



ABBHEYCONSULTANTS

Discharge Planning Condition
Energy & Carbon Emissions

Condition 20 of application
WA/44/17/OUT

Land East of Tye Lane, Walberton

Linden Homes

Report No: DC-ES-LIN-WB-18-03

Report Date: March 2019

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1. ASSESSMENT INFORMATION

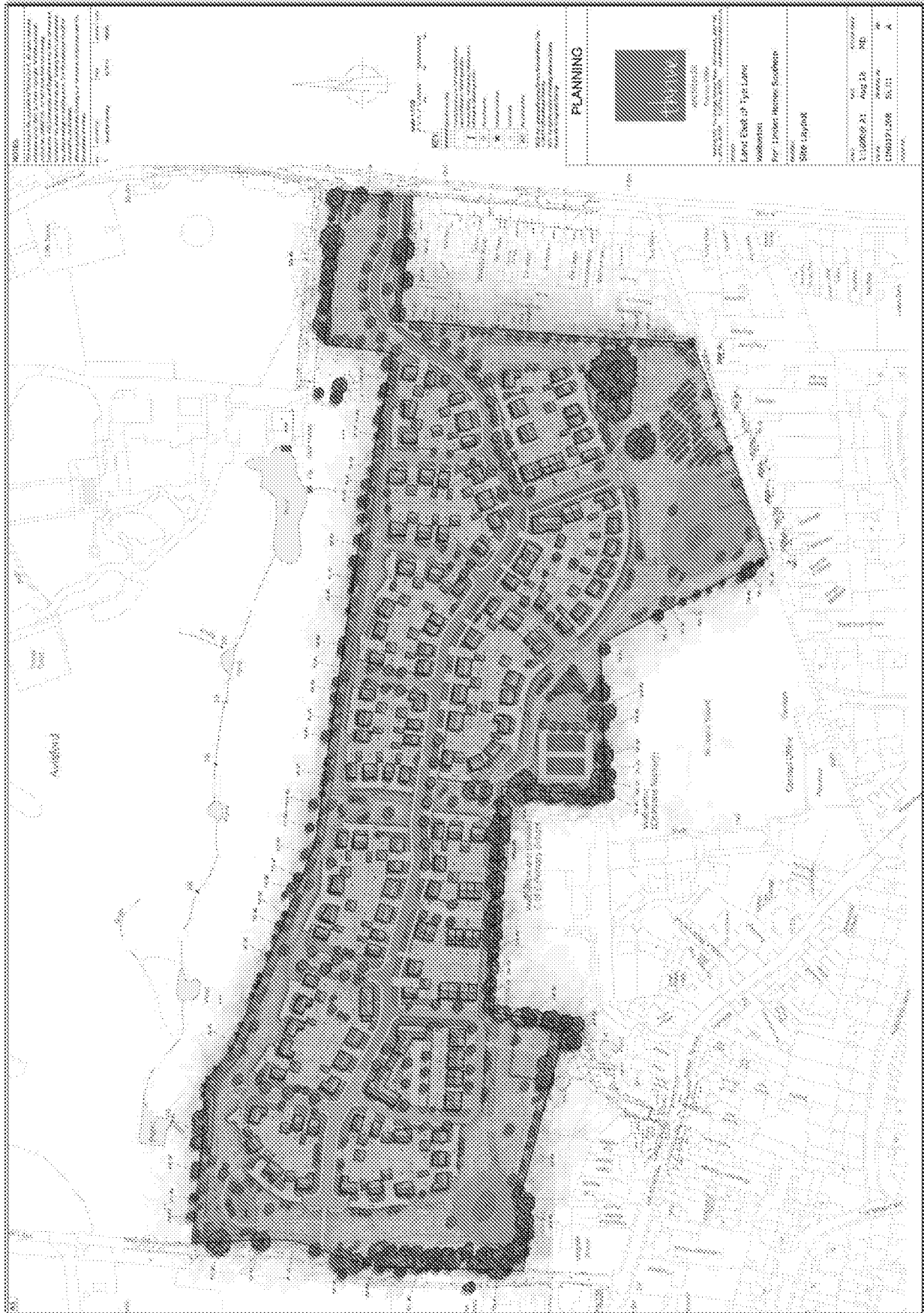
Nature of Assessment:	Condition 20 of application WA/44/17/OUT
Project Name:	Walberton
Project Address:	Land East of Tye Lane, Walberton
Developer:	Linden Homes
Architect:	Thrive Architects
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Issue Number	Date	Reason	Author
01	21/11/2018	First Issue	MF
02	13/02/2019	Improved fabric performance	MF
03	13/03/2019	Revised fabric specification	MF

Project Description	Erection of up to 175 dwellings, new vehicular access, together with associated car parking, landscaping & community facilities to include allotments, play space & community orchard.
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Figure 1: Site Plan



2. EXECUTIVE SUMMARY

In keeping with requirements of planning, this statement comprises:

- A Building Regulation baseline energy assessment for the proposed development.
- Energy conservation measures to be undertaken in the design of the development.
- A calculation of energy savings that are to be achieved as a result of energy efficient measures.
- A calculation of CO₂ savings that are to be achieved as a result of energy efficient measures.

Linden Homes has placed considerable emphasis on utilising passive design measures and targeting fabric efficiency in order to mitigate energy use. In conjunction with high levels of air tightness and proposed Accredited Construction Details (ACD) to all wall junctions; energy consumption for heating will be dramatically reduced, providing home owners with a comfortable, efficient and cost effective dwelling. Highly efficient mechanical ventilation will ensure the dwellings will remain well ventilated and provide a comfortable living environment for home owners.

The overall fabric energy efficiency specification significantly improves on the requirements of Part L1A 2013 , and shows that the development will reduce CO₂ requirements and supply energy efficiently. The proposal demonstrates that all units will achieve a reduction in Dwelling Emission Rates **10.01 %** better than a Part L1A 2013 baseline.

Table 1: Key Figures

Energy and CO ₂ Savings			
	Description	Amount	Unit
Regs & Improvements (TER's)	Total development CO ₂ demand Part L1A 2013 (TER)	304,954	KGCO ₂ /Year
	Total development energy demand Part L1A 2013 (TER)	1,289,724	kWh/Year
	Actual development CO ₂ demand (DER) Part L1A 2013	274,433	KGCO ₂ /Year
	Actual development CO ₂ demand (DER) Part L1A 2013	1,130,125	kWh/Year
	Percentage CO ₂ improvement through fabric/control	10.01	%
	Percentage energy improvement through fabric/control	12.37	%

Fabric Energy Efficiency and low carbon technology measures reduce CO₂ emissions by **10.01 %** and energy demand by **12.37 %** over a 2013 baseline unit.

The reduction in carbon emissions and energy through a fabric approach is in excess of the 10% reduction required by of Arun District Council and Condition 20 of application WA/44/17/OUT.

3. PLANNING CONDITION

The following report sets out Linden Homes' intentions with regards to energy and sustainability to discharge Condition 20 of application WA/44/17/OUT.

Condition 20 reads as follows:

At least 10% of the energy supply of the development shall be secured from decentralised and renewable or low carbon energy sources (as described in the glossary at Annex 2 of the National Planning Policy Framework, March 2012). Details and a timetable of how this is to be achieved for each phase or subphase of development, including details of physical works on site, shall be submitted to and approved in writing by the local Planning Authority before any development in that phase or sub phase begins. The development shall be implemented in accordance with the approved details and timetable and retained as operational thereafter, unless otherwise agreed in writing by the Local Planning Authority.

Reason: In order to secure on site renewable energy in accordance with national planning policy, in accordance with Policy GEN7 of the Arun District Local Plan.

4. BASELINE ENERGY CALCULATIONS

A baseline total energy demand has been established for the proposed development. Reductions in demand due to energy conservation measures are considered and form the basis of the renewable energy strategy which follows.

Floor plans for the development have been used in conjunction with an outline accommodation schedule and building specifications to prepare initial preliminary SAP Calculations on a sample of unit types. SAP calculations have been carried out to Approved Document Part L1A 2013. The relevant energy loads have been collated from the full SAP calculation sheets and entered into a spread sheet that can be found in the appendices, which calculates the total energy and CO₂ demand.

Regulated Energy Demand is calculated from the energy associated with space heating, hot water and fixed electrical demands (for lights, fans and pumps).

Unregulated energy is the annual electrical energy demand from appliances and would be calculated using the methodology as suggested by SAP2012. SAP calculations are extended to allow for CO₂ emissions associated with appliances and cooking, and to allow for site-wide electricity generation technologies.

Total Energy Demand for the development is calculated from the regulated energy demand figures given above and an additional energy demand associated with unregulated energy.

CO₂ emissions from appliances use equation L14

$$L14 = E_A \times E_{\text{Electricity}} / TFA$$

Where $E_{\text{Electricity}}$ is the emission factor for electricity (SAP 2012 Table 12)

CO₂ emissions from cooking uses equation L16

$$L16 = (119 + 24N) / TFA$$

Where $N = 1 + 1.76 \times \{1 - \exp(-0.000349 \times (TFA - 13.9)^2) + 0.0013 \times (TFA - 13.9)\}$

Total Energy Demand is used in the final analysis to determine the contribution which renewable energy technology makes to total energy requirements for the development once energy conservation measures have been considered.

Energy savings are measured in terms of a reduction in CO₂ emissions and kWh, which are calculated from their association with a particular fuel source. CO₂ Conversion Factors have been taken from Table 2, Building Regulations Part L1A 2013:

Table 2: Fuel Conversion factors

Fuel Source	CO ₂ Conversion Factor (Kg/kWh)
Electricity	0.519 (Displaced 0.519)
Gas	0.216

4.1 CALCULATION OF BASELINE ENERGY AND CO₂ EMISSIONS

Thermal insulation levels and air tightness standards for the baseline case are assumed to just meet the requirements Part L1A 2013 of Building Regulations. The unit is assumed to have conventional gas boilers with efficiency of 88.6% to provide space heating and hot water.

Table 3: Predicted Carbon Emissions: Part L1A 2013 Compliant Unit (TER) including Non domestic where applicable

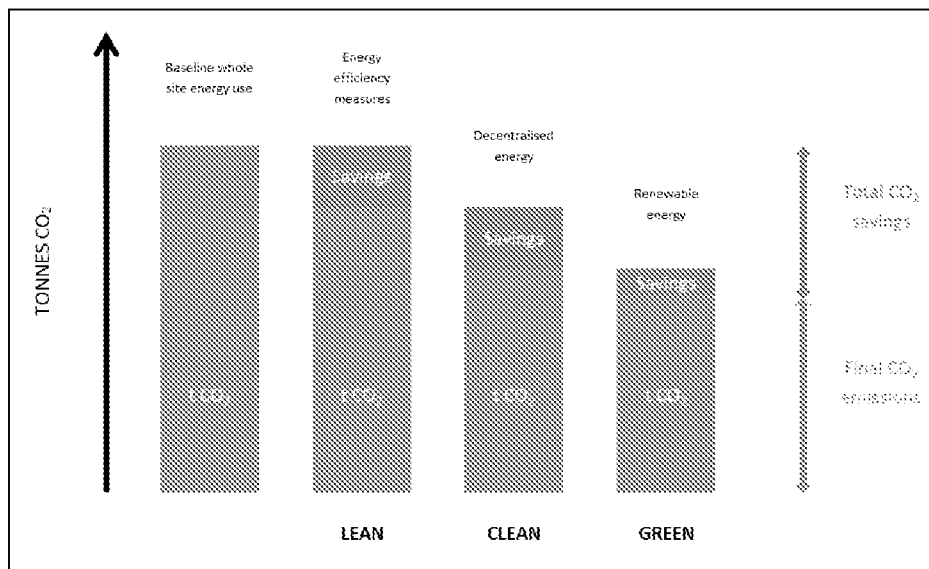
	Space Heating Demand (kWh/a)	Secondary Heating Demand (kWh/a)	Hot Water demand (kWh/a)	Energy from pumps and fans (kWh/a)	Energy from Lighting (kWh/a)	Energy from Appliances (kWh/a)	Totals
Part L1A 2013 Compliant Units	775,334	0	427,348	13,125	73,917	0	1,289,724
CO ₂ Associated with total Energy Demand (kg/a)	167,472	0	92,307	6,812	38,363	0	304,954

5. ENERGY HIERARCHY

The accepted standard approach to reducing carbon dioxide emissions in the built environment is as follows;

1. Reduce energy demand (be lean)
2. Supply energy efficiently (be clean)
3. Use renewable energy (be green)

Figure 2: Energy Hierarchy



5.1 BE LEAN – USE LESS ENERGY

Energy demand reduction provides the greatest opportunity for minimising a building’s potential CO₂ emissions. Design strategies typically include building form and fabric measures (passive design) and energy efficient building services (active design). Focusing on form and fabric, in particular at an early stage in the building process, is often the most cost effective way to reduce energy and consequently CO₂ emissions.

As required by the energy hierarchy, the overall energy demand for the development will be reduced by implementing energy efficiency measures as far as practically and economically possible.

5.2 REGULATED ENERGY

To reduce demand for space heating, emphasis has been placed on providing a very high standard of fabric and reducing heat loss through the building envelope. Approved Document Part L1A 2013 sets out the limiting fabric parameters for each of the building elements. Each stated value represents the area-weighted average U-value. Table 1 details the proposed U-values for the development along with anticipated percentage improvements over the maximum allowable average weighted U-values in Part L1A 2013. A strong emphasis has been placed on improving the building fabric with the minimum improvement over the average weighted U value being at least 25% to ensure the development’s heating and cooling demands are reduced.

To further minimise heat loss through the building envelope, air leakage will be made a priority. The airtightness of the dwellings will be set to a level of 4.5m³/h/m². Such a level of airtightness, along with the proposed enhanced fabric measures, will increase comfort and warmth as well as save future residents money on energy bills.

Repeated thermal bridges such as timber studs or mortar joints are already covered by U value calculations. Non-repeating thermal bridges are intermittent and occur at specific points in the construction. They are often caused by

discontinuities in the thermal envelope. They commonly occur around openings and other instances where materials of different thermal conductivities form part of the external envelope, as illustrated in Figure 3.

Accredited construction details for all wall junctions will be specified to minimise the effects of non-repeating thermal bridging and reduce heat loss further. By specifying and ensuring that ACDs are designed into the build, CO₂ emissions can be reduced by up to 5%.

The use of ACDs will provide a continuous 'blanket' around the dwellings, minimising gaps in the insulation.

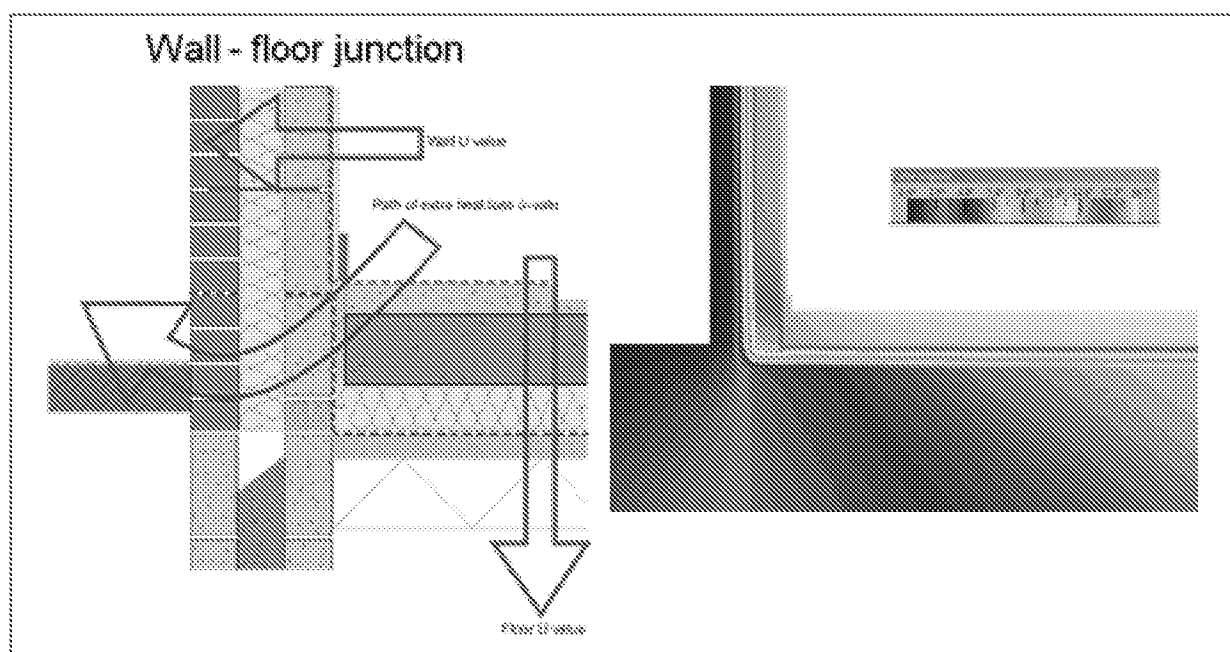
All dwellings will be specified to have 100% of their lighting outlets classed as low energy, thus reducing the future homeowner's electricity bill. Orientation and layout have also been given consideration to help limit heat loss in winter and maximise the potential for free cooling in summer, to limit the risk of overheating.

Overall the proposed passive design measures for this development will provide households with a resource to reduce their energy demand and heat their homes to a satisfactory standard at an affordable cost.

The proposed specification will provide a robust long term solution, future proofing the dwelling for years to come.

Figure 3: Wall-Floor Junction Detail

This image, alongside showing the temperature distribution for the same junction, is taken directly from thermal modelling software



5.3 FABRIC SPECIFICATION

It is Linden Homes intention to use a fabric only approach to achieve the desired CO₂ savings.

The benefits to a fabric only approach are:

- A high performance building fabric that maximises thermal performance and minimises air leakage from the outset, resulting in a reduced need for energy.
- This eliminates the need for expensive and sometimes unsightly bolt-ons such as photo-voltaics and renewable energy generators.
- A fabric-first approach also guarantees the building's performance over its lifespan, without the need for additional maintenance.
- Decreases the need for occupants to use energy through fabric performance and design, rather than by relying on the end-user learning how to use complex devices and building controls.
- This makes for a simple, easy-to-use building with low upkeep.

The following sections in this report set out the building fabric and other low carbon technologies that Linden Homes intend to adopt on the site.

The indicative U Values for the scheme are shown in the table below along with the anticipated percentage improvement over the maximum allowable average area weighted U Value in Part L1A 2013.

Table 4: Proposed U Values - Houses

Element	Average Weighted U Value as Part L1A 2013	Proposed U Value/other	Improvement
External Walls	0.30	0.21	30.00%
Party Wall	0.20	0	100.00%
Floor	0.25	0.13	48.00%
Cold Roof	0.20	0.10	50.00%
Warm/Flat Roof	0.20	0.15	25.00%
Windows	2.0	1.4	30.00%
Air Tightness	10	4.5	55.00%
Average Y Value	0.15	0.049	67.33%

5.4 SUPPLY ENERGY EFFICIENTLY - BE GREEN -- DECENTRALISED ENERGY

There are many benefits of decentralised heat generation and Combined Heat and Power (CHP) in terms of cost and CO₂ emissions savings. However, technology such as this is more significant for larger developments, ideally complimented with some non-residential use of heat and electricity. The proposed development size of 175 dwellings is at the low end of what the industry tends to view as viable for such systems. The development is for residential dwellings only and this will result in 'peaky' thermal demands with little anchor load to enable efficient operation of gas fired CHP. This option also risks the potential to increase costs to residents.

The site is neither sufficiently dense nor large enough to warrant investment from 3rd party managing agents or Energy Supply Companies (ESCOs). The proposed development would need to be run by an independent agent/company and there would be very little if any interest among existing ESCOs in servicing such a small-scale system. Even if it was possible, the cost of managing fuel procurement, customer billing, operation and maintenance would lead to disproportionately and unnecessary high service charges to residents compared to the provision of heat from individual gas boilers.

Multiple Connections from the primary heat main to each house would increase the distribution losses on the heat network as well as increase capital costs for the energy infrastructure. The Installation of a communal heating system would also risk the site becoming isolated limiting any potential connection to a larger district network in the near future to deliver low carbon heat more cost effectively.

Overall this option has been discounted because communal gas boilers do not offer any efficiency gains over individual gas condensing boilers once distribution losses are accounted for.

Individual Gas Boilers

Individual gas condensing boilers have many advantages. They can be highly efficient, have much lower NO_x emissions and lower installation costs. Reliability and maintenance requirements are well understood ensuring low costs of installation, operation and maintenance. Homeowners are also very familiar with the concept of gas central heating.

It is proposed that highly efficient mains gas condensing boilers with efficiencies of circa 89.30% SEDBUK2009 are to be installed. The boilers will incorporate optimum start, weather compensation and full zone controls to ensure efficient operation. The cylinders will be highly insulated to ensure that the heat loss per day is kept to a minimum.

5.5 PROPOSED HEATING AND VENTILATION SYSTEMS

The following specification for the heating and ventilation is proposed:

Apartment	
Heating:	Ideal Logic Combi 35 ESP 1 Efficiency 89.60% SEDBUK 2009
Secondary Heating:	None
Heating Hot Water Controls:	Time and Temperature Zone Control Delayed Start Stat No Weather Compensation
Flue Gas Heat Recovery:	No
Cylinder: Heat Loss:	NA NA
Ventilation:	System 3 fans Decentralised MEV Greenwood CV2 GIP
Waste Water Heat Recovery:	None
House	
Heating:	Boiler dependent on size of unit: Condensing gas boiler- Ideal Logic System Efficiency 89.30% SEDBUK 2009
Secondary Heating:	None
Heating Hot Water Controls:	Time and Temperature Zone Control Delayed Start Stat No Weather Compensation
Flue Gas Heat Recovery:	No
Cylinder: Heat Loss:	180 Litres generally 1.40 kWh/day
Ventilation:	System 3 fans Decentralised MEV Greenwood CV2 GIP
Waste Water Heat Recovery:	None

Unregulated energy

Unregulated energy will be reduced across the site by ensuring:

- All white goods, where supplied by Linden Homes will conform to EU energy labelling scheme.
- All external lighting will be low energy and will have daylight and/or PIR sensors to avoid wastage.

5.6 PROPOSED HEATING AND VENTILATION SYSTEMS

Using the energy efficiency improvement measures as indicated, a revised predicted energy demand can be calculated to show:

Table 5: Predicted Total Energy Demand: Improved building fabric, controls, and gas boilers

	Space Heating Demand (kWh/a)	Secondary Heating Demand (kWh/a)	Hot Water demand (kWh/a)	Energy from pumps and fans (kWh/a)	Energy from Lighting (kWh/a)	Energy from Appliances (kWh/a)	Totals
Energy Part L1A 2013 Compliant Units (TER)	775,334	0	427,348	13,125	73,917	0	1,289,724
CO ₂ Associated with total Energy Demand (kg/a)	167,472	0	92,307	6,812	38,363	0	304,954
Part L1A 2013 Actual Unit (DER)	666,771	-	363,272	26,169	73,913	0	1,130,125
CO ₂ Associated with total Energy Demand (kg/a)	144,023	-	78,467	13,582	38,361	0	274,433

When compared against Part L1A 2013 Building Regulations not including unregulated energy:

- Total CO₂ demand for the residential units is calculated to be **274,433** kg per annum. This represents a saving of **10.01 %** over the part L1A 2013 compliant figure of **304,954** kg per annum.
- Total Energy demand for the residential units is calculated to be **1,130,125** kWh per annum. This represents a saving of **12.37 %** over the part L1A 2013 compliant figure of **1,289,724** kWh per annum.

5.7 BE GREEN – LOW CARBON AND RENEWABLE ENERGY GENERATION OPTIONS

The following options to supply low carbon and renewable energy generation have been explored and discounted based on the following reasons:

Wind Turbines

Wind turbines have been discounted due to concerns over reliable wind resources. The use of wind turbines are likely to present aesthetic as well as nuisance issues.

Biomass Boilers

Unsuitable for this development due to fuel storage issues and increased traffic of heavy vehicles supplying biomass. Individual biomass boilers in the houses are technically feasible, but would be commercially unviable when compared to alternative solutions at the required level of energy abatement.

Air Source Heat Pumps (ASHP)

Air source heat pumps could be utilised but would require outdoor space for the fan-coil units to each dwelling. These outdoor units would be difficult to conceal without affecting the aesthetics of the building facades.

Ground Source Heat Pumps (GSHP)

Discounted on the grounds of costs and available space. Incompatible with individual gas boilers and blocks of apartments.

Solar Thermal

Unsuitable for blocks of flats and low carbon reduction efficiency compared to photovoltaic systems. Solar hot water systems for flatted blocks are only suitable where a central boiler plant room is provided to accommodate a central thermal store.

Solar Photovoltaics (PV)

Solar energy could be a solution to reduce CO2 emissions to satisfy building regulations, however the building fabric has been improved to ensure compliance is met without the need for renewables.

6. CONCLUSIONS

Renewable and low carbon technologies have been considered and discounted for justifiable reasons and therefore the developer has elected for a fabric and renewable approach to meet the necessary energy efficiency and CO₂ targets as required by Planning Policy.

The fabric specification has been enhanced significantly. Emphasis has been placed on the attention to detail around non repeating thermal bridges to ensure that heat loss is further reduced and that an airtight dwelling is achieved. An efficient mechanical ventilation system is proposed that will introduce fresh air to the building to ensure the internal comfort of the building is maintained.

The available options for delivery of energy have been appraised and highly efficient individual condensing gas boilers are the optimal method of supplying the homeowners with efficient, cost effective space heating and hot water.

The heating design will be enhanced by specifying full zone and optimum start controls to ensure that the homeowners have an effective, easy to control system. A high percentage of internal lights will be low energy which will reduce energy and CO₂ emissions further.

CO₂ has been reduced on the scheme through a fabric only approach.

Total Energy and CO₂ savings across the site - Regulated Energy only, are summarised in the table below as follows:

Table 6: Predicted CO₂ and Energy Savings

Energy and CO ₂ Savings			
	Description	Amount	Unit
Regs & Improvements (TER's)	Total development CO ₂ demand Part L1A 2013 (TER)	304,954	KGCO ₂ /Year
	Total development energy demand Part L1A 2013 (TER)	1,289,724	kWh/Year
	Actual development CO ₂ demand (DER) Part L1A 2013	274,433	KGCO ₂ /Year
	Actual development CO ₂ demand (DER) Part L1A 2013	1,130,125	kWh/Year
	Percentage CO ₂ improvement through fabric/control	10.01	%
	Percentage energy improvement through fabric/control	12.37	%

Fabric Energy Efficiency and low carbon technology measures reduce CO₂ emissions by **10.01** % and energy demand by **12.37** % over a 2013 baseline unit.

The reduction in carbon emissions and energy through a fabric approach is in excess of the 10% reduction required by of Arun District Council and Condition 20 of application WA/44/17/OUT.

7. APPENDICES

The following pages detail, the actual building specification along with the energy and CO2 outputs from each house type.

Table 7: Proposed House Specification

Element			U Value/Note	Specification
Fabric U Values	Roof	Cold Roof	0.11	400 mm mineral wool ($\lambda = 0.044\text{w/mK}$)
		Sloping (warm)	0.19	120mm Celotex between the rafters and 12mm Celotex underslung ($\lambda = 0.023\text{w/mK}$)
		Flat Roof (warm)	0.14	165mm Celotex tuff-R Deck TA3000 ($\lambda = 0.024\text{w/mK}$) on 9mm ply on 300mm timber joists.
	Walls	External Wall	0.21	102.5mm Brick 125mm Mineral Wool ($\lambda = 0.034\text{w/mK}$) 100mm Aircrete 7.3 N blocks ($\lambda = 0.15\text{w/mK}$) 12.5mm plasterboard
		Party	0.00	This is a fully filled cavity wall effectively sealed all sides
		Lintels		IG Hi Therm lintels or similar
	Floors	Exposed Floor	0.17	75mm fibre reinforced screed sand/cement screed laid on vapour barrier on 100mm Kingspan floor grade insulation on RC podium slab to engineers details
		Block and Beam ground floor	0.13	175mm concrete floor joists infilled with 150mm white EPS polystyrene panels (0.038W/mK), overlaid with 125mm Platinum EPS top sheet (0.030 W/mK) all in accordance with specialist designs and details.
	Windows		1.40 U Value 0.45 G Figure	Double glazed with BFRC
	Doors		1.50	Front doors to houses.
Thermal Bridging	Y-Value			Measured Lengths by AC - Psi Values as per Constructive Details Accredited Details
Ventilation	Air Permeability		4.5	Air-pressure test results must achieve air-permeability result of $\leq 5\text{m}^3(\text{H.m}^2) @ 50\text{ Pa}$
	Mechanical ventilation		System 3	Greenwood CV2 GIP
Heating	Boiler units with 4 or more beds		Condensing Gas Boiler	Condensing gas boiler- Ideal Logic System
	Boiler units with 3 or less beds		Condensing Gas Boiler	Ideal Logic Combi ESP1 35
	Heat Emitters			Radiators
	Controls			Time and Temperature Zone Control
	Weather Compensation			None
	Delayed Start Stat			Delayed Start Stat installed
	Water Heating			Range Cylinder 150-210 Litre
	Standing Loss			1.23 – 1.50 kW/24hr
	Secondary Heating			None
Lighting	Low Energy lighting			100%

Table 8: Proposed Apartment Specification

Element			U Value/Note	Specification
Fabric U Values	Roof	Cold Roof	0.11	400 mm mineral wool ($\lambda = 0.044\text{w/mK}$)
		Flat Roof (warm)	0.14	165mm Celotex tuff-R Deck TA3000 ($\lambda = 0.024\text{w/mK}$) on 9mm ply on 300mm timber joists.
	Walls	External Wall	0.21	102.5mm Brick 125mm Mineral Wool ($\lambda = 0.034\text{w/mK}$) 100mm Aircrete 7.3 N blocks ($\lambda = 0.15\text{w/mK}$) 12.5mm plasterboard
		Party	0.00	This is a fully filled cavity wall effectively sealed all sides
		Lintels		IG lintels or similar
		Corridors		All corridors to be heated, sheltered walls adjoining corridors to be fully filled as party walls and to have a U value of 0
	Floors	Exposed Floor	0.17	75mm fibre reinforced screed sand/cement screed laid on vapour barrier on 100mm Kingspan floor grade insulation on RC podium slab to engineers details
		Block and Beam ground floor	0.13	175mm concrete floor joists infilled with 150mm white EPS polystyrene panels (0.038W/mK), overlaid with 125mm Platinum EPS top sheet (0.030 W/mK) all in accordance with specialist designs and details.
	Windows		1.40 U Value 0.43 G Figure	Double glazed with BFRC
	Doors		1.50	Front doors to apartments
Thermal Bridging	Y-Value			Measured Lengths by AC - Psi Values as per Constructive Details Accredited Details
Ventilation	Air Permeability		4.5	Air-pressure test results must achieve air-permeability result of $\leq 5\text{m}^3(\text{H.m}^2) @ 50 \text{ Pa}$
	Mechanical ventilation		System 3	Greenwood CV2 GIP
Heating	Boiler		Condensing Gas Boiler	Ideal Logic Combi ESP1 35
	Heat Emitters			Radiators
	Controls			Time and Temperature Zone Control
	Weather Compensation			None
	Delayed Start Stat			Delayed Start Stat installed
	Water Heating			NA
	Standing Loss			NA
	Secondary Heating			None
Lighting	Low Energy lighting			100%

7.1 THE PREDICTED ENERGY AND CO2 DEMAND

Table 9: Predicted Energy Demand

Energy Type	Include Unregulated Energy			No.	Building Regs. Version			2013	Predicted Energy Demand				
	Dwelling Name	TFA	No of Types	Main Heating Fuel Requirement t (DER)	Secondary Main Heating Fuel Requirement t (DER)	Secondary Heating Fuel Requirement t (DER)	Water Fuel Requirement t (DER)	Electricity Pumps/Fans Requirement t (DER)	Electricity Lighting Requirement t (DER)	Unit Total	Unregulated Energy Demand	Development t Total	
1	1 Bed GF	50.66	6	1,993	-	-	1,512	111	254	3,869	0	23,214	
2	1 Bed TF	50.66	6	1,858	-	-	1,512	111	254	3,735	0	22,409	
3	2 Bed GF	69.68	6	2,759	-	-	1,734	124	323	4,940	0	29,642	
4	2 Bed TF	69.68	6	2,525	-	-	1,734	124	323	4,706	0	28,235	
5	HT A24L	80.5	10	2,849	-	-	1,832	135	384	5,200	0	51,997	
6	HT A24L MT	80.5	3	2,269	-	-	1,835	135	384	4,622	0	13,867	
7	HT A32	95.96	13	3,244	-	-	1,927	147	447	5,765	0	74,941	
8	HT BEC	95.24	2	4,333	-	-	1,921	146	412	6,812	0	13,624	
9	HT COTT	149.62	22	6,236	-	-	2,560	185	504	9,485	0	208,680	
10	HT ELM - DET	87.42	10	3,657	-	-	1,879	140	397	6,073	0	60,730	
11	HT ELM ET	87.48	10	3,071	-	-	1,882	140	397	5,490	0	54,899	
12	HT ELM MT	87.48	10	2,493	-	-	1,884	140	397	4,914	0	49,137	
13	LEVERTON	113.66	4	4,454	-	-	2,530	159	462	7,605	0	30,420	
14	HT MYLNE	107.04	9	4,005	-	-	2,516	154	464	7,139	0	64,252	
15	HT PEMBROO	126.62	12	5,042	-	-	2,547	169	494	8,251	0	99,016	
16	WALBERTON	79.76	19	2,692	-	-	1,827	134	385	5,038	0	95,713	
17	HT A40L	107.56	14	3,677	-	-	1,969	155	452	6,253	0	87,544	
18	HT KEMPSTON	142.66	13	6,112	-	-	2,555	180	522	9,370	0	121,804	
Totals		17,657	175	666,771	-	-	363,272	26,169	73,913	1,130,425	-	1,130,425	

Table 10: Predicted CO2 Demand

CO2	Include Unregulated Energy			No	Building Regs Version			Predicted CO2 Demand				
Type	Dwelling Name	TFA	No of Types	Main Heating Fuel Requirement t (DER)	Secondary Main Heating Fuel Requirement t (DER)	Secondary Heating Fuel Requirement t (DER)	Water Fuel Requirement t (DER)	Electricity Pumps Fans Requirement t (DER)	Electricity Lighting Requirement t (DER)	Unit Total	Unregulated Energy Demand	Development t Total
1	1 Bed GF	50.66	6	430	-	-	327	58	132	946	0	5,677
2	1 Bed TF	50.66	6	401	-	-	327	58	132	917	0	5,503
3	2 Bed GF	69.68	6	596	-	-	374	65	168	1,203	0	7,216
4	2 Bed TF	69.68	6	545	-	-	375	65	168	1,152	0	6,912
5	HT A24L	80.5	10	615	-	-	396	70	199	1,280	0	12,803
6	HT A24L MT	80.5	3	490	-	-	396	70	199	1,156	0	3,467
7	HT A32	95.96	13	701	-	-	416	76	232	1,425	0	18,527
8	HT BEC	95.24	2	936	-	-	415	76	214	1,640	0	3,281
9	HT COTT	149.62	22	1,347	-	-	553	96	262	2,258	0	49,670
10	HT ELM - DET	87.42	10	790	-	-	406	73	206	1,474	0	14,744
11	HT ELM ET	87.48	10	663	-	-	406	73	206	1,349	0	13,485
12	HT ELM MT	87.48	10	538	-	-	407	73	206	1,224	0	12,240
13	LEVERTON	113.66	4	962	-	-	547	83	240	1,831	0	7,324
14	HT MYLNE	107.04	9	865	-	-	544	80	241	1,729	0	15,564
15	HT PEMBROO	126.62	12	1,089	-	-	550	88	256	1,983	0	23,796
16	WALBERTON	79.76	19	581	-	-	395	70	200	1,245	0	23,662
17	HT A40L	107.56	14	794	-	-	425	81	235	1,535	0	21,486
18	HT KEMPSTON	142.66	13	1,320	-	-	552	94	271	2,237	0	29,075
Totals		17,657	175	144,023	-	-	78,467	13,582	38,361	274,432	-	274,432

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.16
Printed on 13 March 2019 at 10:36:55

Project Information:

Assessed By: Matt Fitzpatrick (STRO003572)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 50.66m²

Site Reference : Walberton

Plot Reference: 1 Bed GF

Address : 1 Bed GF, Avisford Grange, Walberton, West Sussex, TBC

Client Details:

Name: Linden Homes Southern

Address : 1A Guildford Business Park , Guildford, Surrey, GU2 8XG

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 21.49 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 18.68 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 44.9 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.70 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 440, product index 017929): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 35 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls TTZC by plumbing and electrical services OK
 Hot water controls: No cylinder
 No cylinder
 Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%
 Minimum 75.0% OK

8 Mechanical ventilation

Continuous extract system (decentralised)
 Specific fan power: 0.19 0.18
 Maximum 0.7 OK

9 Summer time temperatures

Overheating risk (South East England): Medium OK

Based on:

Overshading: Average or unknown
 Windows facing: North 3m²
 Windows facing: South 3.83m²
 Ventilation rate: 2.00
 Blinds/curtains: Dark-coloured curtain or roller blind
 Closed 100% of daylight hours

10 Key features

Thermal bridging 0.039 W/m²K

SAP Input

Property Details: 1 Bed GF

Address: 1 Bed GF, Avisford Grange, Walberton, West Sussex, TBC
Located in: England
Region: South East England
UPRN:
Date of assessment: 13 March 2019
Date of certificate: 13 March 2019
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Calculated 191.41
Water use <= 125 litres/ person/ day: True
PCDF Version: 440

Property description

Dwelling type: Flat
Detachment:
Year Completed: 2018
Floor Location: **Floor area:** **Storey height:**
 Floor 0 50.66 m² 2.4 m
Living area: 25.14 m² (fraction 0.496)
Front of dwelling faces: North

Opening types

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door 1	Manufacturer	Solid			PVC-U
1	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
2	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door 1	mm	0.7	0.63	1.4	2.15	1
1	16mm or more	0	0.45	1.4	3	1
2	16mm or more	0	0.45	1.4	3.83	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door 1		Communal Wall	North	0	0
1		Brick	North	0	0
2		Brick	South	0	0

Overshading: Average or unknown

Opaque Elements

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Brick	50.89	6.83	44.06	0.21	0	False	60
Communal Wall	17.46	2.15	15.31	0.25	0.43	False	60
Suspended	50.66			0.13			75
<u>Internal Elements</u>							
Metal Stud	90.62						9
<u>Party Elements</u>							
Party ceiling	50.66						30

Thermal bridges

SAP Input

Thermal bridges:

User-defined (individual PSI-values) Y-Value = 0.0386

Length	Psi-value		
6.72	0.223	E2	Other lintels (including other steel lintels)
5.7	0.034	E3	Sill
15.9	0.04	E4	Jamb
28.48	0.06	E5	Ground floor (normal)
0	0.07	E19	Ground floor (inverted)
0	0.32	E20	Exposed floor (normal)
0	0.32	E21	Exposed floor (inverted)
0	0.07	E22	Basement floor
0	0	E6	Intermediate floor within a dwelling
28.48	0	E7	Party floor between dwellings (in blocks of flats)
0	0	E8	Balcony within a dwelling, wall insulation continuous
0	0.04	E9	Balcony between dwellings, wall insulation continuous
0	1	E23	Balcony within or between dwellings, balcony support penetrates wall
[Approved]	0	E10	Eaves (insulation at ceiling level)
	0	E24	Eaves (insulation at ceiling level - inverted)
	0	E11	Eaves (insulation at rafter level)
	0	E12	Gable (insulation at ceiling level)
	0	E13	Gable (insulation at rafter level)
	0	E14	Flat roof
	0	E15	Flat roof with parapet
	9.6	E16	Corner (normal)
	0	E17	Corner (inverted – internal area greater than external area)
	0	E18	Party wall between dwellings
	0	E25	Staggered party wall between dwellings c
	0	P1	Ground floor
	0	P2	Intermediate floor within a dwelling
	0	P4	Roof (insulation at ceiling level)

Ventilation

Pressure test:

Yes (As designed)

Ventilation:

Decentralised whole house extract

Number of fans in Wetroom: Kitchen 1 Other 1

Ductwork: ,

Approved Installation Scheme: True

Number of chimneys:

0

Number of open flues:

0

Number of fans:

0

Number of passive stacks:

0

Number of sides sheltered:

2

Pressure test:

4.7

Main heating system:

Main heating system:

Boiler systems with radiators or underfloor heating

Gas boilers and oil boilers

Fuel: mains gas

Info Source: Boiler Database

Database: (rev 440, product index 017929) Efficiency: Winter 87.3 % Summer: 90.5

Brand name: Ideal

Model: LOGIC COMBI

Model qualifier: ESP1 35

(Combi boiler)

Systems with radiators

Central heating pump : 2013 or later

Design flow temperature: Design flow temperature >45°C

Boiler interlock: Yes

Delayed start

SAP Input

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.16

Property Address: 1 Bed GF

Address : 1 Bed GF, Avisford Grange, Walberton, West Sussex, TBC

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.66 (1a)	2.4 (2a)	121.58 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.66 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	121.58 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.69999980926514 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.23 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.2 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23
------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.15	1.4	3.01		(26)
Windows Type 1			3	$\times 1/[1/(1.4) + 0.04]$	3.98		(27)
Windows Type 2			3.83	$\times 1/[1/(1.4) + 0.04]$	5.08		(27)
Floor			50.66	0.13	6.5858	75	3799.5 (28)
Walls Type1	50.89	6.83	44.06	0.21	9.25	60	2643.6 (29)
Walls Type2	17.46	2.15	15.31	0.23	3.46	60	918.6 (29)
Total area of elements, m²			119.01				(31)
Party ceiling			50.66			30	1519.8 (32b)
Internal wall **			90.62			9	815.58 (32c)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 31.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9697.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 191.41 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.59 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 35.95 (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=	20.25	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	56.2	56.01	56.01	56.01	56.01	56.01	56.01	56.01	56.01	56.01	56.01	56.01
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DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

{40}m=	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11		
Average = Sum(40)/12=													1.11	{40}

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{41}m=	31	28	31	30	31	30	31	31	30	31	30	31		{41}

4 Water heating energy requirement

Assumed occupancy, N

1.71

{42}

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

74.8

{43}

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{44}m=	82.28	79.29	76.3	73.31	70.31	67.32	67.32	70.31	73.31	76.3	79.29	82.28		
Total = Sum(44)/12 =													897.62	{44}

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

{45}m=	122.02	106.72	110.13	96.01	92.12	79.5	73.67	84.53	85.54	99.69	108.82	118.17		
Total = Sum(45)/12 =													1176.92	{45}

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

{46}m=	18.3	16.01	16.52	14.4	13.82	11.92	11.05	12.68	12.83	14.95	16.32	17.73		{46}
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

{47}

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

{48}

Temperature factor from Table 2b

0

{49}

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

{50}

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

{51}

If community heating see section 4.3

Volume factor from Table 2a

0

{52}

Temperature factor from Table 2b

0

{53}

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

{54}

Enter (50) or (54) in (55)

0

{55}

Water storage loss calculated for each month

$$(56)m = (55) \times (41)m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	0		{56}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	0		{57}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

{58}

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

{59}m=	0	0	0	0	0	0	0	0	0	0	0	0		{59}
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DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14	12.63	13.96	13.48	13.91	13.44	13.88	13.9	13.46	13.94	13.52	13.99	(61)
--------	----	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	136.02	119.35	124.08	109.49	106.04	92.94	87.54	98.43	99	113.63	122.34	132.16	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	136.02	119.35	124.08	109.49	106.04	92.94	87.54	98.43	99	113.63	122.34	132.16	
Output from water heater (annual): _{1, 12}												1341.03	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	44.07	38.64	40.11	35.29	34.11	29.79	27.96	31.58	31.81	36.63	39.56	42.79	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	85.48	85.48	85.48	85.48	85.48	85.48	85.48	85.48	85.48	85.48	85.48	85.48	(66)

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

(67)m=	14.36	12.76	10.38	7.85	5.87	4.96	5.36	6.96	9.34	11.87	13.85	14.76	(67)
--------	-------	-------	-------	------	------	------	------	------	------	-------	-------	-------	------

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

(68)m=	148.95	150.49	146.6	138.31	127.84	118	111.43	109.89	113.78	122.07	132.54	142.38	(68)
--------	--------	--------	-------	--------	--------	-----	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.55	31.55	31.55	31.55	31.55	31.55	31.55	31.55	31.55	31.55	31.55	31.55	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-68.38	-68.38	-68.38	-68.38	-68.38	-68.38	-68.38	-68.38	-68.38	-68.38	-68.38	-68.38	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	59.24	57.5	53.91	49.02	45.85	41.38	37.58	42.45	44.18	49.24	54.95	57.51	(72)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	274.19	272.4	262.52	246.82	231.2	215.98	206.01	210.94	218.95	234.82	252.98	266.29	(73)
--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3	x	10.63	x	0.45	x	1.11	=	11.05	(74)
North	0.9x	0.77	x	3	x	20.32	x	0.45	x	1.11	=	21.12	(74)
North	0.9x	0.77	x	3	x	34.53	x	0.45	x	1.11	=	35.89	(74)
North	0.9x	0.77	x	3	x	55.46	x	0.45	x	1.11	=	57.66	(74)
North	0.9x	0.77	x	3	x	74.72	x	0.45	x	1.11	=	77.67	(74)

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North	0.9x	0.77	x	3	x	79.99	x	0.45	x	1.11	=	83.14	(74)
North	0.9x	0.77	x	3	x	74.68	x	0.45	x	1.11	=	77.63	(74)
North	0.9x	0.77	x	3	x	59.25	x	0.45	x	1.11	=	61.59	(74)
North	0.9x	0.77	x	3	x	41.52	x	0.45	x	1.11	=	43.16	(74)
North	0.9x	0.77	x	3	x	24.19	x	0.45	x	1.11	=	25.14	(74)
North	0.9x	0.77	x	3	x	13.12	x	0.45	x	1.11	=	13.64	(74)
North	0.9x	0.77	x	3	x	8.86	x	0.45	x	1.11	=	9.21	(74)
South	0.9x	0.77	x	3.83	x	46.75	x	0.45	x	1.11	=	62.04	(78)
South	0.9x	0.77	x	3.83	x	76.57	x	0.45	x	1.11	=	101.61	(78)
South	0.9x	0.77	x	3.83	x	97.53	x	0.45	x	1.11	=	129.44	(78)
South	0.9x	0.77	x	3.83	x	110.23	x	0.45	x	1.11	=	146.29	(78)
South	0.9x	0.77	x	3.83	x	114.87	x	0.45	x	1.11	=	152.44	(78)
South	0.9x	0.77	x	3.83	x	110.55	x	0.45	x	1.11	=	146.71	(78)
South	0.9x	0.77	x	3.83	x	108.01	x	0.45	x	1.11	=	143.34	(78)
South	0.9x	0.77	x	3.83	x	104.89	x	0.45	x	1.11	=	139.21	(78)
South	0.9x	0.77	x	3.83	x	101.89	x	0.45	x	1.11	=	135.21	(78)
South	0.9x	0.77	x	3.83	x	82.59	x	0.45	x	1.11	=	109.6	(78)
South	0.9x	0.77	x	3.83	x	55.42	x	0.45	x	1.11	=	73.54	(78)
South	0.9x	0.77	x	3.83	x	40.4	x	0.45	x	1.11	=	53.61	(78)

Solar gains in watts, calculated for each month

$$(83)m = \text{Sum}(74)m \dots (82)m$$

(83)m=	73.1	122.74	165.33	203.95	230.11	229.85	220.97	200.79	178.37	134.74	87.18	62.83	(83)
--------	------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	347.29	395.13	427.85	450.77	461.31	445.83	426.98	411.73	397.31	369.56	340.16	329.12	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.93	0.85	0.71	0.55	0.59	0.8	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.63	19.82	20.08	20.41	20.71	20.9	20.97	20.97	20.84	20.46	19.98	19.59	(87)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.99	20	20	20	20	20	20	20	20	20	20	20	(88)
--------	-------	----	----	----	----	----	----	----	----	----	----	----	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.91	0.81	0.63	0.44	0.48	0.73	0.92	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.18	18.45	18.83	19.29	19.69	19.92	19.98	19.98	19.86	19.37	18.68	18.11	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) =$$

0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.13	19.45	19.84	20.2	20.41	20.48	20.47	20.34	19.91	19.33	18.85	(92)
--------	------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.75	18.98	19.3	19.69	20.05	20.26	20.33	20.32	20.19	19.76	19.18	18.7	(93)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

8. Space heating calculation

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m} = (76)m$ and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, h_m :

(94)m=	0.98	0.97	0.95	0.91	0.81	0.65	0.48	0.51	0.74	0.91	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	341.59	384.06	406.76	408.17	375.15	290.75	203.31	211.95	294.88	337.81	330.5	324.69	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	812.24	788.68	717.16	604.61	467.48	317.05	208.7	219.51	341.36	513.12	676.45	811.97	(97)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	350.16	271.91	230.94	141.43	68.69	0	0	0	0	130.43	249.08	362.54	
Total per year ($kWh/year$) = $Sum(98)_{1..12} =$												1805.18	(98)

Space heating requirement in $kWh/m^2/year$

35.63	(99)
-------	------

9. Energy requirements - individual heating systems (including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

90.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

350.16	271.91	230.94	141.43	68.69	0	0	0	0	130.43	249.08	362.54
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

386.92	300.45	255.18	156.28	75.9	0	0	0	0	144.12	275.23	400.59
--------	--------	--------	--------	------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = Sum(211)_{1..12} =$$

1994.67	(211)
---------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$$\text{Total (kWh/year)} = Sum(215)_{1..12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

136.02	119.35	124.08	109.49	106.04	92.94	87.54	98.43	99	113.63	122.34	132.16
--------	--------	--------	--------	--------	-------	-------	-------	----	--------	--------	--------

Efficiency of water heater

87.3	(216)
------	-------

(217)m=	89.58	89.5	89.36	89.08	88.53	87.3	87.3	87.3	87.3	88.98	89.42	89.62	(217)
---------	-------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	151.84	133.35	138.87	122.92	119.77	106.46	100.28	112.75	113.41	127.7	136.81	147.46
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

$$\text{Total} = Sum(219a)_{1..12} =$$

1511.62	(219)
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Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1994.67

DER WorkSheet: New dwelling design stage

Water heating fuel used		1511.62	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	35.9		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	110.9	(231)
Electricity for lighting		253.67	(232)

12a CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	430.85 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	326.51 (264)
Space and water heating	(261) + (262) + (263) + (264) =			757.36 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	57.56 (267)
Electricity for lighting	(232) x	0.519	=	131.65 (268)
Total CO2, kg/year		sum of (265)...(271) =		946.57 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.68 (273)
El rating (section 14)				87 (274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.16
Printed on 13 March 2019 at 10:36:36

Project Information:

Assessed By: Matt Fitzpatrick (STRO003572)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 69.68m²

Site Reference : Walberton

Plot Reference: 2 Bed TF

Address : 2 Bed TF, Avisford Grange, Walberton, West Sussex, TBC

Client Details:

Name: Linden Homes Southern

Address : 1A Guildford Business Park , Guildford, Surrey, GU2 8XG

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 19.03 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 16.54 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 51.3 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 42.0 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.21 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 4.70 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main Heating system: Database: (rev 440, product index 017929):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 35
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls TTZC by plumbing and electrical services OK

Hot water controls: No cylinder

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0% OK

8 Mechanical ventilation

Continuous extract system (decentralised)

Specific fan power: 0.19 0.18

Maximum 0.7 OK

9 Summer time temperatures

Overheating risk (South East England): Slight OK

Based on:

Overshading: Average or unknown

Windows facing: North 2.4m²

Windows facing: East 5.04m²

Windows facing: East 3.69m²

Ventilation rate: 4.00

Blinds/curtains: Dark-coloured curtain or roller blind

Closed 100% of daylight hours

10 Key features

Roofs U-value 0.1 W/m²K

SAP Input

Property Details: 2 Bed TF

Address: 2 Bed TF, Avisford Grange, Walberton, West Sussex, TBC
Located in: England
Region: South East England
UPRN:
Date of assessment: 13 March 2019
Date of certificate: 13 March 2019
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Calculated 82.71
Water use <= 125 litres/ person/ day: True
PCDF Version: 440

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2018
Floor Location: **Floor area:** **Storey height:**
 Floor 0 69.68 m² 2.4 m
Living area: 30.19 m² (fraction 0.433)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door 1	Manufacturer	Solid			PVC-U
1	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
2	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
3	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door 1	mm	0.7	0.63	1.4	2.15	1
1	16mm or more	0	0.45	1.4	2.4	1
2	16mm or more	0	0.45	1.4	5.04	1
3	16mm or more	0	0.45	1.4	3.69	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door 1		Communal Wall	North	0	0
1		Brick	North	0	0
2		Brick	East	0	0
3		Brick	East	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Brick	63.4	11.13	52.27	0.21	0	False	60
Communal Wall	17.46	2.15	15.31	0.25	0.43	False	60
Cold Roof	69.68	0	69.68	0.1	0		9
<u>Internal Elements</u>							
Metal Stud	120.14						9
<u>Party Elements</u>							

Thermal bridges:

SAP Input

Thermal bridges:

User-defined (individual PSI-values) Y-Value = 0.04

Length	Psi-value		
10.33	0.223	E2	Other lintels (including other steel lintels)
9.31	0.034	E3	Sill
20.7	0.04	E4	Jamb
0	0.06	E5	Ground floor (normal)
0	0.07	E19	Ground floor (inverted)
0	0.32	E20	Exposed floor (normal)
0	0.32	E21	Exposed floor (inverted)
0	0.07	E22	Basement floor
0	0	E6	Intermediate floor within a dwelling
33.69	0	E7	Party floor between dwellings (in blocks of flats)
0	0	E8	Balcony within a dwelling, wall insulation continuous
0	0.04	E9	Balcony between dwellings, wall insulation continuous
0	1	E23	Balcony within or between dwellings, balcony support penetrates wall
[Approved] 33.69	0.06	E10	Eaves (insulation at ceiling level)
0	0.24	E24	Eaves (insulation at ceiling level - inverted)
0	0.037	E11	Eaves (insulation at rafter level)
0	0.069	E12	Gable (insulation at ceiling level)
0	0.08	E13	Gable (insulation at rafter level)
0	0.08	E14	Flat roof
0	0.56	E15	Flat roof with parapet
9.6	0.058	E16	Corner (normal)
0	-0.069	E17	Corner (inverted internal area greater than external area)
0	0.04	E18	Party wall between dwellings
0	0.12	E25	Staggered party wall between dwellings
0	0.049	P1	Ground floor
0	0	P2	Intermediate floor within a dwelling
0	0.065	P4	Roof (insulation at ceiling level)

Ventilation

Pressure test: Yes (As designed)
 Ventilation: Decentralised whole house extract
 Number of fans in Wetroom: Kitchen 1 Other 1
 Ductwork: ,
 Approved Installation Scheme: True
 Number of chimneys: 0
 Number of open flues: 0
 Number of fans: 0
 Number of passive stacks: 0
 Number of sides sheltered: 2
 Pressure test: 4.7

Main heating system

Main heating system: Boiler systems with radiators or underfloor heating
 Gas boilers and oil boilers
 Fuel: mains gas
 Info Source: Boiler Database
 Database: (rev 440, product index 017929) Efficiency: Winter 87.3 % Summer: 90.5
 Brand name: Ideal
 Model: LOGIC COMBI
 Model qualifier: ESP1 35
 (Combi boiler)
 Systems with radiators
 Central heating pump : 2013 or later
 Design flow temperature: Design flow temperature >45°C
 Boiler interlock: Yes
 Delayed start

SAP Input

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.16

Property Address: 2 Bed TF

Address : 2 Bed TF, Avisford Grange, Walberton, West Sussex, TBC

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.68 (1a)	2.4 (2a)	167.23 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.68 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	167.23 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) ÷ [(10) + (11) + (12) + (13) + (15)] =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.69999980926514 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.23 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.2 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23
------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.15	1.4	3.01		(26)
Windows Type 1			2.4	$\frac{1}{\frac{1}{1.4} + 0.04}$	3.18		(27)
Windows Type 2			5.04	$\frac{1}{\frac{1}{1.4} + 0.04}$	6.68		(27)
Windows Type 3			3.69	$\frac{1}{\frac{1}{1.4} + 0.04}$	4.89		(27)
Walls Type1	63.4	11.13	52.27	0.21	10.98	60	3136.2 (29)
Walls Type2	17.46	2.15	15.31	0.23	3.46	60	918.6 (29)
Roof	69.68	0	69.68	0.1	6.97	9	627.12 (30)
Total area of elements, m²			150.54				(31)
Internal wall **			120.14			9	1081.26 (32c)

* for windows and roof windows, use effective window U-value calculated using formula $\frac{1}{\frac{1}{U\text{-value}} + 0.04}$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 39.17 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5763.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 82.71 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.03 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 45.19 (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=	27.85	27.59	27.59	27.59	27.59	27.59	27.59	27.59	27.59	27.59	27.59	27.59

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.04	72.79	72.79	72.79	72.79	72.79	72.79	72.79	72.79	72.79	72.79	72.79
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DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$\{40\}m = \{39\}m + \{4\}$$

{40}m=	1.05	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04		
Average = Sum{40}/12=													1.04	{40}

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{41}m=	31	28	31	30	31	30	31	31	30	31	30	31		{41}

4 Water heating energy requirement

Assumed occupancy, N

2.24

{42}

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

87.36

{43}

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{44}m=	96.1	92.6	89.11	85.61	82.12	78.62	78.62	82.12	85.61	89.11	92.6	96.1		
Total = Sum{44}/12 =													1048.32	{44}

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

{45}m=	142.51	124.64	128.62	112.13	107.59	92.84	86.03	98.72	99.9	116.43	127.09	138.01		
Total = Sum{45}/12 =													1374.52	{45}

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

{46}m=	21.38	18.7	19.29	16.82	16.14	13.93	12.9	14.81	14.99	17.46	19.06	20.7		{46}
--------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

{47}

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

{48}

Temperature factor from Table 2b

0

{49}

Energy lost from water storage, kWh/year

$$\{48\} \times \{49\} =$$

0

{50}

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

{51}

If community heating see section 4.3

Volume factor from Table 2a

0

{52}

Temperature factor from Table 2b

0

{53}

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

{54}

Enter (50) or (54) in (55)

0

{55}

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	0		{56}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	0		{57}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

{58}

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

{59}m=	0	0	0	0	0	0	0	0	0	0	0	0		{59}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.09	12.7	14.03	13.54	13.97	13.49	13.92	13.95	13.52	14.01	13.6	14.07	(61)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	156.59	137.34	142.65	125.67	121.56	106.33	99.95	112.68	113.42	130.43	140.69	152.09	(62)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	156.59	137.34	142.65	125.67	121.56	106.33	99.95	112.68	113.42	130.43	140.69	152.09	
Output from water heater (annual): _{1, 12}												1539.4	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	50.91	44.62	46.27	40.67	39.27	34.24	32.09	36.31	36.6	42.21	45.66	49.41	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	111.92	111.92	111.92	111.92	111.92	111.92	111.92	111.92	111.92	111.92	111.92	111.92	(66)

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

(67)m=	18.29	16.24	13.21	10	7.48	6.31	6.82	8.86	11.9	15.11	17.63	18.8	(67)
--------	-------	-------	-------	----	------	------	------	------	------	-------	-------	------	------

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

(68)m=	196.55	198.59	193.45	182.51	168.7	155.71	147.04	145	150.14	161.08	174.9	187.88	(68)
--------	--------	--------	--------	--------	-------	--------	--------	-----	--------	--------	-------	--------	------

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

(69)m=	34.19	34.19	34.19	34.19	34.19	34.19	34.19	34.19	34.19	34.19	34.19	34.19	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-89.53	-89.53	-89.53	-89.53	-89.53	-89.53	-89.53	-89.53	-89.53	-89.53	-89.53	-89.53	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	68.42	66.4	62.19	56.48	52.78	47.56	43.13	48.81	50.83	56.74	63.41	66.41	(72)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	342.83	340.8	328.43	308.57	288.52	269.16	256.56	262.25	272.44	292.5	315.51	332.65	(73)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.4	x	10.63	x	0.45	x	1.11	=	8.84	(74)
North	0.9x	0.77	x	2.4	x	20.32	x	0.45	x	1.11	=	16.9	(74)
North	0.9x	0.77	x	2.4	x	34.53	x	0.45	x	1.11	=	28.72	(74)
North	0.9x	0.77	x	2.4	x	55.46	x	0.45	x	1.11	=	46.12	(74)
North	0.9x	0.77	x	2.4	x	74.72	x	0.45	x	1.11	=	62.13	(74)

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North	0.9x	0.77	x	2.4	x	79.99	x	0.45	x	1.11	=	66.52	(74)
North	0.9x	0.77	x	2.4	x	74.68	x	0.45	x	1.11	=	62.1	(74)
North	0.9x	0.77	x	2.4	x	59.25	x	0.45	x	1.11	=	49.27	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.45	x	1.11	=	34.53	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.45	x	1.11	=	20.12	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.45	x	1.11	=	10.91	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.45	x	1.11	=	7.37	(74)
East	0.9x	1	x	5.04	x	19.64	x	0.45	x	1.11	=	34.3	(76)
East	0.9x	1	x	3.69	x	19.64	x	0.45	x	1.11	=	25.11	(76)
East	0.9x	1	x	5.04	x	38.42	x	0.45	x	1.11	=	67.1	(76)
East	0.9x	1	x	3.69	x	38.42	x	0.45	x	1.11	=	49.12	(76)
East	0.9x	1	x	5.04	x	63.27	x	0.45	x	1.11	=	110.5	(76)
East	0.9x	1	x	3.69	x	63.27	x	0.45	x	1.11	=	80.9	(76)
East	0.9x	1	x	5.04	x	92.28	x	0.45	x	1.11	=	161.15	(76)
East	0.9x	1	x	3.69	x	92.28	x	0.45	x	1.11	=	117.99	(76)
East	0.9x	1	x	5.04	x	113.09	x	0.45	x	1.11	=	197.5	(76)
East	0.9x	1	x	3.69	x	113.09	x	0.45	x	1.11	=	144.6	(76)
East	0.9x	1	x	5.04	x	115.77	x	0.45	x	1.11	=	202.18	(76)
East	0.9x	1	x	3.69	x	115.77	x	0.45	x	1.11	=	148.02	(76)
East	0.9x	1	x	5.04	x	110.22	x	0.45	x	1.11	=	192.48	(76)
East	0.9x	1	x	3.69	x	110.22	x	0.45	x	1.11	=	140.92	(76)
East	0.9x	1	x	5.04	x	94.68	x	0.45	x	1.11	=	165.34	(76)
East	0.9x	1	x	3.69	x	94.68	x	0.45	x	1.11	=	121.05	(76)
East	0.9x	1	x	5.04	x	73.59	x	0.45	x	1.11	=	128.51	(76)
East	0.9x	1	x	3.69	x	73.59	x	0.45	x	1.11	=	94.09	(76)
East	0.9x	1	x	5.04	x	45.59	x	0.45	x	1.11	=	79.62	(76)
East	0.9x	1	x	3.69	x	45.59	x	0.45	x	1.11	=	58.29	(76)
East	0.9x	1	x	5.04	x	24.49	x	0.45	x	1.11	=	42.77	(76)
East	0.9x	1	x	3.69	x	24.49	x	0.45	x	1.11	=	31.31	(76)
East	0.9x	1	x	5.04	x	16.15	x	0.45	x	1.11	=	28.21	(76)
East	0.9x	1	x	3.69	x	16.15	x	0.45	x	1.11	=	20.65	(76)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 68.25 133.12 220.11 325.27 404.23 416.72 395.51 335.66 257.13 158.02 84.99 56.23 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 411.09 473.92 548.54 633.83 692.76 685.87 652.07 597.91 529.57 450.52 400.5 388.88 (84)

7. Mean internal temperature (average/season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.95	0.93	0.89	0.82	0.7	0.57	0.44	0.49	0.69	0.87	0.94	0.96

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 18.53 18.82 19.31 19.92 20.43 20.77 20.91 20.88 20.6 19.9 19.1 18.46 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.04	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.92	0.88	0.79	0.66	0.5	0.36	0.41	0.64	0.84	0.93	0.95	(89)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.73	17.14	17.85	18.7	19.4	19.82	19.98	19.95	19.63	18.7	17.55	16.63	(90)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.43 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	17.51	17.87	18.48	19.23	19.85	20.23	20.38	20.35	20.05	19.22	18.22	17.42	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.36	17.72	18.33	19.08	19.7	20.08	20.23	20.2	19.9	19.07	18.07	17.27	(93)
--------	-------	-------	-------	-------	------	-------	-------	------	------	-------	-------	-------	------

9. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.92	0.9	0.85	0.76	0.65	0.51	0.38	0.42	0.63	0.81	0.9	0.93	(94)
--------	------	-----	------	------	------	------	------	------	------	------	-----	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	379.92	425.44	465.73	484.6	448.49	347.25	246.63	252.98	332.12	366.12	360.44	362.39	(95)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(93)m - (96)m]

(97)m=	953.88	933.26	861.22	740.68	582.15	399.07	264.36	276.91	421.99	616.61	798.59	951.54	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	427.02	341.26	294.24	184.38	99.44	0	0	0	0	186.37	315.47	438.33	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..12} = 2286.51 \quad (98)$$

Space heating requirement in kWh/m²/year

$$32.81 \quad (99)$$

9. Energy requirements - individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$90.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

kWh/year

Space heating requirement (calculated above)

427.02	341.26	294.24	184.38	99.44	0	0	0	0	186.37	315.47	438.33
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

471.85	377.08	325.13	203.73	109.88	0	0	0	0	205.93	348.59	484.34
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..12} = 2526.53 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

156.59	137.34	142.65	125.67	121.56	106.33	99.95	112.68	113.42	130.43	140.69	152.09
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

87.3 (216)

(217)m=	89.62	89.56	89.43	89.18	88.71	87.3	87.3	87.3	87.3	89.15	89.49	89.65
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	174.73	153.35	159.51	140.93	137.03	121.8	114.49	129.07	129.92	146.3	157.21	169.64
---------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------

Total = Sum(219a)_{1...12} =

1733.98 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2526.53

Water heating fuel used

1733.98

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

49.38

(230a)

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

124.38

(231)

Electricity for lighting

322.95

(232)

14a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	545.73 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	374.54 (264)
Space and water heating	(261) + (262) + (263) + (264) =			920.27 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	64.55 (267)
Electricity for lighting	(232) x	0.519	=	167.61 (268)
Total CO2, kg/year			sum of (265)...(271) =	1152.44 (272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	16.54 (273)
El rating (section 14)				87 (274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.16
Printed on 13 March 2019 at 10:36:23

Project Information:

Assessed By: Matt Fitzpatrick (STRO003572)

Building Type: Mid-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 80.5m²

Site Reference : Walberton

Plot Reference: HT A24L MT

Address : HT A24I mt, Avisford Grange, Walberton, West Sussex, TBC

Client Details:

Name: Linden Homes Southern

Address : 1A Guildford Business Park , Guildford, Surrey, GU2 8XG

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)

16.91 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER)

14.36 kg/m²

OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)

42.8 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE)

33.9 kWh/m²

OK

2 Fabric U-values

Element

Average

Highest

External wall

0.21 (max. 0.30)

0.21 (max. 0.70)

OK

Party wall

0.00 (max. 0.20)

-

OK

Floor

0.13 (max. 0.25)

0.13 (max. 0.70)

OK

Roof

0.10 (max. 0.20)

0.10 (max. 0.35)

OK

Openings

1.40 (max. 2.00)

1.40 (max. 3.30)

OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals

4.70 (design value)

Maximum

10.0

OK

4 Heating efficiency

Main Heating system:

Database: (rev 440, product index 017929):

Boiler systems with radiators or underfloor heating - mains gas

Brand name: Ideal

Model: LOGIC COMBI

Model qualifier: ESP1 35

(Combi)

Efficiency 89.6 % SEDBUK2009

Minimum 88.0 %

OK

Secondary heating system:

None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.40 kWh/day	
	Permitted by DBSCG: 2.10 kWh/day	OK
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power:	0.19 0.18	
Maximum	0.7	OK

9 Summer time temperature

Overheating risk (South East England):	Slight	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North	4.25m ²	
Windows facing: South	5.6m ²	
Ventilation rate:	4.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Roofs U-value	0.1 W/m ² K
Party Walls U-value	0 W/m ² K

SAP Input

Property Details: HT A24I MT

Address: HT A24I mt, Avisford Grange, Walberton, West Sussex, TBC
Located in: England
Region: South East England
UPRN:
Date of assessment: 13 March 2019
Date of certificate: 13 March 2019
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Calculated 148.28
Water use <= 125 litres/ person/ day: True
PCDF Version: 440

Property Description:

Dwelling type: House
Detachment: Mid-terrace
Year Completed: 2018
Floor Location: **Floor area:** **Storey height:**
 Floor 0 40.25 m² 2.4 m
 Floor 1 40.25 m² 2.7 m
Living area: 19.44 m² (fraction 0.241)
Front of dwelling faces: North

Opening Types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door 1	Manufacturer	Solid			PVC-U
1	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
2	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door 1	mm	0.7	0.63	1.4	2.15	1
1	16mm or more	0	0.45	1.4	4.25	1
2	16mm or more	0	0.45	1.4	5.6	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door 1		Brick	North	0	0
1		Brick	North	0	0
2		Brick	South	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Brick	44.63	12	32.63	0.21	0	False	60
Cold Roof	40.25	0	40.25	0.1	0		9
Suspended	40.25			0.13			75
Internal Elements							
Metal Stud	143.12						9
Int ceiling	40.25						9
Int floor	40.25						18
Party Elements							
Party wall	93.84						45

SAP Input

Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0434			
	Length	Psi-value		
	8.28	0.05	E2	Other lintels (including other steel lintels)
	6.23	0.034	E3	Sill
	21	0.04	E4	Jamb
	8.75	0.06	E5	Ground floor (normal)
	0	0.07	E19	Ground floor (inverted)
	0	0.32	E20	Exposed floor (normal)
	0	0.32	E21	Exposed floor (inverted)
	0	0.07	E22	Basement floor
	8.75	0	E6	Intermediate floor within a dwelling
	0	0	E7	Party floor between dwellings (in blocks of flats)
	0	0	E8	Balcony within a dwelling, wall insulation continuous
	0	0.04	E9	Balcony between dwellings, wall insulation continuous
	0	1	E23	Balcony within or between dwellings, balcony support penetrates wall
[Approved]	8.75	0.06	E10	Eaves (insulation at ceiling level)
	0	0.24	E24	Eaves (insulation at ceiling level - inverted)
	0	0.037	E11	Eaves (insulation at rafter level)
	0	0.069	E12	Gable (insulation at ceiling level)
	0	0.08	E13	Gable (insulation at rafter level)
	0	0.08	E14	Flat roof
	0	0.56	E15	Flat roof with parapet
	0	0.058	E16	Corner (normal)
	0	-0.069	E17	Corner (inverted – internal area greater than external area)
	20.4	0.04	E18	Party wall between dwellings
	0	0.12	E25	Staggered party wall between dwellings c
	18.4	0.049	P1	Ground floor
	18.4	0	P2	Intermediate floor within a dwelling
	18.4	0.065	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Decentralised whole house extract
	Number of fans in Wetroom: Kitchen 1 Other 2
	Ductwork: ,
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	4.7

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating
	Gas boilers and oil boilers
	Fuel: mains gas
	Info Source: Boiler Database
	Database: (rev 440, product index 017929) Efficiency: Winter 87.3 % Summer: 90.5
	Brand name: Ideal
	Model: LOGIC COMBI
	Model qualifier: ESP1 35
	(Combi boiler)
	Systems with radiators
	Central heating pump : 2013 or later
	Design flow temperature: Design flow temperature > 45°C

SAP Input

Boiler interlock: Yes

Delayed start

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 180 litres
Cylinder insulation: Measured loss, 1.4kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.16

Property Address: HT A241 MT

Address : HT A241 mt, Avisford Grange, Walberton, West Sussex, TBC

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	40.25 (1a)	x	2.4 (2a)	=	96.6 (3a)
First floor	40.25 (1b)	x	2.7 (2b)	=	108.68 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	80.5 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	205.28 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.69999980926514 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.23 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.2 (21)
Infiltration rate modified for monthly wind speed			

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
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d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.15	1.4	3.01		
Windows Type 1			4.25	$\times 1/[1/(1.4) + 0.04]$	5.63		
Windows Type 2			5.6	$\times 1/[1/(1.4) + 0.04]$	7.42		
Floor			40.25	0.13	5.2325	75	3018.75
Walls	44.63	12	32.63	0.21	6.85	60	1957.8
Roof	40.25	0	40.25	0.1	4.03	9	362.25
Total area of elements, m ²			125.13				
Party wall			93.84	0	0	45	4222.8
Internal wall **			143.12			9	1288.08
Internal floor			40.25			18	724.5
Internal ceiling			40.25			9	362.25

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 32.18 (33)

Heat capacity Cm = S(A x k) ((23)...(30) + (32) + (32a)...(32e) = 11936.43 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 148.28 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

DER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K

5.43 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss

(33) + (36) =

37.61 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	34.19	33.87	33.87	33.87	33.87	33.87	33.87	33.87	33.87	33.87	33.87	33.87

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

(39)m=	71.8	71.48	71.48	71.48	71.48	71.48	71.48	71.48	71.48	71.48	71.48	71.48
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Average = Sum(39)_{1...12} / 12 =

71.5 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
--------	------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} / 12 =

0.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

2.47

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

92.92

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	102.21	98.49	94.77	91.06	87.34	83.62	83.62	87.34	91.06	94.77	98.49	102.21
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------

Total = Sum(44)_{1...12} =

1115 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	151.57	132.57	136.8	119.26	114.43	98.75	91.51	105	106.26	123.83	135.17	146.79
--------	--------	--------	-------	--------	--------	-------	-------	-----	--------	--------	--------	--------

Total = Sum(45)_{1...12} =

1461.94 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.74	19.88	20.52	17.89	17.17	14.81	13.73	15.75	15.94	18.57	20.28	22.02
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(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year $\{47\} \times \{51\} \times \{52\} \times \{53\} =$

0
0

(54)
 Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month $\{56\}m = \{55\} \times \{41\}m$
 $\{56\}m =$

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(56)

If cylinder contains dedicated solar storage, $\{57\}m = \{56\}m \times [\{50\} - (H11)] \div \{50\}$, else $\{57\}m = \{56\}m$ where (H11) is from Appendix H

$\{57\}m =$

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $\{59\}m = \{58\} \div 365 \times \{41\}m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

$\{59\}m =$

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(59)

Combi loss calculated for each month $\{61\}m = \{60\} \div 365 \times \{41\}m$

$\{61\}m =$

14.12	12.74	14.07	13.57	14	13.51	13.94	13.98	13.55	14.04	13.63	14.11
-------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	-------

(61)

Total heat required for water heating calculated for each month $\{62\}m = 0.85 \times \{45\}m + \{46\}m + \{57\}m + \{59\}m + \{61\}m$

$\{62\}m =$

165.69	145.3	150.86	132.84	128.43	112.26	105.45	118.98	119.8	137.87	148.81	160.9
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------

(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

$\{63\}m =$

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

$\{64\}m =$

165.69	145.3	150.86	132.84	128.43	112.26	105.45	118.98	119.8	137.87	148.81	160.9
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------

(64)
Output from water heater (annual) $\times 12$

1627.19

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times \{45\}m + \{61\}m] + 0.8 \times [\{46\}m + \{57\}m + \{59\}m]$

$\{65\}m =$

53.93	47.26	49	43.05	41.55	36.21	33.91	38.41	38.72	44.68	48.35	52.33
-------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------

(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

$\{66\}m =$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61

(66)

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

$\{67\}m =$

21.72	19.29	15.69	11.88	8.88	7.5	8.1	10.53	14.13	17.94	20.94	22.33
-------	-------	-------	-------	------	-----	-----	-------	-------	-------	-------	-------

(67)

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

$\{68\}m =$

220.48	222.77	217	204.73	189.24	174.68	164.95	162.66	168.42	180.7	196.19	210.75
--------	--------	-----	--------	--------	--------	--------	--------	--------	-------	--------	--------

(68)

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

$\{69\}m =$

35.36	35.36	35.36	35.36	35.36	35.36	35.36	35.36	35.36	35.36	35.36	35.36
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

$\{70\}m =$

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

(70)

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

$\{71\}m =$

-98.89	-98.89	-98.89	-98.89	-98.89	-98.89	-98.89	-98.89	-98.89	-98.89	-98.89	-98.89
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

Water heating gains (Table 5)

$\{72\}m =$

72.48	70.33	65.86	59.79	55.85	50.29	45.58	51.62	53.77	60.06	67.16	70.34
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(72)

Total internal gains =

$\{73\}m =$ $\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$

377.77	375.48	361.64	339.48	317.05	295.55	281.71	287.9	299.41	321.79	347.38	366.51
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.25	x	10.63	x	0.45	x	1.11	=	15.66	(74)
North	0.9x	0.77	x	4.25	x	20.32	x	0.45	x	1.11	=	29.93	(74)
North	0.9x	0.77	x	4.25	x	34.53	x	0.45	x	1.11	=	50.85	(74)
North	0.9x	0.77	x	4.25	x	55.46	x	0.45	x	1.11	=	81.68	(74)
North	0.9x	0.77	x	4.25	x	74.72	x	0.45	x	1.11	=	110.03	(74)
North	0.9x	0.77	x	4.25	x	79.99	x	0.45	x	1.11	=	117.79	(74)
North	0.9x	0.77	x	4.25	x	74.68	x	0.45	x	1.11	=	109.97	(74)
North	0.9x	0.77	x	4.25	x	59.25	x	0.45	x	1.11	=	87.25	(74)
North	0.9x	0.77	x	4.25	x	41.52	x	0.45	x	1.11	=	61.14	(74)
North	0.9x	0.77	x	4.25	x	24.19	x	0.45	x	1.11	=	35.62	(74)
North	0.9x	0.77	x	4.25	x	13.12	x	0.45	x	1.11	=	19.32	(74)
North	0.9x	0.77	x	4.25	x	8.86	x	0.45	x	1.11	=	13.05	(74)
South	0.9x	0.77	x	5.6	x	46.75	x	0.45	x	1.11	=	90.72	(78)
South	0.9x	0.77	x	5.6	x	76.57	x	0.45	x	1.11	=	148.57	(78)
South	0.9x	0.77	x	5.6	x	97.53	x	0.45	x	1.11	=	189.25	(78)
South	0.9x	0.77	x	5.6	x	110.23	x	0.45	x	1.11	=	213.9	(78)
South	0.9x	0.77	x	5.6	x	114.87	x	0.45	x	1.11	=	222.9	(78)
South	0.9x	0.77	x	5.6	x	110.55	x	0.45	x	1.11	=	214.51	(78)
South	0.9x	0.77	x	5.6	x	108.01	x	0.45	x	1.11	=	209.59	(78)
South	0.9x	0.77	x	5.6	x	104.89	x	0.45	x	1.11	=	203.54	(78)
South	0.9x	0.77	x	5.6	x	101.89	x	0.45	x	1.11	=	197.7	(78)
South	0.9x	0.77	x	5.6	x	82.59	x	0.45	x	1.11	=	160.25	(78)
South	0.9x	0.77	x	5.6	x	55.42	x	0.45	x	1.11	=	107.53	(78)
South	0.9x	0.77	x	5.6	x	40.4	x	0.45	x	1.11	=	78.39	(78)

Solar gains in watts, calculated for each month

{83}m = Sum(74)m ... (82)m

{83}m=	106.38	178.5	240.1	295.58	332.92	332.3	319.56	290.78	258.84	195.87	126.85	91.44	{83}
--------	--------	-------	-------	--------	--------	-------	--------	--------	--------	--------	--------	-------	------

Total gains – internal and solar {84}m = {73}m + {83}m , watts

{84}m=	484.15	553.98	601.75	635.06	649.97	627.85	601.27	578.68	558.25	517.66	474.23	457.95	{84}
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 {85}

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
{86}m=	0.99	0.97	0.95	0.91	0.81	0.66	0.5	0.54	0.75	0.92	0.97	0.99	{86}

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

{87}m=	19.67	19.87	20.14	20.46	20.75	20.92	20.98	20.97	20.86	20.5	20.02	19.62	{87}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

{88}m=	20.17	20.18	20.18	20.18	20.18	20.18	20.18	20.18	20.18	20.18	20.18	20.18	{88}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

{89}m=	0.98	0.97	0.94	0.89	0.77	0.59	0.42	0.46	0.69	0.9	0.97	0.99	{89}
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

DER WorkSheet: New dwelling design stage

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.38	18.67	19.07	19.52	19.9	20.11	20.17	20.16	20.05	19.58	18.89	18.31	(90)
fLA = Living area ÷ (4) =													(91)
											0.24		

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.69	18.96	19.33	19.75	20.1	20.31	20.36	20.36	20.24	19.8	19.16	18.62	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.54	18.81	19.18	19.6	19.95	20.16	20.21	20.21	20.09	19.65	19.01	18.47	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

9. Space heating calculation

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.97	0.96	0.93	0.87	0.76	0.59	0.42	0.46	0.69	0.88	0.96	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	471.78	530.39	558.5	552.74	495.89	372.31	253.5	265.36	382.91	456.51	454.05	448.27	(95)
--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	1022.23	994.35	906	764.59	590.02	397.11	258.19	272.07	428.5	647.2	851.41	1020.17	(97)
--------	---------	--------	-----	--------	--------	--------	--------	--------	-------	-------	--------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	409.53	311.78	258.54	152.53	70.03	0	0	0	0	141.87	286.1	425.49	(98)
Total per year (kWh/year) = Sum(98) _{1...12} =													(99)
											2055.88		

Space heating requirement in kWh/m²/year

25.54 (99)

9a. Energy requirements for individual heating systems including micro-CHP

Space heating:

Space heating:			
Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	$(202) = 1 - (201) =$	1	(202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

409.53	311.78	258.54	152.53	70.03	0	0	0	0	141.87	286.1	425.49
--------	--------	--------	--------	-------	---	---	---	---	--------	-------	--------

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

452.52	344.51	285.68	168.54	77.38	0	0	0	0	156.77	316.13	470.15
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1...12} = 2271.69 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1...12} =												0	(215)

Water heating

Output from water heater (calculated above)

165.69	145.3	150.86	132.84	128.43	112.26	105.45	118.98	119.8	137.87	148.81	160.9
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------

Efficiency of water heater 87.3 (216)

DER WorkSheet: New dwelling design stage

(217)m=	89.55	89.46	89.29	88.98	88.4	87.3	87.3	87.3	87.3	88.89	89.38	89.6	(217)
---------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	185.02	162.43	168.95	149.28	145.28	128.59	120.78	136.29	137.23	155.1	166.49	179.58	
Total = Sum{(219a)} _{i=1,12} =												1835.02	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

60.06 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 135.06 (231)

Electricity for lighting

383.65 (232)

12a CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	490.69 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	396.36 (264)
Space and water heating	(261) + (262) + (263) + (264) =		887.05 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	70.1 (267)
Electricity for lighting	(232) x	0.519	199.11 (268)
Total CO2, kg/year		sum of (265)...(271) =	1156.26 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.36 (273)
El rating (section 14)			88 (274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.16
Printed on 13 March 2019 at 10:36:16

Project Information:

Assessed By: Matt Fitzpatrick (STRO003572)

Building Type: End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 95.96m²

Site Reference : Walberton

Plot Reference: HT A32

Address : HT A32, Avisford Grange, Walberton, West Sussex, TBC

Client Details:

Name: Linden Homes Southern

Address : 1A Guildford Business Park , Guildford, Surrey, GU2 8XG

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.07 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 14.86 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.0 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 38.8 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.21 (max. 0.30)	0.21 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.70 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 440, product index 017929): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 35 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.40 kWh/day	
	Permitted by DBSCG: 2.10 kWh/day	OK
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power:	0.19 0.18	
Maximum	0.7	OK

9 Summer time temperature

Overheating risk (South East England):	Slight	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North	3.95m ²	
Windows facing: South	6.32m ²	
Ventilation rate:	4.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Thermal bridging	0.031 W/m ² K
Roofs U-value	0.1 W/m ² K
Party Walls U-value	0 W/m ² K

SAP Input

Property Details: HT A32

Address: HT A32, Avisford Grange, Walberton, West Sussex, TBC
Located in: England
Region: South East England
UPRN:
Date of assessment: 13 March 2019
Date of certificate: 13 March 2019
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Calculated 146.29
Water use <= 125 litres/ person/ day: True
PCDF Version: 440

Property Description

Dwelling type: House
Detachment: End-terrace
Year Completed: 2018
Floor Location: **Floor area:** **Storey height:**
 Floor 0 47.98 m² 2.4 m
 Floor 1 47.98 m² 2.7 m
Living area: 13.26 m² (fraction 0.138)
Front of dwelling faces: North

Opening Types

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door 1	Manufacturer	Solid			PVC-U
1	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
2	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door 1	mm	0.7	0.63	1.4	2.15	1
1	16mm or more	0	0.45	1.4	3.95	1
2	16mm or more	0	0.45	1.4	6.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door 1		Brick	North	0	0
1		Brick	North	0	0
2		Brick	South	0	0

Overshading: Average or unknown

Opaque Elements

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Brick	100.11	12.42	87.69	0.21	0	False	60
Cold Roof	47.98	0	47.98	0.1	0		9
Suspended	47.98			0.13			75
Internal Elements							
Metal Stud	148.79						9
Int ceiling	47.98						9
Int floor	47.98						18
Party Elements							
Party wall	46.92						45

SAP Input

Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.031			
	Length	Psi-value		
	8.74	0.05	E2	Other lintels (including other steel lintels)
	6.69	0.034	E3	Sill
	23.1	0.04	E4	Jamb
	19.63	0.06	E5	Ground floor (normal)
	0	0.07	E19	Ground floor (inverted)
	0	0.32	E20	Exposed floor (normal)
	0	0.32	E21	Exposed floor (inverted)
	0	0.07	E22	Basement floor
	19.63	0	E6	Intermediate floor within a dwelling
	0	0	E7	Party floor between dwellings (in blocks of flats)
	0	0	E8	Balcony within a dwelling, wall insulation continuous
	0	0.04	E9	Balcony between dwellings, wall insulation continuous
	0	1	E23	Balcony within or between dwellings, balcony support penetrates wall
[Approved]	10.43	0.06	E10	Eaves (insulation at ceiling level)
	0	0.24	E24	Eaves (insulation at ceiling level - inverted)
	0	0.037	E11	Eaves (insulation at rafter level)
	9.2	0.069	E12	Gable (insulation at ceiling level)
	0	0.08	E13	Gable (insulation at rafter level)
	0	0.08	E14	Flat roof
	0	0.56	E15	Flat roof with parapet
	10.2	0.058	E16	Corner (normal)
	0	-0.069	E17	Corner (inverted – internal area greater than external area)
	10.2	0.04	E18	Party wall between dwellings
	0	0.12	E25	Staggered party wall between dwellings c
	9.2	0.049	P1	Ground floor
	9.2	0	P2	Intermediate floor within a dwelling
	9.2	0.065	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Decentralised whole house extract
	Number of fans in Wetroom: Kitchen 1 Other 2
	Ductwork: ,
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	4.7

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating
	Gas boilers and oil boilers
	Fuel: mains gas
	Info Source: Boiler Database
	Database: (rev 440, product index 017929) Efficiency: Winter 87.3 % Summer: 90.5
	Brand name: Ideal
	Model: LOGIC COMBI
	Model qualifier: ESP1 35
	(Combi boiler)
	Systems with radiators
	Central heating pump : 2013 or later
	Design flow temperature: Design flow temperature > 45°C

SAP Input

Boiler interlock: Yes

Delayed start

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 180 litres
Cylinder insulation: Measured loss, 1.4kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.16

Property Address: HT A32

Address : HT A32, Avisford Grange, Walberton, West Sussex, TBC

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	47.98	(1a) x	2.4	(2a) =	115.15 (3a)
First floor	47.98	(1b) x	2.7	(2b) =	129.55 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	95.96	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	244.7 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.69999980926514 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.23 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.2 (21)
Infiltration rate modified for monthly wind speed			

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(25)

3. Heat losses and heat capacity parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.15	1.4	3.01		(26)
Windows Type 1			3.95	$\times 1/[1/(1.4) + 0.04]$	5.24		(27)
Windows Type 2			6.32	$\times 1/[1/(1.4) + 0.04]$	8.38		(27)
Floor			47.98	0.13	6.2374	75	3598.5 (28)
Walls	100.11	12.42	87.69	0.21	18.41	60	5261.4 (29)
Roof	47.98	0	47.98	0.1	4.8	9	431.82 (30)
Total area of elements, m ²			196.07				(31)
Party wall			46.92	0	0	45	2111.4 (32)
Internal wall **			148.79			9	1339.11 (32c)
Internal floor			47.98			18	863.64 (32d)
Internal ceiling			47.98			9	431.82 (32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 46.08 (33)

Heat capacity Cm = S(A x k) ((23) ... (30) + (32) + (32a) ... (32e) = 14037.69 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 146.29 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

DER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K

6.08 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss

(39) + (36) =

52.15 (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=	40.75	40.38	40.38	40.38	40.38	40.38	40.38	40.38	40.38	40.38	40.38	40.38

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	92.9	92.53	92.53	92.53	92.53	92.53	92.53	92.53	92.53	92.53	92.53	92.53
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39) / 12 =

92.56 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.97	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
--------	------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40) / 12 =

0.96 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

2.7

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

98.3

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	108.13	104.2	100.26	96.33	92.4	88.47	88.47	92.4	96.33	100.26	104.2	108.13
--------	--------	-------	--------	-------	------	-------	-------	------	-------	--------	-------	--------

Total = Sum(44) / 12 =

1179.57 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	160.35	140.24	144.72	126.17	121.06	104.47	96.8	111.08	112.41	131	143	155.29
--------	--------	--------	--------	--------	--------	--------	------	--------	--------	-----	-----	--------

Total = Sum(45) / 12 =

1546.6 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.05	21.04	21.71	18.93	18.16	15.67	14.52	16.66	16.86	19.65	21.45	23.29
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year $\{47\} \times \{51\} \times \{52\} \times \{53\} =$

0
0

(54)
 Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month $\{56\}m = \{55\} \times \{41\}m$
 (56)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(56)

If cylinder contains dedicated solar storage, $\{57\}m = \{56\}m \times [\{50\} - (H11)] \div \{50\}$, else $\{57\}m = \{56\}m$ where (H11) is from Appendix H

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $\{59\}m = \{58\} \div 365 \times \{41\}m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(59)

Combi loss calculated for each month $\{61\}m = \{60\} \div 365 \times \{41\}m$

(61)m=

14.14	12.76	14.1	13.6	14.03	13.53	13.96	14	13.57	14.07	13.66	14.13
-------	-------	------	------	-------	-------	-------	----	-------	-------	-------	-------

(61)

Total heat required for water heating calculated for each month $\{62\}m = 0.85 \times \{45\}m + \{46\}m + \{57\}m + \{59\}m + \{61\}m$

(62)m=

174.49	153	158.82	139.77	135.09	118	110.77	125.09	125.98	145.08	156.66	169.42
--------	-----	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------

(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

(64)m=

174.49	153	158.82	139.77	135.09	118	110.77	125.09	125.98	145.08	156.66	169.42
--------	-----	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------

(64)

Output from water heater (annual) $\times 12$

1712.17

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times \{45\}m + \{61\}m] + 0.8 \times [\{46\}m + \{57\}m + \{59\}m]$

(65)m=

56.85	49.82	51.64	45.35	43.76	38.12	35.68	40.44	40.77	47.08	50.96	55.17
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
134.94	134.94	134.94	134.94	134.94	134.94	134.94	134.94	134.94	134.94	134.94	134.94

(66)

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

(67)m=

25.33	22.5	18.3	13.85	10.35	8.74	9.44	12.28	16.48	20.92	24.42	26.03
-------	------	------	-------	-------	------	------	-------	-------	-------	-------	-------

(67)

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

(68)m=

249.63	252.22	245.69	231.79	214.25	197.76	186.75	184.16	190.69	204.58	222.13	238.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=

36.49	36.49	36.49	36.49	36.49	36.49	36.49	36.49	36.49	36.49	36.49	36.49
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

(70)

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

(71)m=

-107.95	-107.95	-107.95	-107.95	-107.95	-107.95	-107.95	-107.95	-107.95	-107.95	-107.95	-107.95
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=

76.41	74.14	69.41	62.99	58.82	52.94	47.95	54.35	56.62	63.28	70.78	74.15
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(72)

Total internal gains =

$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$

(73)m=

417.85	415.33	399.88	375.12	349.9	325.93	310.63	317.27	330.27	355.26	383.81	405.28
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b			FF Table 6c			Gains (W)	
North	0.9x	0.77	x	3.95	x	10.63	x	0.45	x	1.11	=	14.55	(74)		
North	0.9x	0.77	x	3.95	x	20.32	x	0.45	x	1.11	=	27.81	(74)		
North	0.9x	0.77	x	3.95	x	34.53	x	0.45	x	1.11	=	47.26	(74)		
North	0.9x	0.77	x	3.95	x	55.46	x	0.45	x	1.11	=	75.91	(74)		
North	0.9x	0.77	x	3.95	x	74.72	x	0.45	x	1.11	=	102.26	(74)		
North	0.9x	0.77	x	3.95	x	79.99	x	0.45	x	1.11	=	109.47	(74)		
North	0.9x	0.77	x	3.95	x	74.68	x	0.45	x	1.11	=	102.21	(74)		
North	0.9x	0.77	x	3.95	x	59.25	x	0.45	x	1.11	=	81.09	(74)		
North	0.9x	0.77	x	3.95	x	41.52	x	0.45	x	1.11	=	56.82	(74)		
North	0.9x	0.77	x	3.95	x	24.19	x	0.45	x	1.11	=	33.11	(74)		
North	0.9x	0.77	x	3.95	x	13.12	x	0.45	x	1.11	=	17.95	(74)		
North	0.9x	0.77	x	3.95	x	8.86	x	0.45	x	1.11	=	12.13	(74)		
South	0.9x	0.77	x	6.32	x	46.75	x	0.45	x	1.11	=	102.38	(78)		
South	0.9x	0.77	x	6.32	x	76.57	x	0.45	x	1.11	=	167.67	(78)		
South	0.9x	0.77	x	6.32	x	97.53	x	0.45	x	1.11	=	213.59	(78)		
South	0.9x	0.77	x	6.32	x	110.23	x	0.45	x	1.11	=	241.4	(78)		
South	0.9x	0.77	x	6.32	x	114.87	x	0.45	x	1.11	=	251.55	(78)		
South	0.9x	0.77	x	6.32	x	110.55	x	0.45	x	1.11	=	242.09	(78)		
South	0.9x	0.77	x	6.32	x	108.01	x	0.45	x	1.11	=	236.53	(78)		
South	0.9x	0.77	x	6.32	x	104.89	x	0.45	x	1.11	=	229.71	(78)		
South	0.9x	0.77	x	6.32	x	101.89	x	0.45	x	1.11	=	223.12	(78)		
South	0.9x	0.77	x	6.32	x	82.59	x	0.45	x	1.11	=	180.85	(78)		
South	0.9x	0.77	x	6.32	x	55.42	x	0.45	x	1.11	=	121.36	(78)		
South	0.9x	0.77	x	6.32	x	40.4	x	0.45	x	1.11	=	88.47	(78)		

Solar gains in watts, calculated for each month

{83}m = Sum{74}m ... {82}m

{83}m=	116.94	195.49	260.85	317.31	353.82	351.56	338.74	310.8	279.94	213.96	139.31	100.6	{83}
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	------

Total gains – internal and solar {84}m = {73}m + {83}m , watts

{84}m=	534.79	610.82	660.73	692.43	703.72	677.49	649.37	628.06	610.21	569.22	523.12	505.88	{84}
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 {85}

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
{86}m=	0.99	0.98	0.96	0.93	0.86	0.74	0.58	0.62	0.81	0.94	0.98	0.99	{86}

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

{87}m=	19.43	19.63	19.92	20.27	20.61	20.86	20.96	20.94	20.78	20.34	19.81	19.38	{87}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

{88}m=	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	{88}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

{89}m=	0.99	0.98	0.96	0.92	0.83	0.67	0.48	0.52	0.75	0.92	0.98	0.99	{89}
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

DER WorkSheet: New dwelling design stage

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18	18.29	18.7	19.21	19.68	19.98	20.09	20.08	19.9	19.32	18.56	17.93	(90)
fLA = Living area ÷ (4) =													(91)
0.14													(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.2	18.48	18.87	19.36	19.81	20.1	20.21	20.2	19.46	18.73	18.13	(92)
--------	------	-------	-------	-------	-------	------	-------	------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.05	18.33	18.72	19.21	19.66	19.95	20.06	20.05	19.87	19.31	18.58	17.98	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

9. Space heating calculation

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.96	0.94	0.9	0.81	0.65	0.48	0.51	0.74	0.9	0.96	0.98	(94)
--------	------	------	------	-----	------	------	------	------	------	-----	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	523.21	589.34	622.38	621.08	569.68	443.51	308.5	321.94	449.17	514.47	504.63	496.75	(95)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m – (96)m)]

(97)m=	1277.08	1242.28	1130.93	953.56	736.14	495.46	319.8	337.35	533.77	805.8	1062.15	1275.07	(97)
--------	---------	---------	---------	--------	--------	--------	-------	--------	--------	-------	---------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	560.88	438.78	378.36	239.38	123.85	0	0	0	0	216.75	401.42	579.07	(98)
Total per year (kWh/year) = Sum(98) _{1...12} =													(98)
2938.48													(98)

Space heating requirement in kWh/m²/year

30.62 (99)

9a. Energy requirements for individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

90.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

kWh/year

Space heating requirement (calculated above)

560.88	438.78	378.36	239.38	123.85	0	0	0	0	216.75	401.42	579.07
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = {[(98)m x (204)]} x 100 ÷ (206) (211)

619.75	484.84	418.08	264.51	136.85	0	0	0	0	239.5	443.55	639.86
--------	--------	--------	--------	--------	---	---	---	---	-------	--------	--------

Total (kWh/year) = Sum(211)_{1...12} = 3246.94 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)]} x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1...12} =												0	(215)

Water heating

Output from water heater (calculated above)

174.49	153	158.82	139.77	135.09	118	110.77	125.09	125.98	145.08	156.66	169.42
--------	-----	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------

Efficiency of water heater 87.3 (216)

DER WorkSheet: New dwelling design stage

{217)m=	89.72	89.65	89.53	89.29	88.8	87.3	87.3	87.3	87.3	89.19	89.58	89.76	{217}
---------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

{219)m=	194.48	170.67	177.4	156.53	152.12	135.17	126.88	143.28	144.31	162.66	174.88	188.76	
Total = Sum({219a}) _{i=1,12} =												1927.15	{219}

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

71.6 {230a}

central heating pump:

30 {230c}

boiler with a fan-assisted flue

45 {230e}

Total electricity for the above, kWh/year

sum of {230a}...{230g} =

146.6 {231}

Electricity for lighting

447.31 {232}

12a CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	{211} x	0.216	701.34 {261}
Space heating (secondary)	{215} x	0.519	0 {263}
Water heating	{219} x	0.216	416.26 {264}
Space and water heating	{261} + {262} + {263} + {264} =		1117.6 {265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	76.08 {267}
Electricity for lighting	{232} x	0.519	232.15 {268}
Total CO2, kg/year		sum of {265}...{271} =	1425.84 {272}
Dwelling CO2 Emission Rate		{272} ÷ (4) =	14.86 {273}
El rating (section 14)			86 {274}

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.16
Printed on 13 March 2019 at 10:36:03

Project Information:

Assessed By: Matt Fitzpatrick (STRO003572)

Building Type: Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 149.62m²

Site Reference : Walberton

Plot Reference: HT COTT

Address : HT COTT, Avisford Grange, Walberton, West Sussex, TBC

Client Details:

Name: Linden Homes Southern

Address : 1A Guildford Business Park , Guildford, Surrey, GU2 8XG

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 16.16 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.10 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 58.6 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 47.8 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.21 (max. 0.30)	0.21 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 4.70 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main Heating system: Database: (rev 440, product index 018042):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC HEAT
Model qualifier: H18
(Regular)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.40 kWh/day	
	Permitted by DBSCG: 2.10 kWh/day	OK
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power:	0.19 0.18	
Maximum	0.7	OK

9 Summer time temperature

Overheating risk (South East England):	Slight	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North	21.98m ²	
Windows facing: East	0.58m ²	
Windows facing: West	1.24m ²	
Windows facing: South	9.87m ²	
Ventilation rate:	4.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Thermal bridging	0.029 W/m ² K
Roofs U-value	0.1 W/m ² K

SAP Input

Property Details: HT COTT

Address: HT COTT, Avisford Grange, Walberton, West Sussex, TBC
Located in: England
Region: South East England
UPRN:
Date of assessment: 13 March 2019
Date of certificate: 13 March 2019
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Calculated 153.01
Water use <= 125 litres/ person/ day: True
PCDF Version: 440

Property description:

Dwelling type: House
Detachment: Detached
Year Completed: 2018
Floor Location: **Floor area:** **Storey height:**
 Floor 0 74.81 m² 2.4 m
 Floor 1 74.81 m² 2.7 m
Living area: 20.74 m² (fraction 0.139)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door 1	Manufacturer	Solid			PVC-U
Utility	Manufacturer	Solid			PVC-U
1	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
2	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
3	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
4	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door 1	mm	0.7	0.63	1.4	2.15	1
Utility	mm	0.7	0.63	1.4	2.15	1
1	16mm or more	0	0.45	1.4	21.98	1
2	16mm or more	0	0.45	1.4	0.58	1
3	16mm or more	0	0.45	1.4	1.24	1
4	16mm or more	0	0.45	1.4	9.87	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door 1		Brick	North	0	0
Utility		Brick	North	0	0
1		Brick	North	0	0
2		Brick	East	0	0
3		Brick	West	0	0
4		Brick	South	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Brick	185.84	37.97	147.87	0.21	0	False	60

SAP Input

Cold Roof	73.58	0	73.58	0.1	0	9
Bay roof	1.23	0	1.23	0.11	0	9
Suspended	74.81			0.13		75

Internal Elements

Metal Stud	237.74					9
Block	48.14					75
Int ceiling	73.58					9
Int floor	73.58					18

Party Elements

Thermal bridges

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0289				
	Length	Psi-value			
	24.58	0.05	E2	Other lintels (including other steel lintels)	
	15.03	0.034	E3	Sill	
	54	0.04	E4	Jamb	
	37.12	0.06	E5	Ground floor (normal)	
	0	0.07	E19	Ground floor (inverted)	
	0	0.32	E20	Exposed floor (normal)	
	0	0.32	E21	Exposed floor (inverted)	
	0	0.07	E22	Basement floor	
	35.84	0	E6	Intermediate floor within a dwelling	
	0	0	E7	Party floor between dwellings (in blocks of flats)	
	0	0	E8	Balcony within a dwelling, wall insulation continuous	
	0	0.04	E9	Balcony between dwellings, wall insulation continuous	
	0	1	E23	Balcony within or between dwellings, balcony support penetrates wall	
[Approved]	17.93	0.06	E10	Eaves (insulation at ceiling level)	
	0	0.24	E24	Eaves (insulation at ceiling level - inverted)	
	0	0.037	E11	Eaves (insulation at rafter level)	
	17.91	0.069	E12	Gable (insulation at ceiling level)	
	0	0.08	E13	Gable (insulation at rafter level)	
	2.29	0.08	E14	Flat roof	
	0	0.56	E15	Flat roof with parapet	
	30.3	0.058	E16	Corner (normal)	
	9.9	-0.069	E17	Corner (inverted – internal area greater than external area)	
	0	0.04	E18	Party wall between dwellings	
	0	0.12	E25	Staggered party wall between dwellings c	
	0	0.049	P1	Ground floor	
	0	0	P2	Intermediate floor within a dwelling	
	0	0.065	P4	Roof (insulation at ceiling level)	

Ventilation

Pressure test:	Yes (As designed)
Ventilation:	Decentralised whole house extract
	Number of fans in Wetroom: Kitchen 1 Other 5
	Ductwork: ,
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	4.7

Main heating system

Main heating system:	Boiler systems with radiators or underfloor heating
	Gas boilers and oil boilers
	Fuel: mains gas
	Info Source: Boiler Database

SAP Input

Database: (rev 440, product index 018042) Efficiency: Winter 79.9 % Summer: 90.6
Brand name: Ideal
Model: LOGIC HEAT
Model qualifier: H18
(Regular boiler)
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature > 45°C
Boiler interlock: Yes
Delayed start

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 180 litres
Cylinder insulation: Measured loss, 1.4kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.16

Property Address: HT COTT

Address : HT COTT, Avisford Grange, Walberton, West Sussex, TBC

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	74.81	(1a) x	2.4	(2a) =	179.54 (3a)
First floor	74.81	(1b) x	2.7	(2b) =	201.99 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	149.62	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	381.53 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.69999980926514 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.23 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.2 (21)
Infiltration rate modified for monthly wind speed			

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(25)
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------

3. Thermal losses and heat loss parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.15	1.4	3.01		(26)
Doors Type 2			2.15	1.4	3.01		(26)
Windows Type 1			21.98	$\times 1/[1/(1.4) + 0.04]$	29.14		(27)
Windows Type 2			0.58	$\times 1/[1/(1.4) + 0.04]$	0.77		(27)
Windows Type 3			1.24	$\times 1/[1/(1.4) + 0.04]$	1.64		(27)
Windows Type 4			9.87	$\times 1/[1/(1.4) + 0.04]$	13.09		(27)
Floor			74.81	0.13	9.725299	75	5610.75 (28)
Walls	185.84	37.97	147.87	0.21	31.05	60	8872.2 (29)
Roof Type1	73.58	0	73.58	0.1	7.36	9	662.22 (30)
Roof Type2	1.23	0	1.23	0.11	0.14	9	11.07 (30)
Total area of elements, m²			335.46				(31)
Internal wall **			237.74			9	2139.66 (32c)
Internal wall **			48.14			75	3610.5 (32c)
Internal floor			73.58			18	1324.44 (32d)
Internal ceiling			73.58			9	662.22 (32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 98.93 (33)

DER WorkSheet: New dwelling design stage

Heat capacity $C_m = S(A \times k)$

$$\{(28)\dots(30) + (32) + (32a)\dots(32e) = 22893.06 \quad (34)$$

Thermal mass parameter (TMP = $C_m \div TFA$) in $\text{kJ/m}^2\text{K}$

$$= (34) \div (4) = 153.01 \quad (35)$$

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : $S (L \times Y)$ calculated using Appendix K

$$9.7 \quad (36)$$

if details of thermal bridging are not known $(36) = 0.15 \times (31)$

Total fabric heat loss

$$(33) + (36) = 108.63 \quad (37)$$

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(38)m =$	63.54	62.95	62.95	62.95	62.95	62.95	62.95	62.95	62.95	62.95	62.95	62.95	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(39)m =$	172.17	171.58	171.58	171.58	171.58	171.58	171.58	171.58	171.58	171.58	171.58	171.58	
Average = $\text{Sum}(39)_{1..12} / 12 =$												171.63	(39)

Heat loss parameter (HLP), W/m^2K

$$(40)m = (39)m \div (4)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(40)m =$	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	
Average = $\text{Sum}(40)_{1..12} / 12 =$												1.15	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(41)m =$	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

if $TFA > 13.9$, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if $TFA \leq 13.9$, $N = 1$

$$2.93 \quad (42)$$

Annual average hot water usage in litres per day $V_{d, \text{average}} = (25 \times N) + 36$

$$103.87 \quad (43)$$

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(44)m =$	114.26	110.11	105.95	101.8	97.64	93.49	93.49	97.64	101.8	105.95	110.11	114.26	
Total = $\text{Sum}(44)_{1..12} =$												1246.47	(44)

Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times nm \times DTm / 3600 \text{ kWh/month}$ (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(45)m =$	169.44	148.2	152.93	133.32	127.93	110.39	102.29	117.38	118.79	138.43	151.11	164.1	
Total = $\text{Sum}(45)_{1..12} =$												1634.32	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(46)m =$	25.42	22.23	22.94	20	19.19	16.56	15.34	17.61	17.82	20.77	22.67	24.61	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

$$180 \quad (47)$$

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

$$1.4 \quad (48)$$

Temperature factor from Table 2b

$$0.54 \quad (49)$$

Energy lost from water storage, kWh/year

$$(48) \times (49) = 0.76 \quad (50)$$

b) If manufacturer's declared cylinder loss factor is not known:

DER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)												
If community heating see section 4.3														
Volume factor from Table 2a	0	(52)												
Temperature factor from Table 2b	0	(53)												
Energy lost from water storage, kWh/year	(47) × (51) × (52) × (53) = 0	(54)												
Enter (50) or (54) in (55)	0.76	(55)												
Water storage loss calculated for each month	((56)m = (55) × (41)m													
(56)m=	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(56)	
If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H														
(57)m=	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(57)	
Primary circuit loss (annual) from Table 3	0												(58)	
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m														
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)														
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m														
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)	
Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m														
(62)m=	216.14	190.38	199.62	178.52	174.63	155.58	148.99	164.08	163.98	185.13	196.3	210.8	(62)	
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)														
(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)														
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)	
Output from water heater														
(64)m=	216.14	190.38	199.62	178.52	174.63	155.58	148.99	164.08	163.98	185.13	196.3	210.8	(64)	
												Output from water heater (annual) 1...12	2184.16	(64)
Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]														
(65)m=	93.7	83.02	88.21	80.48	79.89	72.86	71.37	76.39	75.65	83.39	86.4	91.92	(65)	
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating														
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=	146.68	146.68	146.68	146.68	146.68	146.68	146.68	146.68	146.68	146.68	146.68	146.68	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5														
(67)m=	28.53	25.34	20.61	15.6	11.66	9.85	10.64	13.83	18.56	23.57	27.51	29.33	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5														
(68)m=	320.11	323.43	315.06	297.24	274.75	253.6	239.48	236.16	244.53	262.35	284.84	305.98	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5														
(69)m=	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	(69)	
Pumps and fans gains (Table 5a)														
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)	
Losses e.g. evaporation (negative values) (Table 5)														
(71)m=	-117.34	-117.34	-117.34	-117.34	-117.34	-117.34	-117.34	-117.34	-117.34	-117.34	-117.34	-117.34	(71)	
Water heating gains (Table 5)														
(72)m=	125.94	123.54	118.56	111.78	107.39	101.19	95.93	102.67	105.07	112.08	120	123.55	(72)	

DER WorkSheet: New dwelling design stage

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	544.59	542.32	524.23	494.63	463.8	434.65	416.05	422.67	438.17	468	502.35	528.87	(73)
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6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m²	Flux Table 6a			g_ Table 6b	FF Table 6c		Gains (W)	
North	0.9x	0.77	x	21.98	x	10.63	x	0.45	x	1.11	=	80.98 (74)
North	0.9x	0.77	x	21.98	x	20.32	x	0.45	x	1.11	=	154.77 (74)
North	0.9x	0.77	x	21.98	x	34.53	x	0.45	x	1.11	=	262.98 (74)
North	0.9x	0.77	x	21.98	x	55.46	x	0.45	x	1.11	=	422.42 (74)
North	0.9x	0.77	x	21.98	x	74.72	x	0.45	x	1.11	=	569.04 (74)
North	0.9x	0.77	x	21.98	x	79.99	x	0.45	x	1.11	=	609.17 (74)
North	0.9x	0.77	x	21.98	x	74.68	x	0.45	x	1.11	=	568.74 (74)
North	0.9x	0.77	x	21.98	x	59.25	x	0.45	x	1.11	=	451.22 (74)
North	0.9x	0.77	x	21.98	x	41.52	x	0.45	x	1.11	=	316.19 (74)
North	0.9x	0.77	x	21.98	x	24.19	x	0.45	x	1.11	=	184.23 (74)
North	0.9x	0.77	x	21.98	x	13.12	x	0.45	x	1.11	=	99.9 (74)
North	0.9x	0.77	x	21.98	x	8.86	x	0.45	x	1.11	=	67.51 (74)
East	0.9x	1	x	0.58	x	19.64	x	0.45	x	1.11	=	3.95 (76)
East	0.9x	1	x	0.58	x	38.42	x	0.45	x	1.11	=	7.72 (76)
East	0.9x	1	x	0.58	x	63.27	x	0.45	x	1.11	=	12.72 (76)
East	0.9x	1	x	0.58	x	92.28	x	0.45	x	1.11	=	18.55 (76)
East	0.9x	1	x	0.58	x	113.09	x	0.45	x	1.11	=	22.73 (76)
East	0.9x	1	x	0.58	x	115.77	x	0.45	x	1.11	=	23.27 (76)
East	0.9x	1	x	0.58	x	110.22	x	0.45	x	1.11	=	22.15 (76)
East	0.9x	1	x	0.58	x	94.68	x	0.45	x	1.11	=	19.03 (76)
East	0.9x	1	x	0.58	x	73.59	x	0.45	x	1.11	=	14.79 (76)
East	0.9x	1	x	0.58	x	45.59	x	0.45	x	1.11	=	9.16 (76)
East	0.9x	1	x	0.58	x	24.49	x	0.45	x	1.11	=	4.92 (76)
East	0.9x	1	x	0.58	x	16.15	x	0.45	x	1.11	=	3.25 (76)
South	0.9x	0.77	x	9.87	x	46.75	x	0.45	x	1.11	=	159.89 (78)
South	0.9x	0.77	x	9.87	x	76.57	x	0.45	x	1.11	=	261.86 (78)
South	0.9x	0.77	x	9.87	x	97.53	x	0.45	x	1.11	=	333.56 (78)
South	0.9x	0.77	x	9.87	x	110.23	x	0.45	x	1.11	=	377 (78)
South	0.9x	0.77	x	9.87	x	114.87	x	0.45	x	1.11	=	392.85 (78)
South	0.9x	0.77	x	9.87	x	110.55	x	0.45	x	1.11	=	378.07 (78)
South	0.9x	0.77	x	9.87	x	108.01	x	0.45	x	1.11	=	369.4 (78)
South	0.9x	0.77	x	9.87	x	104.89	x	0.45	x	1.11	=	358.73 (78)
South	0.9x	0.77	x	9.87	x	101.89	x	0.45	x	1.11	=	348.44 (78)
South	0.9x	0.77	x	9.87	x	82.59	x	0.45	x	1.11	=	282.44 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	9.87	x	55.42	x	0.45	x	1.11	=	189.52	(78)
South	0.9x	0.77	x	9.87	x	40.4	x	0.45	x	1.11	=	138.16	(78)
West	0.9x	0.77	x	1.24	x	19.64	x	0.45	x	1.11	=	8.44	(80)
West	0.9x	0.77	x	1.24	x	38.42	x	0.45	x	1.11	=	16.51	(80)
West	0.9x	0.77	x	1.24	x	63.27	x	0.45	x	1.11	=	27.19	(80)
West	0.9x	0.77	x	1.24	x	92.28	x	0.45	x	1.11	=	39.65	(80)
West	0.9x	0.77	x	1.24	x	113.09	x	0.45	x	1.11	=	48.59	(80)
West	0.9x	0.77	x	1.24	x	115.77	x	0.45	x	1.11	=	49.74	(80)
West	0.9x	0.77	x	1.24	x	110.22	x	0.45	x	1.11	=	47.36	(80)
West	0.9x	0.77	x	1.24	x	94.68	x	0.45	x	1.11	=	40.68	(80)
West	0.9x	0.77	x	1.24	x	73.59	x	0.45	x	1.11	=	31.62	(80)
West	0.9x	0.77	x	1.24	x	45.59	x	0.45	x	1.11	=	19.59	(80)
West	0.9x	0.77	x	1.24	x	24.49	x	0.45	x	1.11	=	10.52	(80)
West	0.9x	0.77	x	1.24	x	16.15	x	0.45	x	1.11	=	6.94	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	253.26	440.85	636.45	857.61	1033.21	1060.25	1007.64	869.66	711.04	495.42	304.87	215.86	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	797.85	983.17	1160.68	1352.24	1497.01	1494.9	1423.7	1292.33	1149.21	963.42	807.23	744.72	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.8	0.65	0.5	0.56	0.79	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.11	19.37	19.76	20.23	20.64	20.88	20.96	20.94	20.75	20.21	19.56	19.06	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.96	19.96	19.96	19.96	19.96	19.96	19.96	19.96	19.96	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.89	0.75	0.57	0.39	0.45	0.72	0.92	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.43	17.81	18.36	19.03	19.58	19.86	19.94	19.93	19.73	19.01	18.08	17.35	(90)
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fLA = Living area ÷ (4) =

0.14 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.66	18.03	18.56	19.2	19.73	20.01	20.08	20.07	19.87	19.18	18.29	17.59	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.51	17.88	18.41	19.05	19.58	19.86	19.93	19.92	19.72	19.03	18.14	17.44	(93)
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8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.93	0.86	0.74	0.56	0.39	0.45	0.7	0.9	0.97	0.99	(94)
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DER WorkSheet: New dwelling design stage

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	783.96	950.14	1084.13	1166.8	1100.5	832.57	557.34	580.27	809.04	869.62	782.69	734.22	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m - (96)m)]

(97)m=	2275.19	2226.34	2042.96	1741.58	1351.63	901.66	572.04	604.02	964.32	1446.09	1893.98	2271.68	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m

(98)m=	1109.48	857.6	713.37	413.84	186.84	0	0	0	0	428.89	800.13	1143.87	(98)
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Total per year (kWh/year) = Sum(98)_{1..12} = 5654.02 (98)

Space heating requirement in kWh/m²/year

37.79 (99)

9. Energy requirements: individual heating systems (including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 - (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) x [1 - (203)] =

1 (204)

Efficiency of main space heating system 1

90.6 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

1109.48	857.6	713.37	413.84	186.84	0	0	0	0	428.89	800.13	1143.87
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(211)m = [(98)m x (204)] x 100 ÷ (206)

(211)

1224.59	946.58	787.38	456.78	206.22	0	0	0	0	473.39	883.15	1262.55
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Total (kWh/year) = Sum(211)_{1..12} = 6240.64 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0
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Total (kWh/year) = Sum(215)_{1..12} = 0 (215)

Water heating

Output from water heater (calculated above)

216.14	190.38	199.62	178.52	174.63	155.58	148.99	164.08	163.98	185.13	196.3	210.8
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Efficiency of water heater

79.9 (216)

(217)m=	88.66	88.45	88.02	87.09	85.09	79.9	79.9	79.9	79.9	87.08	88.27	88.75	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	243.78	215.24	226.79	204.99	205.21	194.72	186.47	205.36	205.23	212.59	222.39	237.52
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Total = Sum(219a)_{1..12} = 2560.3 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

6240.64

Water heating fuel used

2560.3

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

110.4 (230a)

DER WorkSheet: New dwelling design stage

central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	185.4	(231)
Electricity for lighting		503.92	(232)

12a CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	1347.98 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	553.02 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1901 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	96.22 (267)
Electricity for lighting	(232) x	0.519	=	261.53 (268)
Total CO2, kg/year		sum of (265)...(271) =		2258.76 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.1 (273)
El rating (section 14)				84 (274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.16
Printed on 13 March 2019 at 10:35:20

Project Information:

Assessed By: Matt Fitzpatrick (STRO003572)

Building Type: Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 126.62m²

Site Reference : Walberton

Plot Reference: HT PEMBROOK

Address : HT PEMBROOK, Avisford Grange, Walberton, West Sussex, TBC

Client Details:

Name: Linden Homes Southern

Address : 1A Guildford Business Park , Guildford, Surrey, GU2 8XG

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 16.63 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.67 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 46.0 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.21 (max. 0.30)	0.21 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 4.70 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main Heating system: Database: (rev 440, product index 018042):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC HEAT
Model qualifier: H18
(Regular)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.40 kWh/day	
	Permitted by DBSCG: 2.10 kWh/day	OK
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power:	0.19 0.18	
Maximum	0.7	OK

9 Summer time temperature

Overheating risk (South East England):	Slight	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North	8.24m ²	
Windows facing: East	0.61m ²	
Windows facing: West	0.61m ²	
Windows facing: South	8.61m ²	
Ventilation rate:	4.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Thermal bridging	0.032 W/m ² K
Roofs U-value	0.1 W/m ² K

SAP Input

Property Details: HT PEMBROOK

Address: HT PEMBROOK, Avisford Grange, Walberton, West Sussex, TBC
Located in: England
Region: South East England
UPRN:
Date of assessment: 13 March 2019
Date of certificate: 13 March 2019
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Calculated 164.03
Water use <= 125 litres/ person/ day: True
PCDF Version: 440

Property description:

Dwelling type: House
Detachment: Detached
Year Completed: 2018
Floor Location: **Floor area:** **Storey height:**
 Floor 0 63.88 m² 2.4 m
 Floor 1 62.74 m² 2.7 m
Living area: 17.12 m² (fraction 0.135)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door 1	Manufacturer	Solid			PVC-U
Utility	Manufacturer	Solid			PVC-U
1	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
2	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
3	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
4	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door 1	mm	0.7	0.63	1.4	2.15	1
Utility	mm	0.7	0.63	1.4	2.15	1
1	16mm or more	0	0.45	1.4	8.24	1
2	16mm or more	0	0.45	1.4	0.61	1
3	16mm or more	0	0.45	1.4	0.61	1
4	16mm or more	0	0.45	1.4	8.61	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door 1		Brick	North	0	0
Utility		Brick	North	0	0
1		Brick	North	0	0
2		Brick	East	0	0
3		Brick	West	0	0
4		Brick	South	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Brick	164.5	22.37	142.13	0.21	0	False	60

SAP Input

Cold Roof	62.74	0	62.74	0.1	0	9
Bay Roof	1.14	0	1.14	0.11	0	9
Suspended	63.88			0.13		75

Internal Elements

Metal Stud	226.99					9
Block Wall	41.85					75
Int ceiling	62.74					9
Int floor	62.74					18

Party Elements

Thermal bridges

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0325				
	Length	Psi-value			
	15.96	0.05	E2	Other lintels (including other steel lintels)	
	12.41	0.034	E3	Sill	
	39	0.04	E4	Jamb	
	32.89	0.06	E5	Ground floor (normal)	
	0	0.07	E19	Ground floor (inverted)	
	0	0.32	E20	Exposed floor (normal)	
	0	0.32	E21	Exposed floor (inverted)	
	0	0.07	E22	Basement floor	
	31.69	0	E6	Intermediate floor within a dwelling	
	0	0	E7	Party floor between dwellings (in blocks of flats)	
	0	0	E8	Balcony within a dwelling, wall insulation continuous	
	0	0.04	E9	Balcony between dwellings, wall insulation continuous	
	0	1	E23	Balcony within or between dwellings, balcony support penetrates wall	
[Approved]	16.18	0.06	E10	Eaves (insulation at ceiling level)	
	0	0.24	E24	Eaves (insulation at ceiling level - inverted)	
	0	0.037	E11	Eaves (insulation at rafter level)	
	15.51	0.069	E12	Gable (insulation at ceiling level)	
	0	0.08	E13	Gable (insulation at rafter level)	
	0	0.08	E14	Flat roof	
	2.7	0.56	E15	Flat roof with parapet	
	20.4	0.058	E16	Corner (normal)	
	0	-0.069	E17	Corner (inverted – internal area greater than external area)	
	0	0.04	E18	Party wall between dwellings	
	0	0.12	E25	Staggered party wall between dwellings c	
	0	0.049	P1	Ground floor	
	0	0	P2	Intermediate floor within a dwelling	
	0	0.065	P4	Roof (insulation at ceiling level)	

Ventilation

Pressure test:	Yes (As designed)
Ventilation:	Decentralised whole house extract
	Number of fans in Wetroom: Kitchen 1 Other 4
	Ductwork: ,
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	4.7

Main heating system

Main heating system:	Boiler systems with radiators or underfloor heating
	Gas boilers and oil boilers
	Fuel: mains gas
	Info Source: Boiler Database

SAP Input

Database: (rev 440, product index 018042) Efficiency: Winter 79.9 % Summer: 90.6
Brand name: Ideal
Model: LOGIC HEAT
Model qualifier: H18
(Regular boiler)
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature > 45°C
Boiler interlock: Yes
Delayed start

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 180 litres
Cylinder insulation: Measured loss, 1.4kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.16

Property Address: HT PEMBROOK

Address : HT PEMBROOK, Avisford Grange, Walberton, West Sussex, TBC

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	63.88	(1a) x	2.4	(2a) =	153.31 (3a)
First floor	62.74	(1b) x	2.7	(2b) =	169.4 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	126.62	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			322.71 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.69999980926514 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.23 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.2 (21)
Infiltration rate modified for monthly wind speed			

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(25)
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------

3. Thermal losses and heat loss parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors Type 1			2.15	1.4	3.01		(26)
Doors Type 2			2.15	1.4	3.01		(26)
Windows Type 1			8.24	$\times 1/[1/(1.4) + 0.04]$	10.92		(27)
Windows Type 2			0.61	$\times 1/[1/(1.4) + 0.04]$	0.81		(27)
Windows Type 3			0.61	$\times 1/[1/(1.4) + 0.04]$	0.81		(27)
Windows Type 4			8.61	$\times 1/[1/(1.4) + 0.04]$	11.41		(27)
Floor			63.88	0.13	8.304399	75	4791 (28)
Walls	164.5	22.37	142.13	0.21	29.85	60	8527.8 (29)
Roof Type1	62.74	0	62.74	0.1	6.27	9	564.66 (30)
Roof Type2	1.14	0	1.14	0.11	0.13	9	10.26 (30)
Total area of elements, m ²			292.26				(31)
Internal wall **			226.99			9	2042.91 (32c)
Internal wall **			41.85			75	3138.75 (32c)
Internal floor			62.74			18	1129.32 (32c)
Internal ceiling			62.74			9	564.66 (32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 74.53 (33)

DER WorkSheet: New dwelling design stage

Heat capacity $C_m = S(A \times k)$

$$\{(28)\dots(30) + (32) + (32a)\dots(32e) = 20769.36 \quad (34)$$

Thermal mass parameter (TMP = $C_m \div TFA$) in $\text{kJ/m}^2\text{K}$

$$= (34) \div (4) = 164.03 \quad (35)$$

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : $S (L \times Y)$ calculated using Appendix K

$$9.49 \quad (36)$$

if details of thermal bridging are not known $(36) = 0.15 \times (31)$

Total fabric heat loss

$$(33) + (36) = 84.02 \quad (37)$$

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(38)m =$	53.75	53.25	53.25	53.25	53.25	53.25	53.25	53.25	53.25	53.25	53.25	53.25	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(39)m =$	137.76	137.26	137.26	137.26	137.26	137.26	137.26	137.26	137.26	137.26	137.26	137.26	
Average = $\text{Sum}(39)_{1..12} / 12 =$												137.31	(39)

Heat loss parameter (HLP), W/m^2K

$$(40)m = (39)m \div (4)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(40)m =$	1.09	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	
Average = $\text{Sum}(40)_{1..12} / 12 =$												1.08	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(41)m =$	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

$$\text{if } TFA > 13.9, N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9) \quad (42)$$

$$\text{if } TFA \leq 13.9, N = 1$$

Annual average hot water usage in litres per day $V_{d, \text{average}} = (25 \times N) + 36$

$$102.73 \quad (43)$$

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(44)m =$	113.01	108.9	104.79	100.68	96.57	92.46	92.46	96.57	100.68	104.79	108.9	113.01	
Total = $\text{Sum}(44)_{1..12} =$												1232.81	(44)

Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(45)m =$	167.59	146.57	151.25	131.86	126.53	109.18	101.17	116.1	117.48	136.92	149.46	162.3	
Total = $\text{Sum}(45)_{1..12} =$												1616.41	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
$(46)m =$	25.14	21.99	22.69	19.78	18.98	16.38	15.18	17.41	17.62	20.54	22.42	24.34	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

$$180 \quad (47)$$

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

$$1.4 \quad (48)$$

Temperature factor from Table 2b

$$0.54 \quad (49)$$

Energy lost from water storage, kWh/year

$$(48) \times (49) = 0.76 \quad (50)$$

b) If manufacturer's declared cylinder loss factor is not known:

DER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)																								
If community heating see section 4.3																										
Volume factor from Table 2a	0	(52)																								
Temperature factor from Table 2b	0	(53)																								
Energy lost from water storage, kWh/year	(47) × (51) × (52) × (53) = 0	(54)																								
Enter (50) or (54) in (55)	0.76	(55)																								
Water storage loss calculated for each month	((56)m = (55) × (41)m																									
(56)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>23.44</td><td>21.17</td><td>23.44</td><td>22.68</td><td>23.44</td><td>22.68</td><td>23.44</td><td>23.44</td><td>22.68</td><td>23.44</td><td>22.68</td><td>23.44</td> </tr> </table>	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(56)												
23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44															
If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H																										
(57)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>23.44</td><td>21.17</td><td>23.44</td><td>22.68</td><td>23.44</td><td>22.68</td><td>23.44</td><td>23.44</td><td>22.68</td><td>23.44</td><td>22.68</td><td>23.44</td> </tr> </table>	23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44	(57)												
23.44	21.17	23.44	22.68	23.44	22.68	23.44	23.44	22.68	23.44	22.68	23.44															
Primary circuit loss (annual) from Table 3	0	(58)																								
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m																										
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)																										
(59)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>23.26</td><td>21.01</td><td>23.26</td><td>22.51</td><td>23.26</td><td>22.51</td><td>23.26</td><td>23.26</td><td>22.51</td><td>23.26</td><td>22.51</td><td>23.26</td> </tr> </table>	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26															
Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m																										
(61)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	0	0	0	0	0	0	0	0	0	0	0	(61)												
0	0	0	0	0	0	0	0	0	0	0	0															
Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m																										
(62)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>214.29</td><td>188.75</td><td>197.95</td><td>177.06</td><td>173.22</td><td>154.37</td><td>147.87</td><td>162.8</td><td>162.68</td><td>183.62</td><td>194.65</td><td>209</td> </tr> </table>	214.29	188.75	197.95	177.06	173.22	154.37	147.87	162.8	162.68	183.62	194.65	209	(62)												
214.29	188.75	197.95	177.06	173.22	154.37	147.87	162.8	162.68	183.62	194.65	209															
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)																										
(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)																										
(63)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	0	0	0	0	0	0	0	0	0	0	0	(63)												
0	0	0	0	0	0	0	0	0	0	0	0															
Output from water heater																										
(64)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>214.29</td><td>188.75</td><td>197.95</td><td>177.06</td><td>173.22</td><td>154.37</td><td>147.87</td><td>162.8</td><td>162.68</td><td>183.62</td><td>194.65</td><td>209</td> </tr> </table>	214.29	188.75	197.95	177.06	173.22	154.37	147.87	162.8	162.68	183.62	194.65	209													
214.29	188.75	197.95	177.06	173.22	154.37	147.87	162.8	162.68	183.62	194.65	209															
Output from water heater (annual):...12											2166.25	(64)														
Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]																										
(65)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>93.08</td><td>82.48</td><td>87.65</td><td>80</td><td>79.43</td><td>72.46</td><td>71</td><td>75.96</td><td>75.22</td><td>82.88</td><td>85.85</td><td>91.32</td> </tr> </table>	93.08	82.48	87.65	80	79.43	72.46	71	75.96	75.22	82.88	85.85	91.32	(65)												
93.08	82.48	87.65	80	79.43	72.46	71	75.96	75.22	82.88	85.85	91.32															
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating																										
5. Internal gains (see Table 5 and 5a)																										
Metabolic gains (Table 5), Watts																										
(66)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th> </tr> <tr> <td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td><td>144.28</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	(66)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec															
144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28	144.28															
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5																										
(67)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>27.96</td><td>24.84</td><td>20.2</td><td>15.29</td><td>11.43</td><td>9.65</td><td>10.43</td><td>13.55</td><td>18.19</td><td>23.1</td><td>26.96</td><td>28.74</td> </tr> </table>	27.96	24.84	20.2	15.29	11.43	9.65	10.43	13.55	18.19	23.1	26.96	28.74	(67)												
27.96	24.84	20.2	15.29	11.43	9.65	10.43	13.55	18.19	23.1	26.96	28.74															
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5																										
(68)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>293.6</td><td>296.65</td><td>288.97</td><td>272.62</td><td>251.99</td><td>232.6</td><td>219.65</td><td>216.6</td><td>224.28</td><td>240.62</td><td>261.25</td><td>280.64</td> </tr> </table>	293.6	296.65	288.97	272.62	251.99	232.6	219.65	216.6	224.28	240.62	261.25	280.64	(68)												
293.6	296.65	288.97	272.62	251.99	232.6	219.65	216.6	224.28	240.62	261.25	280.64															
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5																										
(69)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td><td>37.43</td> </tr> </table>	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	(69)												
37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43															
Pumps and fans gains (Table 5a)																										
(70)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td> </tr> </table>	3	3	3	3	3	3	3	3	3	3	3	3	(70)												
3	3	3	3	3	3	3	3	3	3	3	3															
Losses e.g. evaporation (negative values) (Table 5)																										
(71)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td><td>-115.43</td> </tr> </table>	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	(71)												
-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43	-115.43															
Water heating gains (Table 5)																										
(72)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>125.11</td><td>122.74</td><td>117.81</td><td>111.11</td><td>106.76</td><td>100.63</td><td>95.43</td><td>102.1</td><td>104.47</td><td>111.4</td><td>119.23</td><td>122.75</td> </tr> </table>	125.11	122.74	117.81	111.11	106.76	100.63	95.43	102.1	104.47	111.4	119.23	122.75	(72)												
125.11	122.74	117.81	111.11	106.76	100.63	95.43	102.1	104.47	111.4	119.23	122.75															

DER WorkSheet: New dwelling design stage

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	515.96	513.5	496.26	468.31	439.47	412.17	394.79	401.54	416.22	444.41	476.73	501.42	(73)
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6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b	FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.24	x	10.63	x	0.45	x	1.11	=	30.36 (74)
North	0.9x	0.77	x	8.24	x	20.32	x	0.45	x	1.11	=	58.02 (74)
North	0.9x	0.77	x	8.24	x	34.53	x	0.45	x	1.11	=	98.59 (74)
North	0.9x	0.77	x	8.24	x	55.46	x	0.45	x	1.11	=	158.36 (74)
North	0.9x	0.77	x	8.24	x	74.72	x	0.45	x	1.11	=	213.33 (74)
North	0.9x	0.77	x	8.24	x	79.99	x	0.45	x	1.11	=	228.37 (74)
North	0.9x	0.77	x	8.24	x	74.68	x	0.45	x	1.11	=	213.21 (74)
North	0.9x	0.77	x	8.24	x	59.25	x	0.45	x	1.11	=	169.16 (74)
North	0.9x	0.77	x	8.24	x	41.52	x	0.45	x	1.11	=	118.54 (74)
North	0.9x	0.77	x	8.24	x	24.19	x	0.45	x	1.11	=	69.06 (74)
North	0.9x	0.77	x	8.24	x	13.12	x	0.45	x	1.11	=	37.45 (74)
North	0.9x	0.77	x	8.24	x	8.86	x	0.45	x	1.11	=	25.31 (74)
East	0.9x	1	x	0.61	x	19.64	x	0.45	x	1.11	=	4.15 (76)
East	0.9x	1	x	0.61	x	38.42	x	0.45	x	1.11	=	8.12 (76)
East	0.9x	1	x	0.61	x	63.27	x	0.45	x	1.11	=	13.37 (76)
East	0.9x	1	x	0.61	x	92.28	x	0.45	x	1.11	=	19.5 (76)
East	0.9x	1	x	0.61	x	113.09	x	0.45	x	1.11	=	23.9 (76)
East	0.9x	1	x	0.61	x	115.77	x	0.45	x	1.11	=	24.47 (76)
East	0.9x	1	x	0.61	x	110.22	x	0.45	x	1.11	=	23.3 (76)
East	0.9x	1	x	0.61	x	94.68	x	0.45	x	1.11	=	20.01 (76)
East	0.9x	1	x	0.61	x	73.59	x	0.45	x	1.11	=	15.55 (76)
East	0.9x	1	x	0.61	x	45.59	x	0.45	x	1.11	=	9.64 (76)
East	0.9x	1	x	0.61	x	24.49	x	0.45	x	1.11	=	5.18 (76)
East	0.9x	1	x	0.61	x	16.15	x	0.45	x	1.11	=	3.41 (76)
South	0.9x	0.77	x	8.61	x	46.75	x	0.45	x	1.11	=	139.48 (78)
South	0.9x	0.77	x	8.61	x	76.57	x	0.45	x	1.11	=	228.43 (78)
South	0.9x	0.77	x	8.61	x	97.53	x	0.45	x	1.11	=	290.98 (78)
South	0.9x	0.77	x	8.61	x	110.23	x	0.45	x	1.11	=	328.87 (78)
South	0.9x	0.77	x	8.61	x	114.87	x	0.45	x	1.11	=	342.7 (78)
South	0.9x	0.77	x	8.61	x	110.55	x	0.45	x	1.11	=	329.8 (78)
South	0.9x	0.77	x	8.61	x	108.01	x	0.45	x	1.11	=	322.24 (78)
South	0.9x	0.77	x	8.61	x	104.89	x	0.45	x	1.11	=	312.94 (78)
South	0.9x	0.77	x	8.61	x	101.89	x	0.45	x	1.11	=	303.96 (78)
South	0.9x	0.77	x	8.61	x	82.59	x	0.45	x	1.11	=	246.38 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	8.61	x	55.42	x	0.45	x	1.11	=	165.33	(78)
South	0.9x	0.77	x	8.61	x	40.4	x	0.45	x	1.11	=	120.52	(78)
West	0.9x	0.77	x	0.61	x	19.64	x	0.45	x	1.11	=	4.15	(80)
West	0.9x	0.77	x	0.61	x	38.42	x	0.45	x	1.11	=	8.12	(80)
West	0.9x	0.77	x	0.61	x	63.27	x	0.45	x	1.11	=	13.37	(80)
West	0.9x	0.77	x	0.61	x	92.28	x	0.45	x	1.11	=	19.5	(80)
West	0.9x	0.77	x	0.61	x	113.09	x	0.45	x	1.11	=	23.9	(80)
West	0.9x	0.77	x	0.61	x	115.77	x	0.45	x	1.11	=	24.47	(80)
West	0.9x	0.77	x	0.61	x	110.22	x	0.45	x	1.11	=	23.3	(80)
West	0.9x	0.77	x	0.61	x	94.68	x	0.45	x	1.11	=	20.01	(80)
West	0.9x	0.77	x	0.61	x	73.59	x	0.45	x	1.11	=	15.55	(80)
West	0.9x	0.77	x	0.61	x	45.59	x	0.45	x	1.11	=	9.64	(80)
West	0.9x	0.77	x	0.61	x	24.49	x	0.45	x	1.11	=	5.18	(80)
West	0.9x	0.77	x	0.61	x	16.15	x	0.45	x	1.11	=	3.41	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	178.14	302.69	416.32	526.24	603.84	607.12	582.05	522.12	453.61	334.72	213.13	152.66	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	694.1	816.2	912.58	994.55	1043.3	1019.29	976.83	923.66	869.83	779.13	689.87	654.08	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.86	0.73	0.58	0.62	0.82	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.33	19.54	19.86	20.25	20.61	20.86	20.96	20.94	20.76	20.29	19.73	19.28	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.92	0.83	0.65	0.46	0.51	0.76	0.94	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.77	18.08	18.54	19.09	19.59	19.9	19.99	19.98	19.79	19.16	18.35	17.71	(90)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.14 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.98	18.28	18.71	19.25	19.73	20.03	20.12	20.11	19.92	19.31	18.54	17.92	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.83	18.13	18.56	19.1	19.58	19.88	19.97	19.96	19.77	19.16	18.39	17.77	(93)
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8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.95	0.9	0.81	0.64	0.46	0.51	0.75	0.92	0.97	0.99	(94)
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DER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	683.73	794.25	867.48	897.14	840.56	653.35	448.13	467.14	648.66	715.25	671.85	646.08	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1864.45	1816.09	1655.95	1399.57	1081.31	724.28	462.75	488.59	778.47	1175.4	1549.64	1862.6	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	878.46	686.68	586.62	361.75	179.11	0	0	0	0	342.36	632.01	905.09	(98)
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Total per year (kWh/year) = Sum(98)_{1..12} = 4572.08 (98)

Space heating requirement in kWh/m²/year

36.11 (99)

Space heating requirements, individual heating systems, including micro CHP:

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) x [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

90.6 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

878.46	686.68	586.62	361.75	179.11	0	0	0	0	342.36	632.01	905.09
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(211)m = [(98)m x (204)] x 100 ÷ (206) (211)

969.6	757.92	647.48	399.29	197.7	0	0	0	0	377.88	697.58	998.99
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Total (kWh/year) = Sum(211)_{1..12} = 5046.44 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	(215)
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Total (kWh/year) = Sum(215)_{1..12} = 0 (215)

Water heating

Output from water heater (calculated above)

214.29	188.75	197.95	177.06	173.22	154.37	147.87	162.8	162.68	183.62	194.65	209
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Efficiency of water heater

79.9 (216)

(217)m=	88.28	88.06	87.64	86.78	85	79.9	79.9	79.9	79.9	86.55	87.83	88.38	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	242.73	214.35	225.87	204.03	203.79	193.21	185.07	203.75	203.6	212.14	221.62	236.48	(219)
---------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------

Total = Sum(219a)_{1..12} = 2546.63 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

5046.44

Water heating fuel used

2546.63

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

93.61 (230a)

DER WorkSheet: New dwelling design stage

central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	168.61	(231)
Electricity for lighting		493.85	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	1090.03 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	550.07 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1640.1 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	87.51 (267)
Electricity for lighting	(232) x	0.519	=	256.31 (268)
Total CO2, kg/year		sum of (265)...(271) =		1983.92 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.67 (273)
El rating (section 14)				85 (274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.16
Printed on 13 March 2019 at 10:35:12

Project Information:

Assessed By: Matt Fitzpatrick (STRO003572) **Building Type:** Semi-detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 79.76m²

Site Reference : Walberton

Plot Reference: WALBERTON

Address : WALBERTON, Avisford Grange, Walberton, West Sussex, TBC

Client Details:

Name: Linden Homes Southern

Address : 1A Guildford Business Park , Guildford, Surrey, GU2 8XG

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 18.03 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.62 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 39.4 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.21 (max. 0.30)	0.21 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 4.70 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main Heating system: Database: (rev 440, product index 017929):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 35
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.40 kWh/day	
	Permitted by DBSCG: 2.10 kWh/day	OK
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power:	0.19 0.18	
Maximum	0.7	OK

9 Summer time temperature

Overheating risk (South East England):	Slight	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North	3.78m ²	
Windows facing: South	5.55m ²	
Ventilation rate:	4.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Thermal bridging	0.025 W/m ² K
Roofs U-value	0.1 W/m ² K
Party Walls U-value	0 W/m ² K

SAP Input

Property Details: WALBERTON

Address: WALBERTON, Avisford Grange, Walberton, West Sussex, TBC
Located in: England
Region: South East England
UPRN:
Date of assessment: 13 March 2019
Date of certificate: 13 March 2019
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Calculated 158.48
Water use <= 125 litres/ person/ day: True
PCDF Version: 440

Property description

Dwelling type: House
Detachment: Semi-detached
Year Completed: 2018
Floor Location: **Floor area:** **Storey height:**
 Floor 0 39.88 m² 2.4 m
 Floor 1 39.88 m² 2.7 m
Living area: 12.62 m² (fraction 0.158)
Front of dwelling faces: North

Opening types

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door 1	Manufacturer	Solid			PVC-U
1	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	
2	BFRC	Windows	low-E, En = 0.1, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door 1	mm	0.7	0.63	1.4	2.15	1
1	16mm or more	0	0.45	1.4	3.78	1
2	16mm or more	0	0.45	1.4	5.55	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door 1		Brick	North	0	0
1		Brick	North	0	0
2		Brick	South	0	0

Overshading: Average or unknown

Opaque Elements

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Brick	91.18	11.48	79.7	0.21	0	False	60
Cold Roof	39.98	0	39.98	0.1	0		9
Suspended	39.88			0.13			75
Internal Elements							
Metal Stud	163.42						9
Int ceiling	39.88						9
Int floor	39.88						18
Party Elements							
Party wall	43.56						45

SAP Input

Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0253			
	Length	Psi-value		
	7.63	0.05	E2	Other lintels (including other steel lintels)
	5.11	0.034	E3	Sill
	18	0.04	E4	Jamb
	17.88	0.06	E5	Ground floor (normal)
	0	0.07	E19	Ground floor (inverted)
	0	0.32	E20	Exposed floor (normal)
	0	0.32	E21	Exposed floor (inverted)
	0	0.07	E22	Basement floor
	17.88	0	E6	Intermediate floor within a dwelling
	0	0	E7	Party floor between dwellings (in blocks of flats)
	0	0	E8	Balcony within a dwelling, wall insulation continuous
	0	0.04	E9	Balcony between dwellings, wall insulation continuous
	0	1	E23	Balcony within or between dwellings, balcony support penetrates wall
[Approved]	0	0.06	E10	Eaves (insulation at ceiling level)
	0	0.24	E24	Eaves (insulation at ceiling level - inverted)
	0	0.037	E11	Eaves (insulation at rafter level)
	0	0.069	E12	Gable (insulation at ceiling level)
	0	0.08	E13	Gable (insulation at rafter level)
	0	0.08	E14	Flat roof
	0	0.56	E15	Flat roof with parapet
	10.2	0.058	E16	Corner (normal)
	0	-0.069	E17	Corner (inverted – internal area greater than external area)
	10.2	0.04	E18	Party wall between dwellings
	0	0.12	E25	Staggered party wall between dwellings c
	8.54	0.049	P1	Ground floor
	8.54	0	P2	Intermediate floor within a dwelling
	8.54	0.065	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Decentralised whole house extract
	Number of fans in Wetroom: Kitchen 1 Other 3
	Ductwork: ,
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	4.7

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating
	Gas boilers and oil boilers
	Fuel: mains gas
	Info Source: Boiler Database
	Database: (rev 440, product index 017929) Efficiency: Winter 87.3 % Summer: 90.5
	Brand name: Ideal
	Model: LOGIC COMBI
	Model qualifier: ESP1 35
	(Combi boiler)
	Systems with radiators
	Central heating pump : 2013 or later
	Design flow temperature: Design flow temperature > 45°C

SAP Input

Boiler interlock: Yes
Delayed start

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 180 litres
Cylinder insulation: Measured loss, 1.4kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.16

Property Address: WALBERTON

Address : WALBERTON, Avisford Grange, Walberton, West Sussex, TBC

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	39.88 (1a)	x	2.4 (2a)	=	95.71 (3a)
First floor	39.88 (1b)	x	2.7 (2b)	=	107.68 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	79.76 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.39 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.69999980926514 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.23 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.2 (21)
Infiltration rate modified for monthly wind speed			

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.15	1.4	3.01		(26)
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04]$	5.01		(27)
Windows Type 2			5.55	$\times 1/[1/(1.4) + 0.04]$	7.36		(27)
Floor			39.88	0.13	5.1844	75	2991 (28)
Walls	91.18	11.48	79.7	0.21	16.74	60	4782 (29)
Roof	39.98	0	39.98	0.1	4	9	359.82 (30)
Total area of elements, m ²			171.04				(31)
Party wall			43.56	0	0	45	1960.2 (32)
Internal wall **			163.42			9	1470.78 (32c)
Internal floor			39.88			18	717.84 (32d)
Internal ceiling			39.88			9	358.92 (32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 41.3 (33)

Heat capacity Cm = S(A x k) ((23) ... (30) + (32) + (32a) ... (32e) = 12640.56 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 158.48 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

DER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K

4.32 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss

(33) + (36) =

45.62 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	33.87	33.56	33.56	33.56	33.56	33.56	33.56	33.56	33.56	33.56	33.56	33.56

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

(39)m=	79.49	79.18	79.18	79.18	79.18	79.18	79.18	79.18	79.18	79.18	79.18	79.18
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39)_{1...12} / 12 =

79.21 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
--------	---	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} / 12 =

0.99 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

2.46

(42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

92.58

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	101.84	98.14	94.44	90.73	87.03	83.33	83.33	87.03	90.73	94.44	98.14	101.84
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------

Total = Sum(44)_{1...12} =

1111.01 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	151.03	132.09	136.31	118.84	114.03	98.4	91.18	104.63	105.88	123.39	134.69	146.26
--------	--------	--------	--------	--------	--------	------	-------	--------	--------	--------	--------	--------

Total = Sum(45)_{1...12} =

1456.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.65	19.81	20.45	17.83	17.1	14.76	13.68	15.69	15.88	18.51	20.2	21.94
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year $\{47\} \times \{51\} \times \{52\} \times \{53\} =$

0
0

 (54)

Enter (50) or (54) in (55)

0

 (55)

Water storage loss calculated for each month $\{56\}m = \{55\} \times \{41\}m$

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (56)

If cylinder contains dedicated solar storage, $\{57\}m = \{56\}m \times [\{50\} - (H11)] \div \{50\}$, else $\{57\}m = \{56\}m$ where (H11) is from Appendix H

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (57)

Primary circuit loss (annual) from Table 3

0

 (58)

Primary circuit loss calculated for each month $\{59\}m = \{58\} \div 365 \times \{41\}m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (59)

Combi loss calculated for each month $\{61\}m = \{60\} \div 365 \times \{41\}m$

(61)m=

14.12	12.74	14.07	13.57	13.99	13.51	13.94	13.98	13.54	14.04	13.63	14.11
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 (61)

Total heat required for water heating calculated for each month $\{62\}m = 0.85 \times \{45\}m + \{46\}m + \{57\}m + \{59\}m + \{61\}m$

(62)m=

165.15	144.83	150.37	132.41	128.02	111.91	105.12	118.6	119.42	137.43	148.32	160.37
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

165.15	144.83	150.37	132.41	128.02	111.91	105.12	118.6	119.42	137.43	148.32	160.37
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Output from water heater (annual) $\times 12$

1621.94

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times \{45\}m + \{61\}m] + 0.8 \times [\{46\}m + \{57\}m + \{59\}m]$

(65)m=

53.75	47.1	48.84	42.91	41.41	36.09	33.8	38.28	38.59	44.54	48.19	52.16
-------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
122.91	122.91	122.91	122.91	122.91	122.91	122.91	122.91	122.91	122.91	122.91	122.91

 (66)

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

(67)m=

21.79	19.35	15.74	11.91	8.91	7.52	8.12	10.56	14.17	18	21.01	22.39
-------	-------	-------	-------	------	------	------	-------	-------	----	-------	-------

 (67)

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

(68)m=

218.94	221.21	215.49	203.3	187.91	173.45	163.79	161.52	167.24	179.43	194.82	209.28
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 (68)

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

(69)m=

35.29	35.29	35.29	35.29	35.29	35.29	35.29	35.29	35.29	35.29	35.29	35.29
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
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 (70)

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

(71)m=

-98.33	-98.33	-98.33	-98.33	-98.33	-98.33	-98.33	-98.33	-98.33	-98.33	-98.33	-98.33
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

72.24	70.1	65.64	59.59	55.66	50.13	45.43	51.46	53.6	59.86	66.93	70.11
-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

 (72)

Total internal gains = $\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$

(73)m=

375.84	373.53	359.74	337.68	315.35	293.98	280.22	286.41	297.89	320.17	345.63	364.65
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 (73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b			FF Table 6c			Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.45	x	1.11	=	13.93	(74)		
North	0.9x	0.77	x	3.78	x	20.32	x	0.45	x	1.11	=	26.62	(74)		
North	0.9x	0.77	x	3.78	x	34.53	x	0.45	x	1.11	=	45.23	(74)		
North	0.9x	0.77	x	3.78	x	55.46	x	0.45	x	1.11	=	72.65	(74)		
North	0.9x	0.77	x	3.78	x	74.72	x	0.45	x	1.11	=	97.86	(74)		
North	0.9x	0.77	x	3.78	x	79.99	x	0.45	x	1.11	=	104.76	(74)		
North	0.9x	0.77	x	3.78	x	74.68	x	0.45	x	1.11	=	97.81	(74)		
North	0.9x	0.77	x	3.78	x	59.25	x	0.45	x	1.11	=	77.6	(74)		
North	0.9x	0.77	x	3.78	x	41.52	x	0.45	x	1.11	=	54.38	(74)		
North	0.9x	0.77	x	3.78	x	24.19	x	0.45	x	1.11	=	31.68	(74)		
North	0.9x	0.77	x	3.78	x	13.12	x	0.45	x	1.11	=	17.18	(74)		
North	0.9x	0.77	x	3.78	x	8.86	x	0.45	x	1.11	=	11.61	(74)		
South	0.9x	0.77	x	5.55	x	46.75	x	0.45	x	1.11	=	89.91	(78)		
South	0.9x	0.77	x	5.55	x	76.57	x	0.45	x	1.11	=	147.25	(78)		
South	0.9x	0.77	x	5.55	x	97.53	x	0.45	x	1.11	=	187.56	(78)		
South	0.9x	0.77	x	5.55	x	110.23	x	0.45	x	1.11	=	211.99	(78)		
South	0.9x	0.77	x	5.55	x	114.87	x	0.45	x	1.11	=	220.91	(78)		
South	0.9x	0.77	x	5.55	x	110.55	x	0.45	x	1.11	=	212.59	(78)		
South	0.9x	0.77	x	5.55	x	108.01	x	0.45	x	1.11	=	207.72	(78)		
South	0.9x	0.77	x	5.55	x	104.89	x	0.45	x	1.11	=	201.72	(78)		
South	0.9x	0.77	x	5.55	x	101.89	x	0.45	x	1.11	=	195.93	(78)		
South	0.9x	0.77	x	5.55	x	82.59	x	0.45	x	1.11	=	158.82	(78)		
South	0.9x	0.77	x	5.55	x	55.42	x	0.45	x	1.11	=	106.57	(78)		
South	0.9x	0.77	x	5.55	x	40.4	x	0.45	x	1.11	=	77.69	(78)		

Solar gains in watts, calculated for each month

{83}m = Sum{74}m ... {82}m

{83}m=	103.84	173.86	232.79	284.63	318.77	317.35	305.52	279.32	250.31	190.5	123.75	89.3	{83}
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Total gains – internal and solar {84}m = {73}m + {83}m , watts

{84}m=	479.68	547.39	592.53	622.31	634.12	611.33	585.75	565.73	548.2	510.67	469.38	453.95	{84}
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7. Mean internal temperature (heating season)

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

21 {85}

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
{86}m=	0.99	0.98	0.96	0.93	0.85	0.72	0.56	0.6	0.8	0.94	0.98	0.99	{86}

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

{87}m=	19.53	19.72	20	20.34	20.66	20.88	20.97	20.96	20.81	20.4	19.89	19.48	{87}
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

{88}m=	20.09	20.09	20.09	20.09	20.09	20.09	20.09	20.09	20.09	20.09	20.09	20.09	{88}
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

{89}m=	0.99	0.98	0.96	0.91	0.82	0.65	0.46	0.5	0.74	0.92	0.98	0.99	{89}
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DER WorkSheet: New dwelling design stage

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.11	18.4	18.8	19.28	19.72	19.99	20.07	20.06	19.91	19.38	18.65	18.04	(90)
fLA = Living area ÷ (4) =													(91)
											0.16		

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.34	18.61	18.99	19.45	19.87	20.13	20.21	20.2	20.05	19.54	18.84	18.27	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.19	18.46	18.84	19.3	19.72	19.98	20.06	20.05	19.9	19.39	18.69	18.12	(93)
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9. Space heating calculation

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.98	0.96	0.94	0.89	0.8	0.64	0.46	0.49	0.72	0.9	0.96	0.98	(94)
--------	------	------	------	------	-----	------	------	------	------	-----	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	469.38	528.03	557.35	555.43	506.47	388.85	266.71	278.97	396.09	459.72	452.63	445.87	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m – (96)m)]

(97)m=	1103.76	1073.51	977.08	823.49	634.86	425.97	274.11	289.29	459.54	695.84	917.95	1102.18	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	471.98	366.56	312.28	193	95.52	0	0	0	0	175.67	335.03	488.29	
Total per year (kWh/year) = Sum(98) _{1...12} =													(98)
											2438.34		

Space heating requirement in kWh/m²/year

30.57 (99)

9a. Energy requirements for individual heating systems including micro-CHP

Space heating:

Space heating:			
Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	$\{202\} = 1 - \{201\} =$	1	(202)
Fraction of total heating from main system 1	$\{204\} = \{202\} \times [1 - \{203\}] =$	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

471.98	366.56	312.28	193	95.52	0	0	0	0	175.67	335.03	488.29
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(211)m = {[(98)m x (204)]} x 100 ÷ (206) (211)

521.53	405.04	345.06	213.26	105.54	0	0	0	0	194.12	370.2	539.55
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Total (kWh/year) = Sum(211)_{1...12} = 2694.3 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)]} x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) = Sum(215) _{1...12} =													(215)
											0		

Water heating

Output from water heater (calculated above)

165.15	144.83	150.37	132.41	128.02	111.91	105.12	118.6	119.42	137.43	148.32	160.37
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Efficiency of water heater 87.3 (216)

DER WorkSheet: New dwelling design stage

{217)m=	89.65	89.57	89.43	89.17	88.64	87.3	87.3	87.3	87.3	89.07	89.49	89.69	{217}
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

{219)m=	184.22	161.69	168.14	148.49	144.43	128.18	120.41	135.86	136.79	154.3	165.73	178.81	
Total = Sum({219a}) _{i=1,12} =												1827.05	{219}

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

59.2 {230a}

central heating pump:

30 {230c}

boiler with a fan-assisted flue

45 {230e}

Total electricity for the above, kWh/year

sum of {230a}...{230g} =

134.2 {231}

Electricity for lighting

384.77 {232}

12a CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	{211} x	0.216	581.97 {261}
Space heating (secondary)	{215} x	0.519	0 {263}
Water heating	{219} x	0.216	394.64 {264}
Space and water heating	{261} + {262} + {263} + {264} =		976.61 {265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	69.65 {267}
Electricity for lighting	{232} x	0.519	199.7 {268}
Total CO2, kg/year		sum of {265}...{271} =	1245.96 {272}
Dwelling CO2 Emission Rate		{272} ÷ (4) =	15.62 {273}
El rating (section 14)			87 {274}