453	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		22.7453	ZC8