

Open University, 1 – 11 Hawley Crescent, Camden, NW1 8NP

Energy Strategy Report



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Executive Summary

This report details the proposed energy strategy for the proposed residential development at the Open University on Hawley Crescent.

The ground, first and second floors are B1 Commercial let to the Open University. The third and fourth floors are residential. The proposed development involves the part demolition of existing residential flats at third and fourth floor and construction of new three storey extension at third fourth and fifth to replace and extend existing residential accommodation.

The development is in the London Borough of Camden.

The proposed development addresses national planning policies on energy; in particular, mitigation of climate change and energy security through energy efficiency enhancements and use of alternative energy technologies. In order to reduce the carbon footprint of the building beyond the requirements of current regulatory and market standards, the development will benefit from the following integrated systems:

- Passive design features (Be Lean)
- Energy efficiency measures (Be Clean)
- Low and zero carbon technologies (Be Green)

The building fabric performance will meet or exceed the Part L 2013 requirements where applicable.

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy.

The development does not have much external space apart from a green roof and terrace amenity space provided on the fourth and fifth floors. The flat roof will be used to provide additional green roof and also to house 9 kWp of PV panels (roughly 28 panels). One Air Source Heat Pump will be provided per apartment to provide heating and hot water, 10 on the fourth floor terrace and 5 in the basement, and a comfort cooling will also be provided sited on the terrace.

The proposed strategy has the potential to provide a 30% improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies.

As the project is a minor development, renewable technologies have been specified to achieve a 22.8% reduction in site wide CO_2 emissions and generate 22.8% of the total energy consumption of the development.



1 Introduction

1.1 Site Analysis

Price & Myers have been commissioned by Castle Haven Row Limited to produce an Energy Strategy Report for the proposed development at the Open University, 1 – 11 Hawley Crescent on behalf of their client.

The existing building is mixed use and is currently 5 storeys with basement car parking. The ground, first and second floors are commercial let to the Open University. The third and fourth floors are residential. The proposed development involves the part demolition of existing residential flats at third and fourth floor and construction of new three storey extension at third fourth and fifth to replace and extend existing residential accommodation. The development is in the London Borough of Camden.

The building has a flat roof, some of which will be used as a green roof for ecological enhancement. The building footprint occupies the majority of the site so there is not much available usable space at ground level.



Figure 1 Google Maps extract indicating site location of 1-11 Hawley Crescent

Our assessment has been based on drawings and details provided by Chassay & Last Architects.

1.2 Objectives

This report summarises the work undertaken to support the development of an energy strategy for the scheme. This work has resulted in a strategy that requires design, technical and commercial decisions in order to continue the design development and ultimately select the most appropriate solution for ensuring a low carbon development.

This report outlines the energy strategy for the development, including passive design, energy and CO2 footprint of the proposed scheme, and renewable energy options.

The proposed strategy would allow the scheme to demonstrate compliance with the guidelines set out by the London Borough of Camden and the London Plan in demonstrating a positive commitment to sustainability through providing environmental improvements.



2 Policy

2.1 London Borough of Camden Policies on Energy

Camden Development Policy DP22 - Promoting sustainable design and construction

The Council will promote and measure sustainable design and construction by:

- Expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;*
- Expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;
- Expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

CPG3 Sustainability

The Council adopted CPG3 Sustainability on 6 April 2011 following statutory consultation.

- All developments are to be design to reduce carbon dioxide emissions
- Energy strategies are to be designed following the steps set out by the energy hierarchy
- Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies

*NB since the Code for Sustainable Homes has been withdrawn, this policy no longer applies. The London Borough of Camden will expect the development to demonstrate how it will incorporate sustainable design measures in line with the policies above.

2.2 The London Plan Policies on Energy

The London Plan, March 2015, requires compliance with the following policies relating to climate change:

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning Decisions

Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- 1. Be Lean: use less energy
- 2. Be Clean: supply energy efficiently
- 3. Be Green: use Renewable energy

As this is not a major development, the remaining London Plan policies are not applicable.



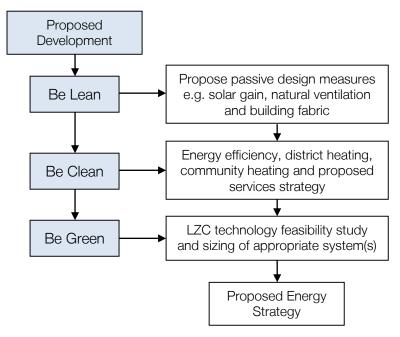
3 Approach

The approach to achieving the planning policy energy objectives has been to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The development will adopt the following energy hierarchy:

- Use less energy through passive design measures (Be Lean)
- Supply and consume energy efficiently (Be Clean)
- Utilise renewable energy sources to reduce carbon emissions (Be Green)

This energy strategy examines the energy performance of the proposed development based on the following methodology:



The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment, ensuring that both regulated and unregulated energy is considered when determining the performance of the proposed energy strategy.

3.1 Accredited Energy Assessor

This report has been checked and reviewed by Deepika Singhal who is an accredited Low Carbon Energy Assessor (LCEA). The energy consumption and carbon emission figures within this report have been calculated using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP), current SAP 2012 version.



4 Energy Targets

The target for the project is a 19% improvement over Building regulations Part L 2013 to meet the London Plan and the London Borough of Camden policy. Table 4-1 details the energy broken down by fuel types and fuel use categories for the site taking into account the regulated and unregulated energy. These are the target energy and carbon calculations before any passive design and energy efficient measures.

	Building Regulations Target Emission Rate Breakdown Regulated Energy & CO ₂												
	Gas Demand Electricity Demand								Total	Total			
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO ₂ (kgCO ₂ /yr)	Energy (kWh/yr)	CO ₂ (kg/yr)
Residential	42,224	33,873	76,097	16,437	0	0	0	1,125	4,762	5,887	3,055	81,984	19,492

Table 4-1 Estimated regulated and unregulated energy demand and carbon emissions per energy source

The energy consumption calculations for this and all subsequent stages of the assessment include regulated energy (space and water heating, lighting, pumps and fans) derived from outputs of the SAP calculations & dynamic thermal modelling using TAS for the site and unregulated energy (household appliances and equipment) based on the BRE methodology.



5 Be Lean: Passive Design

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce energy demand.

5.1 Passive design

Passive design measures have been considered where possible throughout the pre-planning stage to reduce energy demand

As an existing building; the orientation along the north-south axis is fixed. However, thermal elements of the proposed residential development will be specified to meet or exceed Building Regulations minimum standards.

5.2 Solar Gain Control and Daylighting

The development has been designed to balance the use of solar gain to reduce reliance on space heating whilst ensuring that the gains do not result in summer overheating. The U-Values of all glazed elements will meet or exceed Building Regulations standards. Windows will be specified to incorporate low emissivity coating to limit overheating, resulting in an efficient balance between passive solar gain and the thermal losses from each room.

The size and orientation of external windows has been considered carefully to incorporate good levels of daylight and reduce lighting demand. Duel aspect layouts have been maximised to enhance the provision of natural daylight. Table 5.1 provides further information on the parameters that will be met by the glazing installed.

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and the risk of solar overheating has been concluded to be medium for the 'worst case scenario' units.

Glazing Parameters	Double glazing – windows and glazed doors
U-value	1.4 W/m ² K
Light Transmittance	0.7
Frame factor	0.8

Table 5-1 Proposed glazing parameters for the doors and windows

5.3 Ventilation

A natural ventilation strategy will be available in the form of openable windows in all flats. Cross ventilation has been incorporated where feasible by providing all flats with dual aspect layouts.

Due to the location of the dwelling near to surrounding sources of external noise, a natural ventilation strategy will not always be practicable, as windows will need to remain closed at times in order to preserve the sound insulation performance of the building envelope.

An efficient balanced mechanical ventilation heat recovery will therefore be installed to all flats to provide controlled ventilation. As required to comply with Building Regulations, extract ventilation will be installed to serve all wet rooms.



5.4 Thermal Performance

To further improve the passive design of the development, the thermal envelope will be designed to minimise heat loss by specifying low U-values and minimising thermal bridges where possible. Table 5.2 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage. The fabric performance values for air tightness and thermal bridging are also detailed.

Element	U-Value - Proposed
External wall	0.14 W/m ² K
Corridor wall	0.25 W/m ² K
Flat roof	0.11 W/m ² K
Terrace	0.11 W/m²K
Heat loss floor (over unheated spaces)	0.22 W/m ² K
Windows / Glazed doors	1.1 W/m²K
External door	1.4 W/m²K
Element	Measure
Air Tightness	Pressure testing will be carried out to determine air tightness. This will be an assumed:
	4 m ³ /m ² /h
Thermal Bridging	Independently assessed, designed to be equivalent to accredited detail figures
	Details to be calculated at the detailed design stage

Table 5-2 Proposed Be Lean passive design measures

The building utilises a Mechanical Ventilation Heat Recovery (MVHR) system. As such, a low air tightness value must be achieved in order to allow the system to work efficiently. Potential air leakage paths must be minimised during design and construction stages to achieve this, for example gaps around service pipes, windows and floor boards.

In order to further improve the thermal performance of the development; Approved Thermal Bridging values have been used rather than default values. In order to achieve the values required; Accredited Construction Details (ACDs) must be used in the design and construction of all thermal junctions. The ACD checklists should be used by the Designer, Constructor and Building Control Body to demonstrate compliance.



5.5 Improvement Over Part L

Based on the performance of the passive design measures proposed in Section 5, as calculated using SAP, Figure 5-1 demonstrates the percentage improvement over the notional baseline levels in each type of use on the development. Table 5.3 confirms that the development can achieve a 2.04% improvement over Part L before any energy efficiency or low or zero carbon technologies have been considered.

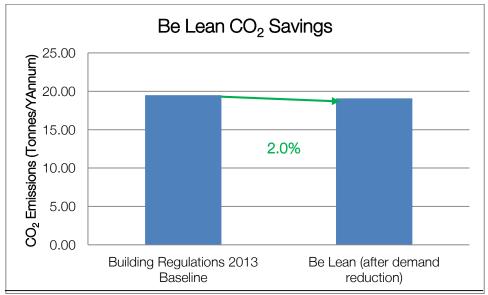


Figure 5-1 Improvement over Building Regulations Part L 2013 with passive design measures

The Be Lean stage has the potential to provide a 2.04% improvement over the Building Regulations 2013 minimum target; through passive design measures, and the energy use for the Be Lean case is broken down (Table 5-3 and Table 5-4).



	Be Lean Regulated Energy & CO₂												
	Gas Demand Electricity Demand								Total	Total			
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO ₂ (kgCO ₂ /yr)	Energy (kWh/yr)	CO ₂ (kg/yr)
Residential	38,912	34,684	73,596	15,897	0	0	0	450	5,711	6,161	3,198	79,757	19,094

Table 5-3 Estimated regulated and unregulated energy demand and carbon emissions per energy source

Site Wide	CO ₂ Emissions (tonnes /annum)	CO ₂ Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	19.49		
Be Lean (after demand reduction)	19.09	0.40	2.0%

Table 5-4 % improvement over Part L 2013 at Be Lean Stage



6 Be Clean: Energy Efficiency

As part of the Be Clean approach, the use of heat networks, community heating and cooling and energy efficient equipment has been considered for this development.

6.1 District Energy Systems

District energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't required their own boilers or chillers.

According to the London Heat Map Study, a potential heat network is located close to the site. The potential Euston Road heat network has been identified shown in Figure 6-1 below.

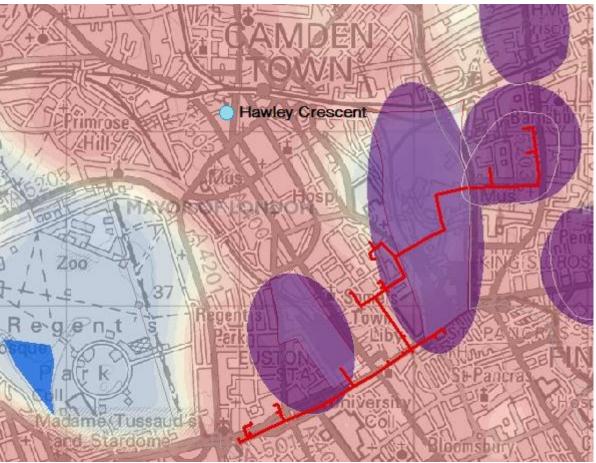


Figure 6-1: London Heat Map

As this network is not yet available, it is not possible to connect at this time. During the detailed design stages of the project, the developer will seek to gain more information on the heat network to ascertain the possibility of connecting in the future.



6.2 Community Heating

Community heating involves distributing space and water heating services throughout the development served from a central plant, making use of higher efficiencies available from larger systems.

As this development is relatively small, the installation of a community energy system would not be cost effective. A CHP system would not be viable for such small development due to low peak demand. The potential savings associated with a communal gas heating system would not be significant enough to justify the additional cost. Fabric improvements would have a greater impact and are therefore more cost effective for this development.

6.3 Services Strategy

In addition to the passive design measures identified in Section 4, energy efficient equipment has been proposed where possible to support the services strategy. All lights will be energy efficient (>45 lumens/watt). Efficient gas boilers have been used to model the Be Lean and Be Clean cases. However, it should be noted that gas will not be used in the development, as noted in the Be Green case.

Table 6-1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Measure
Ventilation	MVHR 90% efficient
	SFP 0.5 w/l/s
Comfort Cooling	VRF split / multi-split system
	Modulating control
	EER 2.5
Lighting	100% low energy lighting

Table 6-1 Proposed energy efficient design measures

6.4 Improvement Over Part L

Based on the performance of the passive design and energy efficient measures proposed in Sections 4 and 5, as calculated using SAP 2012, Figure 6-2 demonstrates the percentage improvement these have over the notional baseline levels for the development before any low or zero carbon technologies have been considered.



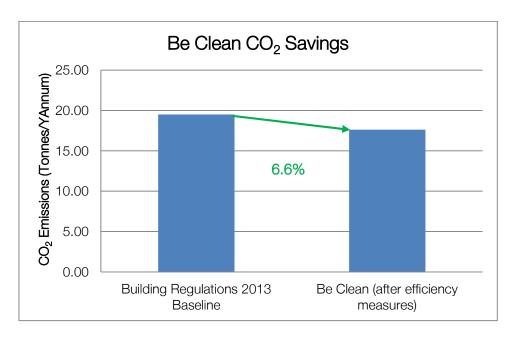


Figure 6-2 Improvement over Building Regulations Part L 2013 before LZCs for residential units

Table 6-1 confirms that the development can achieve 7.59% improvement over Part L 2013 before any on-site renewables have been considered.

Site Wide	CO ₂ Emissions (tonnes /annum)	CO ₂ Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	19.49		
Be Lean (after demand reduction)	19.09	0.40	2.0%
Be Clean (after efficiency measures)	17.82	1.28	6.6%
Total Cumulative Savings		1.67	8.6%

Table 6-1 % improvement over Part L 2013 at Be Clean Stage



The energy use for the Be Clean case is broken down in Table 6-3.

	Be Clean Regulated Energy & CO₂												
	Gas Demand Electricity Demand								Total	Total			
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO ₂ (kgCO ₂ /yr)	Energy (kWh/yr)	CO ₂ (kg/yr)
Residential	0	0	0	0	9,081	16,606	1272	2,612	4,759	34,330	17,817	34,330	17,817

Table 6-3 Estimated regulated and unregulated energy demand and carbon emissions per energy source

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7 Be Green: Low and Zero Carbon (LZC) Technologies Feasibility Study

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon technologies and their feasibility on this development to contribute to meeting the relevant London Plan and Borough's sustainability targets.

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar Thermal Collectors	Solar thermal collectors can be used to provide hot water using the irradiation from the sun They can generally provide approx. 50% of the hot water demand	No noise issues associated with Solar thermal collectors No additional land use from the installation of solar thermal collectors Low maintenance and easy to manage Favourable payback periods	The hot water cylinder will need to be larger than a traditional cylinder Needs unobstructed space on roof Low efficiencies Often not compatible with other LZC technologies Saves less carbon when offsetting gas systems	There is a south facing flat roof where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon savings.	×
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low- maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is a large flat roof on which Solar PV panels could be installed to contribute to the electricity demand of the building	✓

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CHP (Combined Heat & Power)	CHP systems use an engine driven alternator to generate electricity while using the waste heat from the engine, jacket and exhaust to provide heating and hot water Economic viability relies on at least 4,000 hours running time per annum	Mature technology High CO ₂ savings	Cost of the system is relatively high for small schemes Only appropriate for large development with high heat loads	Communal CHP is not viable for such a small development Micro CHP would be technically feasible but is unlikely to save enough carbon to meet the targets with incorporating multiple technologies	×
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating	Potential to reduce large component of the total CO ₂ A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers	Regular maintenance is required Reliability of fuel access/supply can be a problem The noise generated by a biomass boiler is similar to that of a gas boiler. It is advisable not to locate next to particularly sensitive areas such as bedrooms A plant room and fuel store will be required which may take additional land from the proposed development or surroundings Biomass is often not a favoured technology in new development due to the potential local impacts of NO _x emissions and delivery vehicles for the fuel	This is a small tight site in an urban area and so there is insufficient space for a biomass boiler system Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NO _x emissions	×

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Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in an urban environment and so a wind turbine will not generate much energy	×
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	GSHP are not a feasible technology for the site since there is a no external space available for installation of boreholes	×

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Air Source Heat Pumps (ASHP)	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps	ASHP systems are generally cheaper than GSHP as there is no requirement for long lengths of buried piping or boreholes Low maintenance and easy to manage Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The ASHP unit has a noise level around 50-60dB so some attenuation may be required and it should be sensibly located The potential noise from the external unit may mean there is local opposition to their installation Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	The use of ASHP is technically feasible for the development and there is a screened location where the units could be located with minimal visual impact; on a screen terrace and in the basement.	√
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Table 7-1 Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be ASHP combined with solar PV panels, which would most suitably be installed on the roof space. The chosen system should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

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7.1 Summary of CO2 Emission Savings

The most appropriate LZC technology for the development has been identified as solar PV panels and air source heat pumps to meet the London Borough of Camden's target for on-site renewables.

Table 7-2 shows the proposed system size and the estimated energy and carbon emissions savings for this development. Table 7-3 shows the proposed system size and estimated energy and carbon emissions savings and financial feasibility for this development.

	Be Green													
						Re	gulated En	ergy & CO2	2					
		Gas De	s Demand Electricity Demand					Total Energy (kWh/yr)	Total CO ₂ (kg/yr)					
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO ₂ (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	PV (kWh/yr)	Total (kWh/yr)	Electricity CO ₂ (kgCO2/yr)		
Residential	0	0	0	0	9,081	16,606	1272	2,612	4,759	-7,726	26,216	13,606	26,216	13,606

Table 7-2 Estimated regulated and unregulated energy demand and carbon emissions per energy source

		Energy & CO2			
Proposed LZC Technologies	Energy Generated (kWh/yr)	% site energy demand met	CO2 saved by system (kgCO2/yr)	% reduction in site CO2 emissions	25 year CO2 saving (kgCO2)
Total Solar PV = 8.75 kWp 27 High High efficiency, Horizontal South facing	7,511	21.88%	3,898	21.9%	97,455

Table 7-3 Energy, carbon and financial performance of the proposed LZC technologies

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7.2 Improvement Over Part L with LZC

Figure 7-1 and Figure 7-2 demonstrate the percentage improvement over the notional baseline levels for the development. Table 7-4 confirms that the development can achieve 20.57% improvement over the Part L 2013 target emissions with on-site renewables.

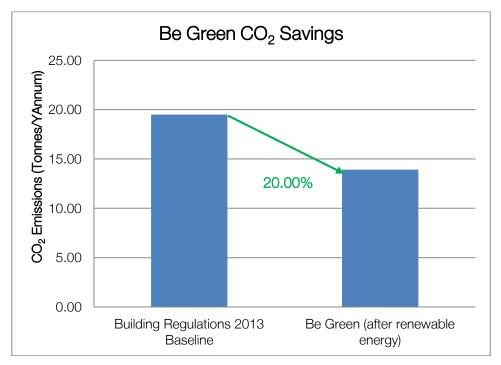


Figure 7-1 Site Wide Improvement over Building Regulations Part L 2013 after LZCs

Site Wide	CO ₂ Emissions (tonnes /annum)	CO ₂ Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	19.49		
Be Lean (after demand reduction)	19.09	0.40	2.0%
Be Clean (after efficiency measures)	17.82	1.28	6.6%
Be Green (after renewable energy)	13.92	3.90	20.0%
Total Cumulative Savings	_	5.57	28.6%

Table 7-4 Summary of carbon savings through the Energy Hierarchy after LZCs



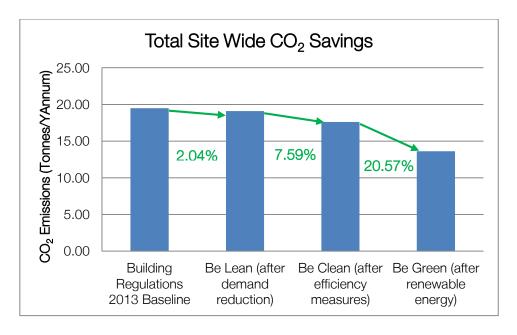


Figure 7-2 Summary of CO2 savings (tonnes CO2/annum) over Building Regulations 2013 baseline

8 Conclusion

Following the Be Lean, Be Clean and Be Green energy hierarchy, passive design measures, energy efficient equipment and LZC technologies have been shown to provide a 30.20% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) and an overall 22.8% saving in carbon emissions from renewables.

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Borough of Camden.

Fabric improvements have been prioritised for the development, which will have a longer lasting impact on energy use than renewable technologies with a finite lifetime. The fabric U-Values exceed Building Regulations. Efficiencies for building services are all particularly high and represent the best that is available on the market. The PV system specified occupies all available roof space. The strategy therefore represents the best possible savings that could be achieved for this development.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.



Appendix A

The following tables show figures used in the energy and CO_2 calculations to estimate energy produced and CO_2 savings from LZC technologies. These figures can be used to validate the results.

CO₂ Intensity Values					
Gas Intensity	0.216 kgCO ₂ /kWh				
Electricity Intensity	0.519 kgCO ₂ /kWh				

Energy & Renewable Technology Outputs				
PV energy produced per kWp	768.8 kWh/kWp			
PV kWp per m ² panel	0.2 kWp/m ²			
EER of VRF system	2.5			
Electricity efficiency	100%			
Gas boiler efficiency	90%			

Fuel Prices (as of March 2016)					
Natural Gas	4.18 p/kWh				
Electricity (Grid)	13.86 p/kWh				



Appendix B

The following grants may be available with the use of renewable technologies on this development.

Grant	
Feed-in Tariff	By generating your own renewable electricity your energy supplier may pay you
1 000 11 101111	money, called a 'Feed-in Tariff' (FIT).
	Using an MCS certified installer, the system could entitle you to a rate for each
	unit (kilowatt hour or kWh) of electricity you generate.
	As well as the FIT, you can sell any excess electricity back to your electricity
	supplier through an 'Export Tariff'.
	To qualify, the installation must be less than 5 MW, with the following
	technologies covered:
	Solar photovoltaic (PV) panels
	 Wind turbines
	Water (Hydro) turbines
	Anaerobic digestion (biogas energy)
	Micro combined heat and power (micro-CHP)
	https://www.gov.uk/feed-in-tariffs
Renewable Heat	The RHI is a scheme for the non-domestic sector that provides payments to
Incentive (RHI)	industry, business and public sector organisations that use renewable energy to
	heat their buildings. Payments are made to the owner of the heat installation
	over a 20-year period, for the following technologies:
	Biomass boilers (including CHP biomass boilers)
	Ground source heat pumps (GSHP)
	Water source heat pumps
	 Deep geothermal heat pumps
	All solar thermal collectors
	Biomethane and biogas
	There are plans to extend support to the following in 2013:
	Air source heat pumps (ASHP)
	Biomass direct air heating
	Biomass combustion over 200kW
	There are also plans to launch a domestic RHI scheme in summer 2013.
	http://www.ofgem.gov.uk/e-serve/RHI/Pages/RHI.aspx
Green Deal	The Green Deal is a Government backed initiative to promote the installation of
	energy efficiency measures in households in order to reduce energy
	consumption and bills.
	There will be no upfront costs, instead consumers will pay through their
	household energy bills. Consumers can see the Green Deal charge alongside
	the reductions in energy use which generate savings on their bill. It also means
	that if they move out (and cease to be the bill payer) the financial obligation
	remains at the property for the next bill payer: the charge is only paid
	where/whilst the benefits are enjoyed.
	https://www.gov.uk/green-deal-energy-saving-measures/how-the-green-deal-works
ECO	ECO is a requirement for all large gas and electricity suppliers to fund energy
(Energy Company	efficiency improvements to dwellings in the UK.
Obligation)	Energy suppliers have specific carbon reduction targets to achieve, and
	therefore must buy ECO 'credits' of CO ₂ on a free market, either from installers
	(and home owners) or from other energy suppliers. Therefore the price of ECO
	'credits' is not fixed.
	The installer (home owner or private renter with owner's permission) can claim
	back the money for the installation of the improvement measures from the
	energy suppliers (full payback or partial refund depending on type of



improvement(s) and value of ECO 'credits'). The scheme can be used to fund a number of domestic energy efficiency improvements.

If householders are applying for the Green Deal and are eligible for ECO, they will receive a lower quote from their Green Deal Provider and will benefit from lower repayments.

The scheme runs until 31st March 2015, however there are certain Eligibility requirements. See https://www.gov.uk/energy-company-obligation for more information.

Energy Companies Obligation - Guidance for suppliers



Appendix C SAP Calculations

SAP Assumptions

The SAP calculations for the proposed residential development at OU Hawley Crescent have been constructed using the following parameter assumptions;

U-Values

Element	U-Value - Proposed
External wall	0.14 W/m ² K
Corridor wall	0.25 W/m ² K
Flat roof	0.11 W/m ² K
Terrace	0.11 W/m ² K
Heat loss floor (over unheated spaces)	0.22 W/m ² K
Windows / Glazed doors	1.1 W/m ² K
External door	1.4 W/m ² K
Element	Measure
Air Tightness	Pressure test will be carried out to determine air tightness. This will be an assumed:
	4 m³/m²/h
Thermal Bridging	Independently assessed, designed to be equivalent to accredited detail figures
	Details to be calculated at the detailed design stage

<u>Services</u>

Services	Measure
Ventilation	MVHR 90% efficient
	SFP 0.5 w/l/s
	Approved installation
Comfort Cooling	VRF split / multi-split system
	Modulating control
Lighting	100% low energy lighting



Property Reference	25299 OU Hawley Crescent A1				Issued on Date	16/05/2017
Survey Reference	Be Green PT 4 ASHP			rop Type Ref		
Property	1-11 Hawley Crescent, Lo	ndon, NW1 8I	NP			
SAP Rating		88 B	DER	15.95	TER	29.46
Environmental	89 B	% DER <ter< th=""><th></th><th colspan="3">45.85</th></ter<>		45.85		
CO ₂ Emissions (t/year	0.76	DFEE	51.35	TFEE	55.21	
General Requirement	Pass	% DFEE <tfee< th=""><th></th><th colspan="3">6.98</th></tfee<>		6.98		
Surveyor admin Admin, Tel: 4, Fax: s@l.f					Surveyor ID	Admin
Client						

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)
                                                                                                     16/05/2017
  FullRefNo:
                                                                                                      Be Green PT 4 ASHP
                                                                                                     England
  Regs Region:
  SAP Region:
                                                                                                      Thames Valley
  Postcode:
DwellingOrientation:
                                                                                                      NW1 8NP
                                                                                                       West
Flat, End-Terrace
   Property Type:
  Storevs:
  Date Built:
Sheltered Sides:
Sunlight Shade:
                                                                                                      2016
                                                                                                     Average or unknown
Perimeter, Floor Area, Storey Height
20.78, 59.85, 2.6
29.15 m2, fraction: 48.7%
Simple calculation
  Measurements
lst Storey:
Living Area:
Thermal Mass:
Thermal Mass Simple:
Thermal MassValue:
External Walls
External Wall 1
Corridor wall
Party Walls
Party Wall 1
External Roofs
External Roof 1
Party Ceilings
Party Ceilings 1
Heat Loss Floors
                 1st Storey:
                                                                                                      Medium
                                                                                                    250
Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal 8.25, 20.5, 0, Other, Cavity, 0, 0.14, Gross 31.62, 33.51, 18, TimberWallTwoLayers, TimberFrame, 0.31, 0.232018561484919, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal 53.02, 20, PartyWallDoublePlaster, FilledWithEdge, 0, 0
Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal 41.52, 41.52, 0, Other, 0.11
Area, Kappa, Construction, Element 18.33, 0, Other
Area, Kappa, Construction, Element Type, ShelterFactor, UValueFinal
                                                                                                    18.33, 0, Other
Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
59.85, 0, Other, Exposed Floor - Solid, 0.31, 0.205953941209511
Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Manufacturer, Window, Double Low-E Soft 0.1, , , 0.7, , 0.8,
Manufacturer, Solid Door, , , , , ,
Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Window, External Wall 1, North, None, 0, , 0, 0, 7.32,
Window, External Wall 1, South West, , None, 0, , 0, 0, 4.93,
Solid Door, Corridor wall, West, , , , 0, 0, 0, 1.89,
None
 Heat Loss Floors
Heat Loss Floor 1
Description
                  Window
                  Door
  Openings
North elevation
SW elevation
                  Door
  Conservatory:
  Draught Proofing:
Draught Lobby:
Thermal Bridges
                                                                                                       100
                  Bridging:
                                                                                                      Calculate Bridges
                                                                                                    0.056

Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
External wall, El Steel lintel with perforated steel base plate, Table K1 - Approved, Yes, 6.8, 0.5, 0.5, 3.40,
External wall, E3 Sill, Table K1 - Approved, Yes, 5.9, 0.04, 0.04, 0.24,
External wall, E4 Jamb, Table K1 - Approved, Yes, 12.48, 0.05, 0.05, 0.62,
External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 20.78, 0.07, 0.07, 1.45,
External wall, E14 Flat roof, Table K1 - Default, No, 11.33, 0.08, 0.08, 0.08, 0.91,
External wall, E16 Corner (normal), Table K1 - Default, No, 7.8, 0.18, 0.18, 1.40,
External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Default, No, 7.8, 0, 0, 0.00,
External wall, E18 Party wall between dwellings, Table K1 - Approved, No, 10.4, 0.06, 0.06, 0.62,
Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), Table K1 - Default, No, 40.8, 0, 0, 0.00,
True
                  List of Bridges
  Pressure Test:
  Designed q50:
 Designed q50:
AsBuilt q50:
Property Tested:
Mechanical Ventilation
MV System Present
Windows In Hot Weather
                                                                                                      False
                                                                                                     Windows fully open
                  Cross Ventilation
Night Ventilation
Air Change Rate
Approved Installation
                  DataType
                                                                                                      Data Sheet
                                                                                                     Balanced mechanical ventilation with heat recovery
Yes
0.5
                  Type
HR Duct Insulated
                  ManufacturerSFP
                  DuctType
HR Efficiency
                                                                                                      Rigid
                                                                                                      90
                  Wet Rooms
Brand Model
 Chimneys MHS:
Chimneys SHS:
Chimneys Other:
Chimneys Total:
  Open Flues MHS:
Open Flues SHS:
  Open Flues Other:
  Open Flues Total:
```





SAP2012 - 9.92 input data (DesignData) -

```
Intermittent Fans:
Passive Vents:
Flueless Gas Fires:
Cooling System
Cooled Area
         Data Source
                                                       Manufacturer
                                                       Split or Multi-Split
3.6
On/Off
          Type
Energy Efficiency Ratio
         Control
Light Fittings:
                                                       10
LEL Fittings:
Percentage of LEL Fittings:
External Lights Fitted:
External LELs Fitted:
Electricity Tariff:
Main Heating 1
Description
Percentage
                                                       Standard
         MHS
                                                       Electricity PEQ Heat pump air-to-water with flow temperature <= 35°C
                                                       214
SAP Table
249.9
          SAP Code
         Boiler Efficiency Type
Efficiency
Controls by PCDF
                                                       CHD Time and temperature zone control
         MHS Controls
         Boiler Interlock Yes
Ctrl SAP Code 2207
MCS Installation CertificateYes
         Pumped
Heat Pump Age
Heat Emitter
Flow Temperature
Under Floor Heating
                                     Pump in heated space
2013 or later
Underfloor
<= 435°C
ting Yes - Pipes in thin screed
Under Floor Heating Yes - Pipes in thin screed
Main Heating 2 None
Heating Systems Interaction
Smoke Control Area Unknown
Community Heating None
Secondary Heating None
Secondary Heating
Water Heating
Type
WHS
Low Water Usage
SAP Code
Immersion Heater Type
Showers in Property
Suplementary Immersion
Hot Water Cylinder
Cylinder Type
                                                       MainHeating1
HWP From main heating 1
                                                       Yes
                                                        901
                                                       Single
Electric only
Yes
         Cylinder Type HotWate
Cylinder Insulation Type Foam
Cylinder Volume 150.00
Cylinder Stat Yes
                                                       HotWaterCylinder
Cylinder Stat Yes
Pipeworks Insulated Full
Cylinder in Heated Space Yes
Separate Time Control Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery none
                                                        Fully insulated primary pipework
PV Unit
                                                       More Dwellings, One Block
Type
Apportioned Energy
Wind Turbine
                                                       None
Terrain Type:
Small Scale Hydro
Special Features
                                                       Urban
REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
DWELLING AS DESIGNED
Mid-floor flat, total floor area 60 m<sup>2</sup>
This report covers items included within the SAP calculations.
     is not a complete report of regulations compliance.
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 29.46 kgCO\square/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 15.95 kgCO\square/m^2OK
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.4 kWh/m²/yrOK
2 Fabric U-values
| Z rabric U-values | Element | Average | External wall | 0.21 (max. 0.30) | Party wall | 0.00 (max. 0.20) | Floor | 0.21 (max. 0.25) | Roof | 0.11 (max. 0.20) |
                                                                         Highest 0.23 (max. 0.70)
                                                                                                                          OK
                                                                         0.21 (max. 0.70)
0.11 (max. 0.35)
1.40 (max. 3.30)
                                                                                                                          OK
                                                                                                                          OK
                             1.14 (max. 2.00)
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
3 Air permeability
Air permeability at 50 pascals:
Maximum
                                                                          4.00 (design value)
4 Heating efficiency
Main heating system:
```





SAP2012 - 9.92 input data (DesignData) -

Air-to-water heat pump

Secondary heating system:	None	
5 Cylinder insulation Hot water storage Permitted by DBSCG 1.89 Primary pipework insulated:	Nominal cylinder loss: 1.43 kWh/day OK Yes	OK
		OR
6 Controls Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat Independent timer for DHW	OK OK
7 Low energy lights		
Percentage of fixed lights with low-ene	ergy fittings:100% 75% 	OK
8 Mechanical ventilation Continuous supply and extract system Specific fan power:	0.50	
Maximum MVHR efficiency:	1.5 90%	OK
Minimum:	70%	OK
9 Summertime temperature Overheating risk (Thames Valley): Based on:	Slight	ok
Overshading:	Average	
Windows facing North:	7.32 m², No overhang	
Windows facing South West:	4.93 m ² , No overhang	
Air change rate: Blinds/curtains:	6.00 ach None	
BIIIUS/CUICAIIIS.		
10 Key features		
External wall U-value	0.14 W/m²K	
Party wall U-value Roof U-value	0.00 W/m ² K 0.11 W/m ² K	
Window U-value	1.10 W/m²K	
Photovoltaic array	1110 W/ M 1	







CALCULATION OF DWELLING	G EMISSIONS F	OR REGULAT	rions co	OMPLIAN	CE 0 9	Jan 2014				
SAP 2012 WORKSHEET FOR New Build (As	s Designed) (Ver	sion 9.92, Janua	 ry 2014)							
CALCULATION OF DWELLING EMISSIONS FO	OR REGULATIONS COM	PLIANCE 09	Jan 2014							
. Overall dwelling dimensions										
Overall dwelling dimensions					Area	Store	ey height		Volume	
Ground floor Total floor area TFA = (la)+(lb)+(lc) Welling volume	c)+(1d)+(1e)(1n)	59.8500		(m2) 59.8500	(1b) x 3a)+(3b)+(3c)+	(m) 2.6000 +(3d)+(3e)		(m3) 155.6100 155.6100	(4)
. Ventilation rate										
		main heating	se	econdary heating		other	tot	al m	3 per hour	
Number of chimneys Number of open flues Number of intermittent fans Number of passive vents Number of flueless gas fires		0	+ +	0 0	++	0 = 0		0 * 40 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000	(6b) (7a) (7b)
Infiltration due to chimneys, flues	and fans = (6a)	+(6b)+(7a)+(7b)+	(7c) =				0.0000	Air change / (5) =	s per hour 0.0000	(8)
Pressure test Measured/design q50 Infiltration rate Number of sides sheltered									Yes 4.0000 0.2000 2	(18) (19)
Shelter factor Infiltration rate adjusted to includ	de shelter factor					(20) = 1 - (21	[0.075 x L) = (18)		0.8500 0.1700	
Jan Feb Wind speed 5.1000 5.0000 Wind factor 1.2750 1.2500	Mar Apr 4.9000 4.4 1.2250 1.1	000 4.3000	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	
Adj infilt rate 0.2168 0.2125	0.2083 0.1		0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	
Balanced mechanical ventilation wit of mechanical ventilation: of balanced with heat recovery: effi-	-	ing for in-use f	actor (from	m Table 4h)	=				0.5000 76.5000	
Effective ac 0.3343 0.3300	0.3258 0.3	0.3003	0.2790	0.2790	0.2748	0.2875	0.3003	0.3088	0.3173	(25)
3. Heat losses and heat loss paramet										
Element	Gros m			tArea m2	U-value W/m2K	A x U W/F		-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)	***		12.	.2500 .8900	1.0536	12.9071 2.6460	L	, m21	1.0 / 1.	(27) (26)
leat Loss Floor 1 External Wall 1 Corridor wall External Roof 1 Cotal net area of external elements Cabric heat loss, W/K = Sum (A x U)	20.500 33.510 41.520 Aum(A, m2)	0 1.8900	8. 31. 41. 155.		0.2060 0.1400 0.2320 0.1100 30) + (32)) 1 2			(28b) (29a) (29a) (30) (31) (33)
Party Wall 1 Party Ceilings 1				.0200 .3300	0.0000	0.0000)			(32) (32b)
Thermal mass parameter (TMP = Cm / Thermal bridges (Sum(L x Psi) calcul Total fabric heat loss	lated using Append						(33)	+ (36) =	250.0000 8.6490 49.5871	(36)
Ventilation heat loss calculated mor Jan Feb (38)m 17.1642 16.9459	nthly (38)m = 0.33 Mar Apr 16.7277 15.6	May	Jun 14.3270	Jul 14.3270	Aug 14.1088	Sep 14.7635	Oct 15.4182	Nov 15.8547	Dec 16.2912	(38)
teat transfer coeff 66.7512 66.5330 Average = Sum(39)m / 12 =	66.3147 65.2		63.9141	63.9141	63.6958	64.3506	65.0053	65.4418	65.8783 65.1690	(39)
Jan Feb HLP 1.1153 1.1117 HLP (average) Days in month	Mar Apr 1.1080 1.0		Jun 1.0679	Jul 1.0679	Aug 1.0643	Sep 1.0752	Oct 1.0861	Nov 1.0934	Dec 1.1007 1.0889	
31 28	31	30 31	30	31	31	30	31	30	31	(41)
4. Water heating energy requirements	s (kWh/year)									
Assumed occupancy Average daily hot water use (litres/									1.9774 81.1630	
Jan Feb Daily hot water use	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual) 89.2793 86.0328 Energy content (annual)	82.7863 79.5 119.4918 104.1		73.0467 86.2572	73.0467 79.9300	76.2932 91.7208	79.5398 92.8163			89.2793 128.2210 1277.0102	(45)





CALCULAT	TION OF I	DWELLIN	G EMISSI	ONS FO	R REGULA	TIONS CO	OMPLIAN	ICE 09	Jan 2014	ı			
Distribution :													
Water storage Store volume		17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	
b) If manufa												0.0103	
Volume factor Temperature	or from Tab	le 2a	,									0.9283 0.5400	(52)
Enter (49) or Total storage	loss											0.7736	
If cylinder co		icated sola		23.2088		23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	
Primary loss Total heat red		21.0112		22.5120	23.2624	23.2088 22.5120	23.2624	23.2624	22.5120	23.9825 23.2624	22.5120	23.9825 23.2624	
Solar input	179.6435 0.0000	158.4695 0.0000	166.7367 0.0000	149.8967 0.0000	147.2041	131.9780 0.0000	127.1748 0.0000	0.0000	0.0000	155.4133 0.0000 months) = Su	0.0000	175.4659 0.0000 0.0000	(63)
Output from w.		158.4695	166.7367	149.8967	147.2041	131.9780	127.1748			155.4133 h/year) = Su			
Heat gains fro			month 77.5269	71.2151	71.0323	65.2572	64.3726	68.2931	67.4381	73.7619	75.8364	80.4294	(65)
5. Internal ga	ains (see T	able 5 and	5a)										
Metabolic gain	ns (Table 5		Mar	Apr		Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gain:	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Appliances gas	15.3846	13.6645	11.1127	8.4130	6.2888	5.3093	5.7369	7.4570	10.0088	12.7085	14.8327	15.8122	(67)
Cooking gains	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	
Losses e.g. e	-79.0956	-79.0956	alues) (Tab -79.0956		-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating	109.9710	108.0962	104.2029	98.9099	95.4736	90.6350	86.5223	91.7918	93.6640	99.1423	105.3283	108.1040	(72)
Total internal		351.7807	340.8230	323.2237	305.5364	288.3209	277.0217	282.2205	291.1571	308.9418	329.3787	344.5313	(73)
6. Solar gain													
[Jan]			А	rea m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acces facto Table 6	or	Gains W	
[Jan]			7.3 4.9	m2 	Solar flux Table 6a W/m2 10.6334 36.7938	Speci or	g fic data Table 6b 0.7000 0.7000	Specific or Tab	data le 6c	facto	or 6d 00		
[Jan] North Southwest	100.6020	177.6358	7.3 4.9 262.1566	m2	Solar flux Table 6a W/m2 10.6334 36.7938	Speci or 	gfic data Table 6b 0.7000 0.7000	Specific or Tab. 0 0	data le 6c .8000 .8000	factor Table 6 0.770 0.770	or 6d 00 00 121.5812	W 30.2068 70.3952 85.4255	(79)
North Southwest Solar gains Total gains	100.6020 454.1869	177.6358 529.4165 ture (heati	7.3 4.9 262.1566 602.9796	m2 200 300 360.8448 684.0685	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802	Speci or 453.2670 741.5879	gfic data Table 6b 	Specific or Tab.	data le 6c .8000 .8000	factor Table 6 0.770 0.770	or 6d 00 00 121.5812	W 30.2068 70.3952 85.4255	(79) (83)
North Southwest Solar gains Total gains 7. Mean intern Temperature di	100.6020 454.1869 nal tempera	177.6358 529.4165 ture (heati	7.3 4.9 262.1566 602.9796 ng season) in the livi	rea m2 200 300 360.8448 684.0685	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9, 5	Speci or 453.2670 741.5879	gfic data Table 6b 	Specific or Tab.	data le 6c .8000 .8000	factor Table 6 0.770 0.770	or 6d 00 00 121.5812	W 30.2068 70.3952 85.4255	(79) (83) (84)
North Southwest Solar gains Total gains	100.6020 454.1869 nal tempera	177.6358 529.4165 ture (heati	7.3 4.9 262.1566 602.9796 ng season) in the livi	rea m2 200 300 360.8448 684.0685	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9, 12 Table 9a) May	Speci or 453.2670 741.5879	gfic data Table 6b 	Specific or Tab.	data le 6c .8000 .8000	factor Table 6 0.770 0.770	or 6d 00 00 121.5812	W 30.2068 70.3952 85.4255 429.9568	(79) (83) (84)
North Southwest Solar gains Total gains Total gains Tuest gains Themperature distribution for the solution f	100.6020 454.1869 nal tempera uring heating actor for Jan 62.2648 5.1510	177.6358 529.4165 ture (heati- ng periods ains for li Feb	7.3 4.9 262.1566 602.9796 ng season) in the livi ving area, Mar	rea m2 200 300 360.8448 684.0685 mg area fr nil, m (see Apr	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9a) May 63.9371	Speci or 453.2670 741.5879	gfic data Table 6b	Specific or Tab. 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	data le 6c .8000 .8000 295.5856 586.7427	factor Table 6 0.770 0.770 201.2412 510.1829	Dr 6d 00 00 121.5812 450.9598	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec	(79) (83) (84)
North Southwest Solar gains Total gains 7. Mean inter Temperature di Utilisation fotat au alpha util living a:	100.6020 454.1869 nal tempera uring heati actor for g Jan 62.2648 5.1510 rea 0.9942	177.6358 529.4165 ture (heati- ng periods ains for li Feb 62.4690 5.1646 0.9865	7.3 4.9 262.1566 602.9796 ng season) in the livi ving area, Mar 62.6746 5.1783 0.9648	360.8448 684.0685 ng area fr inil,m (see Apr 63.7232 5.2482	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9, Table 9a) May 63.9371 5.2625 0.7413	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410	Jul 65.0287 5.3352 0.3960	Specific or Tab. 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471	data le 6c .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058	factor Table 6 0.770 0.770 201.2412 510.1829 Oct 63.9371 5.2625 0.9327	Nov 63.5107 5.2340 0.9870	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955	(83) (84) (85)
North Southwest Total gains 7. Mean inter Temperature dutilisation fortau alpha util living a:	100.6020 454.1869 anal tempera: uring heating actor for gr Jan 62.2648 5.1510 rea 0.9942 20.1618 19.9884	177.6358 529.4165 ture (heati ng periods ains for li Feb 62.4690 5.1646	7.3 4.9 262.1566 602.9796 ng season) in the livi ving area, Mar 62.6746 5.1783	360.8448 684.0685 	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9a) May 63.9371 5.2625 0.7413 20.8866	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352	gfic data Table 6b 0.7000 0.7000 430.0724 707.0940 Jul 65.0287 5.3352	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501	data de 6c .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058	factor Table 6 0.770 0.770 201.2412 510.1829 Oct 63.9371 5.2625	Nov 63.5107 5.2340	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418	(83) (84) (85) (86) (87)
North Southwest Solar gains Total gains 7. Mean intern Temperature di Utilisation fa tau alpha util living a: MIT Th 2 util rest of 1	100.6020 454.1869 mal tempera: uring heati; actor for Jan 62.2648 5.1510 rea 0.9942 20.1618 19.9884 thouse 0.9923 18.8764	177.6358 529.4165 ture (heati- ng periods ains for li Feb 62.4690 5.1646 0.9865 20.2969	7.3 4.9 262.1566 602.9796 ng season) in the livi ving area, Mar 62.6746 5.1783 0.9648 20.4971	m2 200 300 360.8448 684.0685 ng area fr nil,m (see Apr 63.7232 5.2482 0.8935 20.7365	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9, Table 9a) May 63.9371 5.2625 0.7413 20.8866 20.0122 0.6825	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397	gfic data Table 6b 0.7000 0.7000 430.0724 707.0940 Jul 65.0287 5.3352 0.3960 20.9476	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465	data le 6c .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209	Oct 63.9371 5.2625 0.9327 20.7100 20.0122 0.9060 19.6757	Nov 63.5107 5.2340 0.9870 0.9822 19.2306	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568	(83) (84) (85) (86) (87) (88) (89) (90)
North Southwest Total gains 7. Mean inter Temperature dutilisation for tau alpha util living a: MIT Th 2 util rest of 1 MIT 2 Living area for	100.6020 454.1869 anal temperaruring heating actor for gr Jan 62.2648 5.1510 rea 0.9942 20.1618 10.9884 house 0.9923 18.8764 raction 19.5024	177.6358 529.4165 ture (heati	7.3 4.9 262.1566 602.9796 	360.8448 684.0685 	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9a) May 63.9371 5.2625 0.7413 20.8866 20.0122 0.6825 19.8816	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397 20.0271 0.4634	gfic data Table 6b	Specific or Tab. 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465 20.0301 0.3547	data le 6c .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209	factor Table 6 0.770 0.770 201.2412 510.1829 Oct 63.9371 5.2625 0.9327 20.7100 20.0122 0.9060 19.6757 Living area	Nov 63.5107 5.2340 0.9870 0.9822 19.2306	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568 0.4871 19.4827	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Total gains 7. Mean interr Temperature di Utilisation fa tau alpha util living a: MIT Th 2 util rest of 1	100.6020 454.1869 anal tempera- uring heati: actor for gr Jan 62.2648 5.1510 rea 0.9942 20.1618 19.9884 house 0.9923 18.8764 raction 19.5024 djustment	177.6358 529.4165 ture (heati- ng periods ains for li Feb 62.4690 5.1646 0.9865 20.2969 19.9913 0.9823 19.0741	7.3 4.9 262.1566 602.9796 ng season) in the livi ving area, Mar 62.6746 5.1783 0.9648 20.4971 19.9943 0.9537 19.3620	m2 200 300 360.8448 684.0685 ng area fr nil,m (see Apr 63.7232 5.2482 0.8935 20.7365 20.0092 0.8631 19.6996	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9a) May 63.9371 5.2625 0.7413 20.8866 20.0122 0.6825 19.8816 20.3711	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397 20.0271 0.4634 19.9469	Jul 65.0287 5.3352 0.3960 20.9476 20.0271 0.3094 19.9521	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465 20.0301 0.3547 19.9547	data le 6c .8000 .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209 fLA =	Oct 63.9371 5.2625 0.9327 20.7100 20.0122 0.9060 19.6757 Living area 20.1794	Nov 63.5107 5.2340 0.9870 20.3957 20.0062 0.9822 19.2306 a / (4) =	30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568 0.4871 19.4827 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Solar gains Total gains 7. Mean interr Temperature di Utilisation fa tau alpha util living a: MIT Th 2 util rest of l MIT 2 Living area f: MIT Temperature aa adjusted MIT 8. Space heat:	100.6020 454.1869 al tempera- uring heatinactor for grams of 2.2648 5.1510 rea 0.9942 20.1618 19.9884 house 0.9923 18.8764 raction 19.5024 djustment 19.5024	177.6358 529.4165 ture (heati	7.3 4.9 262.1566 602.9796 10 season) 10 the livi 10 ving area, 10 Mar 62.6746 5.1783 0.9648 20.4971 19.9943 0.9537 19.3620 19.9149 19.9149	mea m2 200 300 360.8448 684.0685 mg area fr nil,m (see Apr 63.7232 5.2482 0.8935 20.7365 20.0092 0.8631 19.6996 20.2046	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9a, May 63.9371 5.2625 0.7413 20.8866 20.0122 0.6825 19.8816 20.3711 20.3711	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397 20.0271 0.4634 19.9469 20.4305 20.4305	Jul 65.0287 5.3352 0.3960 20.9476 20.0271 0.3094 19.9521 20.4369 20.4369	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465 20.0301 0.3547 19.9547 20.4378	data le 6c .8000 .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209 fLA = 20.4043	Oct 63.9371 5.2625 0.9327 20.7100 20.0122 0.9060 19.6757 Living area 20.1794	Nov 63.5107 5.2340 0.9870 20.3957 20.0062 19.2306 a / (4) = 19.7981	30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568 0.4871 19.4827 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
North Southwest	100.6020 454.1869 al tempera- uring heatinactor for grams of 2.2648 5.1510 rea 0.9942 20.1618 19.9884 house 0.9923 18.8764 raction 19.5024 djustment 19.5024	177.6358 529.4165 ture (heati	7.3 4.9 262.1566 602.9796 10 season) 10 the livi 10 ving area, 10 Mar 62.6746 5.1783 0.9648 20.4971 19.9943 0.9537 19.3620 19.9149 19.9149	mea m2 200 300 360.8448 684.0685 mg area fr nil,m (see Apr 63.7232 5.2482 0.8935 20.7365 20.0092 0.8631 19.6996 20.2046	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9a, May 63.9371 5.2625 0.7413 20.8866 20.0122 0.6825 19.8816 20.3711 20.3711	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397 20.0271 0.4634 19.9469 20.4305 20.4305	Jul 65.0287 5.3352 0.3960 20.9476 20.0271 0.3094 19.9521 20.4369 20.4369	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465 20.0301 0.3547 19.9547 20.4378	data le 6c .8000 .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209 fLA = 20.4043	Oct 63.9371 5.2625 0.9327 20.7100 20.0122 0.9060 19.6757 Living area 20.1794	Nov 63.5107 5.2340 0.9870 20.3957 20.0062 19.2306 a / (4) = 19.7981	30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568 0.4871 19.4827 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
North Southwest	100.6020 454.1869 nal temperaruring heating actor for grama 62.2648 5.1510 rea 0.9942 20.1618 19.9884 house 0.9923 18.8764 raction 19.5024 djustment 19.5024 djustment 19.5024	177.6358 529.4165 ture (heati- ng periods ains for li Feb 62.4690 5.1646 0.9865 20.2969 19.9913 0.9823 19.0741 19.6697 19.6697	7.3 4.9	m2 200 300 360.8448 684.0685 ng area fr nil,m (see Apr 63.7232 5.2482 0.8935 20.7365 20.0092 0.8631 19.6996 20.2046 20.2046	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 om Table 9a) May 63.9371 5.2625 0.7413 20.8866 20.0122 0.6825 19.8816 20.3711 20.3711 May 0.7049 525.4619	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397 20.0271 0.4634 19.9469 20.4305 20.4305	Jul 65.0287 5.3352 0.3960 20.9476 20.0271 20.4369 20.4369	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465 20.0301 0.3547 19.9547 20.4378 20.4378	data le 6c .8000 .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209 fLA = 20.4043	Oct 63.9371 5.2625 0.9327 20.129 20.194 20.1794 20.1794	Nov 63.5107 5.2340 0.9870 20.3957 20.0062 19.7981 19.7981	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568 0.4871 19.4827 0.0000 19.4827	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest	100.6020 454.1869 nal tempera uring heati; actor for gr Jan 62.2648 5.1510 rea 0.9942 20.1618 19.9884 house 0.9923 18.8764 raction 19.5024 djustment 19.5024 ing requirer Jan 0.9911 450.1671 4.3000 e W 1014.7815 1.0000	177.6358 529.4165 ture (heati- ng periods ains for li Feb 62.4690 5.1646 0.9865 20.2969 19.9913 0.9823 19.0741 19.6697 19.6697	7.3 4.9 262.1566 602.9796	nea m2 200 300 360.8448 684.0685 ng area fr nil,m (see Apr 63.7232 5.2482 0.8935 20.7365 20.0092 0.8631 19.6996 20.2046 20.2046	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 Om Table 9a, Table 9a) May 63.9371 5.2625 0.7413 20.8866 20.0122 0.6825 19.8816 20.3711 20.3711 May 0.7049 525.4619 11.7000 563.6653	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397 20.0271 0.4634 19.9469 20.4305 20.4305	Jul 65.0287 5.3352 0.3960 20.9476 20.0271 20.4369 20.4369	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465 20.0301 0.3547 19.9547 20.4378 20.4378 20.4378	data le 6c .8000 .8000 .8000 295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209 fLA = 20.4043 20.4043 Sep 0.6580 386.1011	factor Table 6 0.77(0.770 201.2412 510.1829 Oct 63.9371 5.2625 0.9327 20.7100 20.0122 0.9060 19.6757 Living area 20.1794 20.1794	Nov 63.5107 5.2340 0.9870 20.3957 20.0062 0.9822 19.23064 19.7981 19.7981 19.7981	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568 0.4871 19.4827 0.0000 19.4827	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97)
North Southwest	100.6020 454.1869 nal tempera- uring heating actor for gramma for	177.6358 529.4165 ture (heati- ng periods ains for li Feb 62.4690 5.1646 0.9865 20.2969 19.9913 0.9823 19.0741 19.6697 19.6697 Feb 0.9807 519.1797 4.9000 982.6718 1.0000	7.3 4.9 262.1566 602.9796	nrea m2 200 300 360.8448 684.0685 360.8448 684.0685 20.0092 0.8631 19.6996 20.2046 20.2046 20.2046 20.2046 20.3030 737.3257 1.0000	Solar flux Table 6a W/m2 10.6334 36.7938 439.9438 745.4802 00.0122 00.6825 19.8816 20.3711 20.3711 May 07049 525.4619 11.7000 563.6653 1.0000	Speci or 453.2670 741.5879 Th1 (C) Jun 65.0287 5.3352 0.5410 20.9397 20.0271 0.4634 19.9469 20.4305 20.4305	Jul 65.0287 5.3352 0.3960 20.9476 20.0271 0.3094 19.9521 20.4369 Jul 6.6000 245.2346	Specific or Tab 0 0 368.0272 650.2477 Aug 65.2515 5.3501 0.4471 20.9465 20.0301 0.3547 19.9547 20.4378 20.4378 20.4378	data le 6c .8000 .8000 .295.5856 586.7427 Sep 64.5876 5.3058 0.7061 20.9133 20.0211 0.6247 19.9209 fLA = 20.4043 20.4043	Oct 63.9371 5.2625 0.9327 20.7100 20.0122 0.9060 19.6757 Living area 20.1794 20.1794 20.1794 20.1794 20.1794 1.0000 17.4262	Nov 63.5107 5.2340 0.9870 20.3957 20.0062 19.2306 a / (4) = 19.7981 Nov 0.9809 442.3564 7.1000 830.9852	W 30.2068 70.3952 85.4255 429.9568 21.0000 Dec 63.0899 5.2060 0.9955 20.1418 20.0002 0.9941 18.8568 0.4871 19.4827 0.0000 19.4827	(85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (97a) (98)





CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cool:													
Calculated for	June, July a	and August	. See Table	e 10b									
Ext. temp. Heat loss rate	Jan 4.3000	Feb 4.9000	Mar 6.5000	Apr 8.9000	May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	600.7923 0.9627	472.9641 0.9832	484.0883 0.9746	0.0000	0.0000	0.0000	0.0000	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	578.3765 926.1437	465.0192	471.7712 819.0018	0.0000	0.0000	0.0000	0.0000	(102)
Total gains Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	884.6250 1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	
Space cooling Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	250.3924	312.1867	258.3395	0.0000	0.0000	0.0000	0.0000 820.9186	
Cooled fraction Intermittency		= 10h)							fC =	cooled area	4 / (4) =	0.6683	
Space cooling 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	41.8367	52.1615	43.1645	0.0000	0.0000	0.0000	0.0000 137.1627	
Space cooling p	per m2											2.2918	
9a. Energy requ													
Fraction of spa Fraction of spa				ntary system	m (Table 11)						0.0000 1.0000	
Efficiency of a Efficiency of a												249.9000 0.0000	
Space heating : Cooling System		ciency Rat	io (see Tal	ole 10c)								770.5276 4.5000	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	420.0731			102.5214	28.4233	0.0000	0.0000	0.0000	0.0000	117.4262	279.8127	431.3646	(98)
Space heating of	efficiency (r 249.9000 2		ng system : 249.9000	1) 249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)
Space heating	fuel (main he 168.0965		93.8217	41.0250	11.3739	0.0000	0.0000	0.0000	0.0000	46.9893	111.9699	172.6149	(211)
Water heating :	requirement 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
	179.6435		166.7367	149.8967	147.2041	131.9780	127.1748	138.9657	138.5371	155.4133	163.7951	175.4659	
	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 175.1000	
Fuel for water Water heating:	102.5948	90.5023	95.2237	85.6063	84.0686	75.3730	72.6298	79.3636	79.1188	88.7569	93.5438	100.2090 1046.9905	
Space cooling : (221)m Cooling	fuel requirer 0.0000	0.0000	0.0000	0.0000	0.0000	9.2970	11.5915	9.5921	0.0000	0.0000	0.0000	0.0000 30.4806	
Annual totals Space heating :		2172+am										770.5276	
Space heating :												0.0000	
Electricity for (BalancedW	r pumps and : ithHeatRecove		Sheet: in-u	se factor =	1.2500, SF	P = 0.6250)							
mechanical central heat	ventilation : ting pump	fans (SFP	= 0.	6250)								118.6526 30.0000	
Total electric: Electricity for				ix L)								148.6526 271.6969	
Energy saving/			es (Appendi	ces M ,N an	d Q)							2260 2402	(220)
Total delivered	a energy for	all uses										2268.3483	(238)
12a. Carbon die													
								Energy kWh/year		ion factor kg CO2/kWh	k	Emissions g CO2/year	
Space heating - Space heating -		n 1						770.5276 0.0000		0.5190 0.0000		399.9038 0.0000	
Water heating Space and wate:								1046.9905		0.5190		543.3881 943.2919	
Space cooling Pumps and fans								30.4806 148.6526		0.5190 0.5190		15.8194 77.1507	
Energy for ligh								271.6969		0.5190		141.0107	(268)
Energy saving, PV Unit	-	technologi	es					-429.0000		0.5190		-222.6510	
Total CO2, kg/		ission Rat	e (DER)									954.6218 15.9500	
16 CO2 EMISSION	NS ASSOCIATE	O WITH APE	PLIANCES AN	D COOKING A	ND SITE-WID	E ELECTRICI	TY GENERATI	ON TECHNOLO	GIES				
DER Total Floor Are											TFA	15.9500 59.8500	
Assumed number CO2 emission fa			electricit	y displaced	from grid						N EF	1.9774 0.5190	
CO2 emissions :	from appliand	ces, equat	ion (L14)		-							17.0861 2.7812	
Total CO2 emiss Residual CO2 er	sions	-										35.8174 0.0000	ZC4





CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Additional allowable electricity generation, kWh/m²/year
Resulting CO2 emissions offset from additional allowable electricity generation
Net CO2 emissions
O.0000 ZC6
Net CO2 emissions
35.8174 ZC8

elmhurst energy Regs Region: England Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.03r08



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014 1. Overall dwelling dimensions Volume (m3) 155.6100 (1b) - (3b) (m) x 2.6000 (2b) 59.8500 (1b) Ground floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)Dwelling volume 59.8500 $(3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =$ 155.6100 (5) main secondary total m3 per hour heating Number of chimneys Number of open flues 0 * 40 = 0 * 20 = 2 * 10 = 0.0000 (6a) 0.0000 (6b) Number of intermittent fans Number of passive vents Number of flueless gas fires 20.0000 (7a) 0.0000 0 * 40 = Air changes per hour 20.0000 / (5) = Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0.1285 (8) Pressure test Measured/design q50 0.3785 (18) Infiltration rate Number of sides sheltered 2 (19) - [0.075 x (19)] (21) = (18) x (20) Shelter factor Infiltration rate adjusted to include shelter factor May 4.3000 1.0750 Aug 3.7000 0.9250 Sep 4.0000 1.0000 5.1000 1.2750 5.0000 1.2500 4.9000 1.2250 4.4000 1.1000 4.3000 4.5000 1.1250 4.7000 (22) 1.1750 (22a) Wind speed Wind factor Adi infilt rate 0.4102 0.4022 0.3539 0.3459 0.3057 0.3057 0.2976 0.3217 0.3459 0.3620 0.3781 (22b) 0.3941 Effective ac 3. Heat losses and heat loss parameter Openings A x U W/K 1.8900 Element Gross NetArea U-value K-value W/m2K 1.0000 1.3258 1.8900 (26) TER Opaque door TER Opening Type (Uw = 1.40) Heat Loss Floor 1 16.2405 7.7805 12.2500 59.8500 (27) (28b) 0.1300 8.2500 31.6200 41.5200 External Wall 1 20.5000 12.2500 0.1800 1.4850 (29a) Corridor wall External Roof 1 Total net area of external elements Aum(A, m2) 155.3800 (31)38.4852 Fabric heat loss, $W/K = Sum (A \times U)$ (26)...(30) + (32) =(33) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K Thermal bridges (Sum(L x Psi) calculated using Appendix K) Total fabric heat loss 250.0000 (35) 4.2440 (36) (33) + (36) =42.7292 (37) Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
Jan Feb Mar Apr May May 28.7473 Aug 27.9499 Sep 28.3336 (38) m 29.8287 29.6643 28.8918 28.0745 29.0397 29.3453 (38) 29.9965 28.0745 28.7473 Heat transfer coeff 72.7258 Average = Sum(39)m / 12 72 5580 72 3935 71 6210 71 4765 70 8037 70 8037 70 6791 71 0629 71 4765 71.7689 72.0746 (39) 71.6203 (39) Feb Apr 1.1967 May 1.1943 Jun 1.1830 Aug 1.1809 Sep 1.1873 Oct 1.1943 1.2151 1.2123 1.2096 1.2043 (40) 1.1967 (40) 1.1830 1.1991 HLP (average) Days in month 31 (41) 4. Water heating energy requirements (kWh/year) 1.9774 (42) 81.1630 (43) Assumed occupancy Average daily hot water use (litres/day) Feb Jun Jul Aug Nov Apr May Sep Daily hot water use 89.2793 82.7863 79.5398 76.2932 73.0467 73.0467 86.0328 79.5398 Energy conte 132.3986 115.7967 119.4918 104.1759 99.9592 86.2572 79.9300 91.7208 92.8163 108.1684 118.0743 128.2210 (45) 1277.0102 (45) Energy content (annual)
Distribution loss (46)m = 0.15 x (45)m
19.8598 17.3695 17.9238 Total = Sum(45)m =Water storage loss: Store volume
a) If manufacturer declared loss factor is known (kWh/day):
Temperature factor from Table 2b 150.0000 (47) 1.3938 (48) 0.5400 (49)





CALCULAT	ION OF	TARGET E	MISSION	IS 09.	Jan 2014								
Enter (49) or												0.7527	(55)
Total storage			23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	
If cylinder co	23.3325	licated sola 21.0745		22.5798		22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss Total heat red	quired for				n month	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	
Solar input	178.9935 0.0000	157.8824	166.0867 0.0000	149.2677 0.0000	146.5541 0.0000	0.0000	126.5249 0.0000	138.3157 0.0000 Solar inp	137.9081 0.0000 ut (sum of	154.7633 0.0000 months) = St	163.1661 0.0000 um(63)m =	174.8159 0.0000 0.0000	(63)
Output from w		157.8824	166.0867	149.2677	146.5541	131.3491	126.5249	138.3157	137.9081	154.7633	163.1661	174.8159	(64)
Heat gains fro	om water he	eating, kWh/1	month 77.0070	70.7119	70.5124	64.7540	63.8526	Total p	er year (kW 66.9349	h/year) = Si 73.2419	ım(64)m = 75.3332	79.9094	
5. Internal ga	ains (see T	able 5 and	5a)										
Metabolic gair			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains	98.8695	98.8695 ed in Appen	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Appliances gas	15.4584	13.7300	11.1660	8.4534	6.3190	5.3348	5.7644	7.4928	10.0568	12.7694	14.9038	15.8880	(67)
Cooking gains	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)
Pumps, fans			32.8870 3.0000	32.8870		32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	32.8870 3.0000	
Losses e.g. e	vaporation	(negative v	alues) (Tab	le 5)	-79.0956		-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	
Water heating		ole 5) 107.3973	103.5040	98.2110	94.7747	89.9361	85.8234	91.0929	92.9651	98.4434	104.6294	107.4051	
Total interna	l gains	351.1473		322.5652	304.8677	287.6475	276.3503	281.5574	290.5062	308.3038	328.7509	343.9083	
6. Solar gains													
[Jan]		Area m2		Solar flux g Table 6a Specific data W/m2 or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W			
North	7.3200		200				0		0.77		23.7878		
Southwest			4.9		36.7938		0.6300		.7000	0.770	00	55.4362	(79)
Solar gains Total gains			206.4483 546.6257	284.1653 606.7305	346.4557 651.3234	356.9478 644.5952			232.7737 523.2798	158.4774 466.7812	95.7452 424.4961	67.2726 411.1808	
7. Mean inter	nal tempera	ture (heati	ng season)										
Temperature de Utilisation fa						Th1 (C)						21.0000	(85)
tau			Mar 57.4119		May	Jun 58.7010	Jul 58.7010	Aug 58.8045	Sep 58.4870	Oct 58.1485	Nov 57.9116	Dec 57.6660	
alpha util living a:	4.8100 rea		4.8275	4.8687		4.9134	4.9134	4.9203	4.8991	4.8766	4.8608	4.8444	
MTM	0.9955	0.9910	0.9790	0.9397	0.8382	0.6608	0.4975	0.5532	0.8024	0.9589	0.9909	0.9965	
MIT Th 2 util rest of 1	19.7838 19.9079 house	19.9425 19.9101	20.2012 19.9123	20.5387 19.9227	19.9246	20.9576 19.9336	19.9336	20.9859 19.9353	20.8902 19.9301	20.5396 19.9246	20.1027 19.9207	19.7552 19.9166	
MIT 2	0.9940 18.3055		0.9717 18.9124	0.9183 19.3933		0.5675 19.9066	0.3816 19.9306	0.4331 19.9297	0.7215 19.8462	0.9398 19.4052		18.2700	(90)
Living area f: MIT Temperature ac	19.0255	19.2219	19.5401	19.9512	20.2685	20.4185	20.4472	20.4441		Living area 19.9577		0.4871 18.9934 0.0000	(92)
adjusted MIT		19.2219	19.5401	19.9512	20.2685	20.4185	20.4472	20.4441	20.3547	19.9577	19.4239		
8. Space heat:													
Utilisation	Jan 0 9924	Feb 0.9856	Mar 0.9686	Apr 0.9190	May 0.8033	Jun 0.6116	Jul 0.4384	Aug 0.4918	Sep 0.7564	Oct 0.9405	Nov 0.9851	Dec 0.9939	(94)
Useful gains Ext temp.	428.8885	483.9558			523.2235	394.2337 14.6000		281.0264				408.6723	(95)
Heat loss rate	e W 1070.9212	1039.1701	944.0200	791.4974	612.4466	411.9707	272.3990	285.8353	444.4762	668.8568	884.4741	1066.2245	(97)
Month fracti Space heating	kWh	1.0000 373.1041		1.0000		0.0000	0.0000		0.0000	1.0000	1.0000		
Space heating Space heating		5/3.1041	JUO.4303	100.41/1	UD.382U	0.0000	0.0000	0.0000	0.0000			489.2188 2389.9551 39.9324	(98)
8c. Space cool	ling requir	ement											



Not applicable

Regs Region: England Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.03r08



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy red													
Fraction of sp Fraction of sp Efficiency of Efficiency of Space heating	pace heat fr main space secondary/s	om main sy: heating sy: upplementa:	stem(s) stem 1 (in	%)	m (Table 11)						0.0000 1.0000 93.5000 0.0000 2556.1017	(202) (206) (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	477.6723	373.1041	308.4363	168.4171	66.3820	0.0000	0.0000	0.0000	0.0000	170.9956	335.7289	489.2188	(98)
Space heating	efficiency 93.5000	(main heat: 93.5000	ing system 93.5000	1) 93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating			stem) 329.8784	180.1252	70.9968	0.0000	0.0000	0.0000	0.0000	182.8830	359.0684	523.2287	(211)
Water heating	requirement 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating	requirement		166.0867	149.2677	146.5541	131.3491	126.5249	138.3157	137.9081	154.7633	163.1661	174.8159	(64)
Efficiency of (217)m			86.4431	85.1363	82.8539	79.8000	79.8000	79.8000	79.8000	85.0802	86.6980	79.8000 87.4143	(216)
Fuel for water	r heating, k	Wh/month											
Water heating	fuel used	181.4110	192.1341	175.3279	1/6.882/	164.5978	158.5525	173.3280	172.8172	181.9028	188.2005	199.9855 2170.1516	
Annual totals Space heating Space heating	fuel - main											2556.1017 0.0000	
Electricity for central hear main heatin Total electric Electricity for Total delivered	ating pump ng flue fan city for the or lighting	above, kW		ix L)								30.0000 45.0000 75.0000 272.9997 5074.2530	(230e) (231) (232)
12a. Carbon di	ioxide emiss												
Space heating Space heating Water heating	- main syst	em 1						Energy kWh/year 2556.1017 0.0000 2170.1516		ion factor kg CO2/kWh 0.2160 0.0000 0.2160	k	Emissions cg CO2/year 552.1180 0.0000 468.7528	(263)
Space and water Pumps and fans Energy for lic Total CO2, kg, Emissions per Fuel factor (Emissions per Emissions per Target Carbon	er heating s ghting /m2/year m2 for spac electricity) m2 for ligh m2 for pump	e and wate: ting s and fans	-	7.0572 * 1.	55) + 2.367	4 + 0.6504,	rounded to	75.0000 272.9997		0.5190 0.5190		1020.8707 38.9250 141.6868 1201.4826 17.0572 1.5500 2.3674 0.6504 29.4600	(265) (267) (268) (272) (272a) (272b) (272c)







CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014 1. Overall dwelling dimensions Volume (m3) 155.6100 (1b) - (3b) (m) 2.6000 (2b) 59.8500 (1b) Ground floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)Dwelling volume 59.8500 $(3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =$ 155.6100 (5) main secondary total m3 per hour heating 0 0 Number of chimneys Number of open flues 0 * 40 = 0 * 20 = 2 * 10 = 0.0000 (6a) 0.0000 (6b) Number of intermittent fans Number of passive vents Number of flueless gas fires 20.0000 (7a) 0.0000 0 * 40 = Air changes per hour 20.0000 / (5) = Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0.1285 (8) Pressure test Measured/design q50 0.3285 (18) Infiltration rate Number of sides sheltered 2 (19) - [0.075 x (19)] (21) = (18) x (20) Shelter factor Infiltration rate adjusted to include shelter factor May 4.3000 1.0750 Aug 3.7000 0.9250 Sep 4.0000 1.0000 5.1000 1.2750 5.0000 1.2500 4.9000 1.2250 4.4000 1.1000 4.3000 4.5000 1.1250 4.7000 (22) 1.1750 (22a) Wind speed Wind factor Adj infilt rate 0.3560 0.3491 0.3421 0.3072 0.3002 0.2653 0.2653 0.2583 0.2792 0.3002 0.3142 0.3281 (22b) Effective ac 3. Heat losses and heat loss parameter A x U W/K 12.9071 2.6460 12.3263 Openings Element Gross NetArea U-value K-value W/m2K 1.0536 1.4000 12.2500 (27) Window (Uw = 1.10) Door Heat Loss Floor 1 1.8900 59.8500 (26) (28b) 0.2060 External Wall 1 Corridor wall External Roof 1 8.2500 31.6200 41.5200 1.1550 7.3364 4.5672 20.5000 12.2500 0.1400 (29a) Total net area of external elements Aum(A, m2) 155.3800 (31)Fabric heat loss, W/K = Sum (A x U) Party Wall 1 Party Ceilings 1 (26)...(30) + (32) = 40.9381 (33) 53.0200 (32) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35) Thermal bridges (Sum(L x Psi) calculated using Appendix K) Total fabric heat loss 8.6490 (36) 49.5871 (37) (33) + (36) =Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$ Jan Jun Jul (38)m 28.9304 Heat transfer coeff 78.5175 28.8040 28.6801 28.0983 27.9894 27 4826 27 4826 27 3888 27 9894 28.2096 28.4399 (38) 78.0269 (39) 77.6848 (39) 78.3911 78.2672 77.6853 77.0697 77.0697 76.9758 77.2649 77.7967 Average = Sum(39)m / 12 = Jan 1.3119 Apr 1.2980 May 1.2962 Aug 1.2861 1.3037 (40) 1.2980 (40) HLP (average) Days in month 31 2.8 31 3.0 31 30 31 31 30 31 30 31 (41) 4. Water heating energy requirements (kWh/year) 1.9774 (42) Assumed occupancy Average daily hot water use (litres/day) 81.1630 (43) Jan Apr May Jun Aug Sep Daily hot water use 89.2793 82.7863 86.0328 76.2932 73.0467 73.0467 76.2932 79.5398 86.0328 89.2793 (44) Energy conte 132.3986 128.2210 (45) 1277.0102 (45) 115.7967 119.4918 104.1759 99.9592 79.9300 92.8163 108.1684 118.0743 Energy content (and Distribution loss (annual) 0.0000 0.0000 0.0000 (46) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Water storage loss: Total storage loss





CALCULATI	ON OF I	FABRIC E	NERGY EI	FICIENC	Y 09 Ja	n 2014							
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(E.C.)
If cylinder cor		icated sola	r storage									0.0000	
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Heat gains from	28.1347		25.3920	22.1374	21.2413	18.3297	16.9851	19.4907	19.7235	22.9858	25.0908	27.2470	(65)
5. Internal gai													
Metabolic gains	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains			98.8695		98.8695 L9a), also s			98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Appliances gair					6.2888 or L13a), a			7.4570	10.0088	12.7085	14.8327	15.8122	(67)
	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)
umps, fans		32.8870 0.0000		32.8870	32.8870	32.8870	32.8870 0.0000	32.8870 0.0000	32.8870 0.0000	32.8870 0.0000	32.8870 0.0000	32.8870 0.0000	
osses e.g. eva	poration	(negative v		le 5)		-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	
Mater heating o	gains (Tab	le 5)											
Total internal	gains	36.6173	34.1290	30.7463	28.5502	25.4579	22.8295	26.1971	27.3937	30.8949	34.8483	36.6223	
	278.4294	277.3018	267.7492	252.0602	235.6131	220.1438	210.3288	213.6259	221.8868	237.6943	255.8987	270.0496	(73)
6. Solar gains													
[Jan]				rea	Solar flux		g		FF	Acces	ss	Gains	
				m2	Table 6a W/m2	Speci or	fic data Table 6b	Specific or Tab	data	facto Table 6	or	W	
North Southwest			7.3 4.9	200 300	10.6334 36.7938		0.7000 0.7000	0	.8000 .8000	0.770		30.2068 70.3952	
		177.6358 454.9376	262.1566 529.9058		439.9438 675.5568			368.0272 581.6531	295.5856 517.4724	201.2412 438.9355	121.5812 377.4799	85.4255 355.4751	
7. Mean interna 	ing heati tor for g	ng periods ains for li	in the livi	ng area fro nil,m (see	om Table 9, 7 Table 9a)	Th1 (C)			0	0	N	21.0000	(85)
au	Jan 52.9341 4.5289	Feb 53.0194	Mar 53.1033	Apr 53.5011	May 53.5762	Jun 53.9285	Jul 53.9285	Aug 53.9942	Sep 53.7922	Oct 53.5762	Nov 53.4245 4.5616	Dec 53.2669	
lpha til living are		4.5346 0.9937	4.5402 0.9830	4.5667 0.9456	4.5717 0.8464	4.5952	4.5952	4.5996	4.5861 0.8330	4.5717		4.5511	(0.5)
1TT	19.5776	19.7649	20.0634	20.4493	20.7712	0.6756	0.5157	0.5829	20.8438	0.9708	0.9946	0.9981	
h 2 til rest of ho	19.8315	19.8332	19.8348	19.8424	19.8438	19.8505	19.8505	19.8517	19.8479	19.8438	19.8409	19.8379	
	0.9965	0.9915	0.9768	0.9253	0.7920	0.5764	0.3880	0.4500	0.7531	0.9560	0.9924	0.9974	
MIT 2 Living area fra		18.7360	19.0323	19.4100	19.6960	19.8252	19.8473	19.8456		19.3891 Living area		18.5166 0.4871	(91)
MIT 'emperature adj	19.0497 justment	19.2371	19.5345	19.9162	20.2197	20.3689	20.4021	20.3966	20.2903	19.8903	19.3972	19.0153 0.0000	(92)
djusted MIT	19.0497	19.2371	19.5345	19.9162	20.2197	20.3689	20.4021	20.3966	20.2903	19.8903	19.3972	19.0153	(93)
. Space heatin	ng require	ment											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Jtilisation Jseful gains	0.9957	0.9901	0.9748 516.5381	0.9268 568.0319	0.8114 548.1635	0.6233 419.7505	0.4507 288.5990	0.5152 299.6768	0.7872 407.3692	0.9568 419.9562	0.9912 374.1753	0.9968	
xt temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
	158.1088	1123.9027		855.7967	660.9259	444.6045	293.0300	307.6433	478.2929	720.7101		1155.9961	
pace heating k		1.0000 452.5772	1.0000	1.0000	1.0000 83.8952	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	
pace heating pace heating p		402.0112	3/4./003	207.190/	03.0932	0.0000	0.0000	0.0000	5.0000		/ (4) =	2938.8182 49.1031	(98)
c. Space cooli	ng requir	ement											
Ext. temp.	Jan 4.3000	y and Augus Feb 4.9000	Mar 6.5000	e 10b Apr 8.9000	May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000	
Heat loss rate	0.0000	0.0000		0.0000		724.4548		585.0162	0.0000	0.0000	0.0000	0.0000	
Jtilisation Jseful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8842 640.5641	0.9342 532.7742	0.9078 531.0918	0.0000	0.0000	0.0000	0.0000	
Potal gains Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	860.9666 1.0000	820.9321 1.0000	753.4072 1.0000	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling k		0.0000	0.0000	0.0000	0.0000	158.6898	214.3895	165.4026	0.0000	0.0000	0.0000	0.0000	
	0.0000	0.0000	0.0000	0.0000	0.0000	100.0000	221.5055	100.4020	0.0000	0.0000	5.0000	0.0000	(101)





CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling Cooled fraction Intermittency fact	ton (Moble	10%)							fC =	cooled area	/ (4) =	538.4820 1.0000	
			0 0000	0 0000		0.0500	0.0500	0.0500	0 0000	0 0000			(100)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(IU6)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	39.6725	53.5974	41.3507	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												134.6205	(107)
Space cooling per	m2											2.2493	(108)
Energy for space l	heating											49.1031	(99)
Energy for space (2.2493	
Total	-											51.3524	(109)
Dwelling Fabric En	nergy Effi	ciency (DE	FEE)									51.4	(109)
3		2 '											





CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014 1. Overall dwelling dimensions Volume (m3) 155.6100 (1b) - (3b) (m) 2.6000 (2b) 59.8500 (1b) Ground floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)Dwelling volume 59.8500 $(3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =$ 155.6100 (5) main secondary total m3 per hour heating 0 0 Number of chimneys Number of open flues 0 * 40 = 0 * 20 = 2 * 10 = 0.0000 (6a) 0.0000 (6b) Number of intermittent fans Number of passive vents Number of flueless gas fires 20.0000 (7a) 0.0000 0 * 40 = Air changes per hour 20.0000 / (5) = Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0.1285 (8) Pressure test Measured/design q50 0.3785 (18) Infiltration rate Number of sides sheltered 2 (19) - [0.075 x (19)] (21) = (18) x (20) Shelter factor Infiltration rate adjusted to include shelter factor May 4.3000 1.0750 Aug 3.7000 0.9250 Sep 4.0000 1.0000 5.1000 1.2750 5.0000 1.2500 4.9000 1.2250 4.4000 1.1000 4.3000 4.5000 1.1250 4.7000 (22) 1.1750 (22a) Wind speed Wind factor Adj infilt rate 0.4102 0.4022 0.3539 0.3459 0.3057 0.3057 0.2976 0.3217 0.3459 0.3620 0.3781 (22b) 0.3941 Effective ac 3. Heat losses and heat loss parameter Openings A x U W/K 1.8900 Element Gross NetArea U-value K-value W/m2K 1.0000 1.3258 1.8900 (26) TER Opaque door TER Opening Type (Uw = 1.40) Heat Loss Floor 1 16.2405 7.7805 12.2500 59.8500 (27) (28b) 0.1300 8.2500 31.6200 41.5200 External Wall 1 20.5000 12.2500 0.1800 1.4850 (29a) Corridor wall External Roof 1 Total net area of external elements Aum(A, m2) 155.3800 (31)38.4852 Fabric heat loss, $W/K = Sum (A \times U)$ (26)...(30) + (32) =(33) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K Thermal bridges (Sum(L x Psi) calculated using Appendix K) Total fabric heat loss 250.0000 (35) 4.2440 (36) (33) + (36) =42.7292 (37) Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
Jan Feb Mar Apr May May 28.7473 Aug 27.9499 Sep 28.3336 29.8287 (38) m 29.9965 28.8918 28.0745 29.0397 29.3453 (38) 29.6643 28.0745 28.7473 Heat transfer coeff 72.7258 Average = Sum(39)m / 12 72 5580 72 3935 71 6210 71 4765 70 8037 70 8037 70 6791 71 0629 71 4765 71.7689 72.0746 (39) 71.6203 (39) Feb Apr 1.1967 May 1.1943 Jun 1.1830 Aug 1.1809 Sep 1.1873 Oct 1.1943 Nov 1.1991 1.2151 1.2123 1.2096 1.2043 (40) 1.1967 (40) 1.1830 HLP (average) Days in month 31 (41) 4. Water heating energy requirements (kWh/year) 1.9774 (42) 81.1630 (43) Assumed occupancy Average daily hot water use (litres/day) May Feb Jun Jul Aug Sep Nov Apr Daily hot water use 89.2793 82.7863 76.2932 73.0467 73.0467 79.5398 Energy conte 132.3986 115.7967 119.4918 104.1759 99.9592 86.2572 79.9300 91.7208 92.8163 108.1684 118.0743 128.2210 (45) 1277.0102 (45) Energy content (annual)
Distribution loss (46)m = 0.15 x (45)m
0.0000 0.0000 (Total = Sum(45)m =0.0000 0.0000 0.0000 Water storage loss: Total storage loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56) If cylinder contains dedicated solar storage





CALCULAT	ION OF	TARGET F	ABRIC EN	NERGY EI	FFICIENCY	09 Ja	n 2014						
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Primary loss Heat gains fro	0.0000 om water he 28.1347	0.0000 ating, kWh/s 24.6068	0.0000 month 25.3920	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 27.2470	
5. Internal ga	ains (see T	able 5 and	5a)										
Metabolic gair			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Appliances gai	ins (calcul		endix L, eq					7.4928	10.0568	12.7694	14.9038	15.8880	
Cooking gains			ix L, equat		148.1132 L15a), also 32.8870			127.3109 32.8870	131.8234 32.8870	141.4301 32.8870	153.5569 32.8870	164.9543 32.8870	
osses e.g. ev	0.0000 vaporation	0.0000 (negative v	0.0000 alues) (Tab	0.0000 le 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
ater heating		-79.0956 le 5) 36.6173	-79.0956 34.1290	-79.0956 30.7463	-79.0956 28.5502	-79.0956 25.4579	-79.0956 22.8295	-79.0956 26.1971	-79.0956 27.3937	-79.0956 30.8949	-79.0956 34.8483	-79.0956 36.6223	
otal internal	L gains	277.3673		252.1005	235.6432	220.1692	210.3563	213.6616	221.9348	237.7553	255.9698	270.1254	
. Solar gains	3												
Jan]			A:	rea	Solar flux		g		FF	Acces		Gains	
				m2	Table 6a W/m2			Specific or Tab	data le 6c	facto Table 6		W	
orth outhwest			7.3: 4.9:	300	10.6334 36.7938		0.6300 0.6300	0	.7000 .7000	0.770 0.770		23.7878 55.4362	
olar gains		139.8882		284.1653			338.6820		232.7737	158.4774	95.7452	67.2726	
otal gains	357.7272	417.2555	474.2508	536.2658	582.0989	577.1170	549.0383	503.4831	454.7084	396.2327	351.7150	337.3980	(84)
. Mean interr 'emperature du												21.0000	(85)
tilisation fa	actor for g Jan	ains for li	ving area, mar	nil,m (see Apr	Table 9a) May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
au lpha til living ar	57.1496 4.8100	57.2818 4.8188	57.4119 4.8275	58.0311 4.8687	58.1485 4.8766	58.7010 4.9134	58.7010 4.9134	58.8045 4.9203	58.4870 4.8991	58.1485 4.8766	57.9116 4.8608	57.6660 4.8444	
211 1111119 01	0.9980	0.9955	0.9880	0.9608	0.8799	0.7176	0.5517	0.6170	0.8602	0.9777	0.9959	0.9985	(86)
IT h 2	19.6702 19.9079	19.8320 19.9101	20.0979 19.9123	20.4533 19.9227	20.7625 19.9246	20.9392 19.9336	20.9865 19.9336	20.9774 19.9353	20.8454 19.9301	20.4459 19.9246	19.9933 19.9207	19.6420 19.9166	
itil rest of h	0.9973 18.7009	0.9939 18.8638	0.9837 19.1292	0.9456 19.4833	0.8339 19.7651	0.6237 19.9060	0.4260 19.9303	0.4882 19.9289	0.7897 19.8440	0.9663 19.4831	0.9942 19.0335	0.9980 18.6797	
iving area fr	raction 19.1730	19.3353	19.6010	19.9557	20.2509	20.4092	20.4447	20.4396		Living area 19.9521		0.4871 19.1484	(91) (92)
emperature ad djusted MIT		19.3353	19.6010	19.9557	20.2509	20.4092	20.4447	20.4396	20.3318	19.9521	19.5009	0.0000 19.1484	
. Space heati	ing require	ment											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	40.51
Itilisation Iseful gains Ext temp.		0.9928 414.2655 4.9000	0.9821 465.7470 6.5000	0.9461 507.3772 8.9000	0.8494 494.4406 11.7000	0.6679 385.4469 14.6000	0.4877 267.7808 16.6000	0.5515 277.6575 16.4000	0.8193 372.5525 14.1000	0.9667 383.0255 10.6000	0.9933 349.3716 7.1000	0.9975 336.5609 4.2000	(95)
eat loss rate	⊎ W 1081.6500	1047.3986	948.4291	791.8233	611.1881	411.3142	272.2210	285.5147	442.8461	668.4520	890.0020	1077.3986	(97)
Nonth fracti Space heating		1.0000	1.0000 359.1155	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 551.1833	
Space heating Space heating		4.00.4004	555.1133	204.0012	00.0002	0.0000	3.0000	0.0000	0.0000		/ (4) =	2768.5063 46.2574	(98)
c. Space cool	ling requir	ement											
Calculated for	June, Jul	y and Augus Feb	t. See Table Mar	e 10b Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp. Heat loss rate	4.3000 W 0.0000	4.9000	0.0000	8.9000 0.0000		14.6000 665.5549	16.6000 523.9474	16.4000 537.1613	0.0000	0.0000	7.1000	4.2000 0.0000	
Utilisation Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8757	0.9308 487.6721	0.9050	0.0000	0.0000	0.0000	0.0000	(101)
Total gains Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	0.0000	0.0000	(103)
Space cooling Space cooling	kWh 0.0000	0.0000	0.0000	0.0000	0.0000	119.2510	168.5226	130.9054	0.0000	0.0000	0.0000	0.0000 418.6790	
space courrily	on								fC =	cooled area	a / (4) =	1.0000	





CALCULATIO	ON OF TA	ARGET FA	ABRIC EN	ERGY EFI	FICIENCY	09 Jai	n 2014						
Intermittency fa	actor (Tabl	e 10b) 0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kV		0.0000	0.0000	0.0000	0.0000	0.2300	0.2300	0.2300	0.0000	0.0000	0.0000	0.0000	(100)
Space cooling pe Space cooling pe Energy for space Energy for space Total Target Fabric Er	0.0000 er m2 e heating e cooling	0.0000	0.0000	0.0000	0.0000	29.8127	42.1306	32.7264	0.0000	0.0000	0.0000	0.0000 104.6697 1.7489 46.2574 1.7489 48.0063 55.2	(107) (108) (99) (108) (109)





CALCULATION OF HEAT DEMAND	09 Jan 2014
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SAP 2012 WORKSH			s Designed) Jan 2014	(Version	9.92, Januar	y 2014)							
1. Overall dwel		sions											
Ground floor Total floor are Dwelling volume		a)+(1b)+(1c	c)+(1d)+(1e)(ln)	5	9.8500		Area (m2) 59.8500		orey height (m) 2.6000 c)+(3d)+(3e)		Volume (m3) 155.6100 155.6100	(4)
. Ventilation													
					main heating		econdary heating		other	tot		3 per hour	
Number of chimn Number of open Number of inter Number of passi Number of fluel	flues mittent fa: ve vents				0	+ +	0	+ +	0	=	0 * 40 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000	(6b) (7a) (7b)
Infiltration duressure test leasured/design Infiltration ra	q50 te	eys, flues	and fans	= (6a) + (6b))+(7a)+(7b)+(7c) =				0.0000	Air change / (5) =	0.0000 Yes 4.0000 0.2000	
helter factor nfiltration ra		d to includ	de shelter	factor						- [0.075 x (21) = (18)		0.8500 0.1700	(20)
lind speed lind factor	Jan 4.3000 1.0750	Feb 4.1000 1.0250	Mar 4.1000 1.0250	Apr 3.8000 0.9500	May 3.9000 0.9750	Jun 3.4000 0.8500	Jul 3.5000 0.8750	Aug 3.4000 0.8500		Oct 3.7000 0.9250	Nov 3.6000 0.9000	Dec 4.0000 1.0000	
dj infilt rate Balanced mecha f mechanical v	0.1828 nical vent		0.1743 ch heat rec	0.1615 overy	0.1658	0.1445	0.1488	0.1445	0.1445	0.1573	0.1530	0.1700	
f balanced wit	0.3003	overy: effi 0.2918	0.2918	% allowing : 0.2790	for in-use fa 0.2833	0.2620	m Table 4h) 0.2663	0.2620	0.2620	0.2748	0.2705	76.5000 0.2875	
. Heat losses				Gross	Openings		tArea	U-value	A		-value	AxK	
dindow (Uw = 1. oor eat Loss Floor external Wall 1 orridor wall external Roof 1 otal net area abric heat los arty Wall 1	1 of externa		Aum(A, m2)	m2 20.5000 33.5100 41.5200	m2 12.2500 1.8900	12. 1. 59. 8. 31. 41.	m2 .8500 .8900 .8500 .2500 .6200 .5200 .3800 (26)(W/m2K 1.0536 1.4000 0.2060 0.1400 0.2320 0.1100 30) + (32) 0.0000	12.90 2.64 12.32 1.15 7.33 4.56	071 160 263 550 864 572	kJ/m2K	kJ/K	(27) (26) (28b) (29a) (29a) (30) (31) (33) (32)
earty Ceilings Thermal mass pa Thermal bridges Total fabric he	rameter (TI	MP = Cm / T Psi) calcul	FFA) in kJ/ Lated using	m2K Appendix K)	18.	.3300			(33)	+ (36) =	250.0000 8.6490 49.5871	(36)
entilation hea	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38)m eat transfer c .verage = Sum(3	65.0053	14.9817 64.5688	14.9817 64.5688	14.3270 63.9141	14.5453 64.1323	13.4540	13.6723 63.2593	13.4540 63.0411		14.1088 63.6958	13.8905 63.4776	14.7635 64.3506 63.8413	(39)
LP LP (average)	Jan 1.0861	Feb 1.0788	Mar 1.0788	Apr 1.0679	May 1.0716	Jun 1.0533	Jul 1.0570	Aug 1.0533	Sep 1.0533	Oct 1.0643	Nov 1.0606	Dec 1.0752 1.0667	
ays in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)
. Water heatin	g energy r	equirements	kWh/year)									
assumed occupan average daily h	су											1.9774 81.1630	
aily hot water	Jan use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte Energy content	89.2793 132.3986	86.0328 115.7967	82.7863 119.4918	79.5398 104.1759	76.2932 99.9592	73.0467 86.2572	73.0467 79.9300	76.2932 91.7208		82.7863 108.1684 Total = S	86.0328 118.0743 um(45)m =	89.2793 128.2210 1277.0102	(45)





	ION OF H	IEAT DEN	MAND	09 Jan 2	014								
Distribution 1		= 0.15 x (15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(46)
Water storage Store volume	loss:				14.9939	12.9300	11.9093	13.7301	13.9224	10.2255	17.7111	150.0000	
b) If manufa Hot water st	torage loss	factor from			lay)							0.0103	
Volume factor Temperature Enter (49) or	factor from	n Table 2b										0.9283 0.5400 0.7736	(53)
Total storage	23.9825		23.9825	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	(56)
If cylinder co	23.9825	21.6616	23.9825		23.9825 23.2624	23.2088 22.5120	23.9825 23.2624	23.9825 23.2624	23.2088 22.5120	23.9825 23.2624	23.2088 22.5120	23.9825 23.2624	
Total heat red	179.6435	158.4695	166.7367	149.8967	147.2041			138.9657				175.4659	
Solar input Output from w	0.0000 /h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 Solar inp	0.0000 ut (sum of	0.0000 months) = Si	0.0000 am(63)m =	0.0000	
DUT b		158.4695	166.7367	149.8967	147.2041	131.9780	127.1748			155.4133 Jh/year) = Si		1833.2804	(64)
RHI water heat Heat gains fro		ating, kWh/1 72.6406		71.2151	71.0323	65.2572	64.3726	68.2931	67.4381	73.7619	75.8364	1833 80.4294	
5. Internal ga	ains (see Ta	able 5 and	5a)										
Metabolic gair		, Watts	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains	118.6434 s (calculate	118.6434 ed in Appen	118.6434 dix L, equa	118.6434 tion L9 or	118.6434 L9a), also	118.6434 see Table 5	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	
Appliances gas	ins (calcula	ated in App	endix L, eq	uation L13	15.7221 or L13a), a 221.0645	lso see Tab		18.6425	25.0220 196.7514	31.7712 211.0897	37.0816 229.1894	39.5305 246.2004	
Cooking gains	(calculated	d in Append	ix L, equat	ion L15 or		see Table		48.8417	48.8417	48.8417	48.8417	48.8417	
Pumps, fans Losses e.g. ev					3.0000	3.0000 -79.0956	3.0000 -79.0956	3.0000	3.0000	3.0000	3.0000	3.0000	
Water heating	gains (Tabl		-79.0956 104.2029	98.9099	-79.0956 95.4736	90.6350	86.5223	-79.0956 91.7918	-79.0956 93.6640	-79.0956 99.1423	-79.0956 105.3283	-79.0956 108.1040	
Total internal	l gains			450.4961	423.6496		384.9430	391.8401	406.8269	433.3928	462.9888	485.2244	
6. Solar gains	S												
[Jan]			7		Solar flux		g						
				rea	moble Ce	Connei	eia daka	Connifia	FF	Acce:		Gains	
				m2	Table 6a W/m2	Speci: or '	fic data Table 6b	Specific or Tab	FF data le 6c	Acce: facto Table	or	Gains W	
North Southwest			7.3 4.9	m2 200 300	Table 6a W/m2 11.5683 39.0225	Speci: or '	fic data Table 6b 0.7000 0.7000	0 0	FF data le 6c .8000	fact	or 5d 00		
North Southwest	107.5218	171.0326	7.3 4.9 	m2 	Table 6a W/m2 11.5683 39.0225	Speci: or '	fic data rable 6b 0.7000 0.7000 453.1853	399.0462	data le 6c .8000 .8000	factor Table (0.77) 0.77)	or 5d 00 00 134.3037	32.8626 74.6591 89.5721	(79) (83)
North Southwest 	107.5218 604.9087	171.0326 664.9171	7.3 4.9 255.0993 731.9759	m2 200 300 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116	Speci: or 9	fic data Table 6b 0.7000 0.7000 453.1853 838.1283	0 0 399.0462 790.8863	data le 6c .8000 .8000	factor Table 0.770 0.770	or 5d 00 00 134.3037	32.8626 74.6591 89.5721	(79) (83)
North Southwest 	107.5218 604.9087	171.0326 664.9171	7.3 4.9 255.0993 731.9759	m2 200 300 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116	Speci: or 9	fic data Table 6b 0.7000 0.7000 453.1853 838.1283	0 0 399.0462 790.8863	data le 6c .8000 .8000	factor Table 0.770 0.770	or 5d 00 00 134.3037	32.8626 74.6591 89.5721	(79) (83)
North Southwest Solar gains Total gains	107.5218 604.9087 nal temperat	171.0326 664.9171 cure (heati	7.3 4.9 255.0993 731.9759 ng season) in the livi	m2 200 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9, Table 9a)	Speci or 9	fic data Table 6b 0.7000 0.7000 453.1853 838.1283	399.0462 790.8863	data le 6c .8000 .8000 316.8212 723.6481	factor Table 0.771	134.3037 597.2925	W 32.8626 74.6591 89.5721 574.7965	(79) (83) (84)
North Southwest Solar gains Total gains 7. Mean interr Temperature di	107.5218 604.9087 nal temperat	171.0326 664.9171 cure (heating	7.3 4.9 255.0993 731.9759 ng season) in the livi	m2 200 365.2187 815.7148 ng area frc nil,m (see Apr 65.0287	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 mm Table 9a) May 64.8074 8074	Speci or 9	Jul 65.7018	0 0 399.0462 790.8863	data le 6c .8000 .8000	factor Table (0.77) 0.77) 0.77) 212.1159 645.5087	or 5d 00 00 134.3037	W 32.8626 74.6591 89.5721 574.7965	(79) (83) (84)
North Southwest Solar gains Total gains Total gains Total gains Temperature di Utilisation fa	107.5218 604.9087 nal temperaturing heating actor for 3 Jan 63.9371 5.2625	171.0326 664.9171 ure (heating periods ains for live Feb 64.3693	7.3 4.9 255.0993 731.9759 ng season) in the livi ving area, Mar 64.3693	m2 200 365.2187 815.7148 mg area fr nii,m (see Apr 65.0287 5.3352	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9, Table 9a) May 64.8074 5.3205	479.0060 878.3572 Th1 (C) Jun 65.9292	Jul 65.7018 5.3801	399.0462 790.8863	data le 6c .8000 .8000 316.8212 723.6481	factor Table (0.77) 0.77) 0.77) 212.1159 645.5087	Nov 65d 134.3037 597.2925	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058	(79) (83) (84)
North Southwest Solar gains Total gains Total gains Total gains Temperature du Utilisation fatau alpha	107.5218 604.9087 nal temperaturing heatinactor for gause Jan 63.9371 5.2625	171.0326 664.9171 cure (heating periods sins for li- Feb 64.3693 5.2913 0.9515	7.3 4.9 255.0993 731.9759 ng season) in the livi ving area, Mar 64.3693 5.2913 0.8900	m2 200 365.2187 815.7148 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 m Table 9a) May 64.8074 5.3205 0.5419 20.9379	479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953	Jul 65.7018 5.3801	399.0462 790.8863 Aug 65.9292 5.3953 0.2072 20.9496	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953	factor Table 10 0.771 0.771 0.771 212.1159 645.5087 Oct 65.2515 5.3501 0.7719 20.8824	Nov 65.4759 5.3651 0.9356 20.6686	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357	(85) (86) (87)
North Southwest Solar gains Total gains Total gains Total gains Total gains Total gains Temperature di Utilisation for tau alpha util living an MIT Th 2 util rest of h	107.5218 604.9087 anal temperata uring heatin actor for ga Jan 63.9371 5.2625 rea 0.9708 20.4556 20.0122 house 0.9621	171.0326 664.9171 ure (heati: ng periods sins for li- Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378	7.3 4.9 255.0993 731.9759 ng season) in the livi ving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613	m2 200 365.2187 815.7148 365.2187 815.7148 ng area frc nil,m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 mm Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747	479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084	399.0462 790.8863 Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307	Sep 65,9292 5.3953 0.4495 20.9466 20.0391 0.3682	0.771 0.771 212.1159 645.5087 Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685	(79) (83) (84) (85) (86) (87) (88) (89)
North Southwest Solar gains Total gains Total gains 7. Mean interr Temperature du Utilisation fa tau alpha util living an	107.5218 604.9087 nal temperat uring heatin actor for ga Jan 63.9371 5.2625 rea 20.4556 20.0122 house 0.9621 19.3177 raction	171.0326 664.9171 cure (heating periods sins for li- Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625	7.3 4.9 255.0993 731.9759 in the livi ving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181	m2 200 365.2187 815.7148 ng area fro ni,m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9, Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241	79.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391	Jul 65.7018 5.3801 0.1811 20.9495 20.0361	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654	data le 6c .8000 .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640	Cot 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living area	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a/(4) =	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871	(85) (86) (87) (88) (89) (90)
North Southwest	107.5218 604.9087 nal temperat uring heatir actor for ge Jan 63.9371 5.2625 rea 20.4556 20.0122 house 0.9621 19.3177 raction 19.8719 19.8719	171.0326 664.9171 cure (heating periods ains for live Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625	7.3 4.9 255.0993 731.9759 ng season) in the livi ving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 19.7001 20.2028	m2 200 365.2187 815.7148 ng area fro nil,m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884 20.3720	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9, Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269	479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 fLA =	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Elving are 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a / (4) = 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Solar gains Total gains Temperature de Utilisation fa tau alpha util living an MIT Th 2 util rest of h MIT 2 Living area for MIT Temperature ac adjusted MIT	107.5218 604.9087 and temperatering heating actor for graph of the second of the secon	171.0326 664.9171 	7.3 4.9 255.0993 731.9759 In the liviving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028	m2 200 365.2187 815.7148 365.2187 815.7148 ng area frc nil,m (see Apre 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884 20.3720 20.3720	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 m Table 9, Table 9, May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269	3peci: or / 479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445 20.4445	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431 20.4431	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448	data le 6c .8000 .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 gLA = 20.4426	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.918973 ELiving are 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a / (4) = 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest	107.5218 604.9087 anal temperatering heating actor for garantering heating actor for garantering rection 19.8719 djustment 19.8719	171.0326 664.9171	7.3 4.9 255.0993 731.9759 ng season) in the livi ving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028	m2 200 365.2187 815.7148 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 m Table 9a May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269	Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 20.4431 20.4431	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448	data le 6c .8000 .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 gLA = 20.4426	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.918973 ELiving are 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a / (4) = 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Solar gains Total gains Total gains 7. Mean interr Temperature dutilisation fa tau alpha util living an MIT Th 2 util rest of l MIT 2 Living area fr MIT Temperature ac adjusted MIT 8. Space heat:	107.5218 604.9087 and temperatering heating actor for graph of the second of the secon	171.0326 664.9171 	7.3 4.9 255.0993 731.9759 In season) in the liviving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028	m2 200 365.2187 815.7148 365.2187 815.7148 365.2187 91 area from from from from from from from from	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 mm Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269	Speci: or 1 479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 fLA = 20.4426 20.4426	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living are. 20.3771 20.3771	Nov 65.4759 5.3651 0.9356 0.9356 20.6686 20.0331 0.9149 19.6337 a/(4) = 20.1378 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 70.0211 0.9685 19.2973 0.4871 19.8517 0.0000 19.8517	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Solar gains Total gains Total gains 7. Mean interr Temperature di Utilisation fa tau alpha util living an MIT Th 2 util rest of ! MIT 2 Living area fr MIT Temperature ad adjusted MIT 8. Space heat:	107.5218 604.9087 mal temperataring heating actor for garantaring heating actor for garantaring actor for gar	171.0326 664.9171 Eure (heating periods ains for limple for the feb of the f	7.3 4.9 255.0993 731.9759 ng season) in the livi ving area, Mar 20.8672 634.7905	m2 200 365.2187 815.7148 365.2187 815.7148 area fro nii,m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884 20.3720 20.3720 Apr 0.7127	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 m Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269	A79.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445 20.4445	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 20.4431 20.4431 Jul 61.391	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448 20.4448	data le 6c .8000 .8000 .8000 .8000 .8000 .8000 .8000 .8000 .80212 .723.6481 .8212 .723.6481 .8212 .723.6481 .8212 .723.6481 .8212 .723.6481 .8212 .829 .829 .820 .820 .820 .820 .820 .820 .820 .820	Cot 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Eliving are, 20.3771 20.3771 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a / (4) = 20.1378 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 59.2973 0.4871 19.8517 Dec 0.9670	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest Solar gains Total gains Temperature de Utilisation fe tau alpha util living an MIT Th 2 Living area fr MIT Temperature ac adjusted MIT 8. Space heat: Utilisation Useful gains Ext temp. Heat loss rate	107.5218 604.9087 anal temperate tring heating actor for garage triangles and the second sec	171.0326 664.9171 ure (heati: 19 periods sins for li Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625 19.9951 19.9951	7.3 4.9 255.0993 731.9759 In the liviving area, Mar 64.3693 20.0181 0.8613 19.7001 20.2028 20.2028 Mar 0.8672 634.7905 8.1000 781.4664	m2 200 365.2187 815.7148 365.2187 815.7148 365.2287 365.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884 20.3720 20.3720 Apr 0.7127 581.3971 10.6000 624.5658	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116	Speci: or 1 479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445 Jun 0.2757 242.1915 16.6000 242.3603	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431 20.4431 116.5880 18.6000 116.5905	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448 20.4448 20.4448 20.1630 128.8980 18.4000 128.9040	data le 6c .8000 .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 fLA = 20.4426 Sep 0.4026 20.4426	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living are: 20.3771 20.3771 0ct 0.7340 473.8332 12.3000 514.4769	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a/(4) = 20.1378 Nov 0.9174 547.9783 8.5000 738.7370	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 9.8517 0.0000 19.8517	(79) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest	107.5218 604.9087 anal temperation of the properties of the prope	171.0326 664.9171 Ture (heating periods in for life for	7.3 4.9 255.0993 731.9759 Ing season) in the liviving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028	m2 200 365.2187 815.7148 365.2187 815.7148 ang area froil, m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884 20.3720 20.3720 Apr 0.7127 581.3971 10.6000 624.5658 1.0000	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9a May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269 May 0.5028 431.7826 13.6000 437.8266 1.0000	Speci: or 1 479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445 20.4445	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431 20.4431 116.5880 18.6000 116.5905	Aug 65,9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448 20.4448	data le 6c .8000 .	Cot 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living are: 20.3771 20.3771 20.3771 20.3771 20.3771 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a/(4) = 20.1378 20.1378 Nov 0.9174 547.9783 8.5000 738.7370 1.0000	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 Dec 0.9670 555.8134 5.6000	(85) (86) (87) (88) (89) (90) (91) (92) (93)





CALCULATION OF HEAT DEMAND	09 Jan 2014	
RHI space heating demand		1023 (98)

elmhurst energy



CALCULATION OF ENERGY RATINGS 09 Jan 2
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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF ENERGY RATINGS 09 Jan 2014 1. Overall dwelling dimensions Volume (m3) 155.6100 (1b) - (3b) (m) x 2.6000 (2b) 59.8500 (1b) Ground floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)Dwelling volume 59.8500 $(3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =$ 155.6100 (5) main secondary total m3 per hour heating 0 0 Number of chimneys Number of open flues Number of intermittent fans Number of passive vents Number of flueless gas fires 0 * 40 = 0 * 20 = 0 * 10 = 0.0000 (6a) 0.0000 (6b) 0.0000 (7a) 0.0000 0 * 40 = Air changes per hour Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0.0000 / (5) = 0.0000 (8) Pressure test Measured/design q50 0.2000 (18) 2 (19) Infiltration rate Number of sides sheltered - [0.075 x (19)] (21) = (18) x (20) Shelter factor Infiltration rate adjusted to include shelter factor May 4.3000 1.0750 Aug 3.7000 0.9250 5.1000 1.2750 5.0000 4.9000 1.2250 4.4000 1.1000 4.3000 4.5000 1.1250 4.7000 (22) 1.1750 (22a) Wind speed Wind factor Adj infilt rate 0.2168 0.2125 0.2083 0.1870 0.1828 0.1615 0.1573 0.1700 0.1913 0.1998 (22b) 0.1615 0.1828 Balanced mechanical ventilation with heat recovery

If mechanical ventilation:

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.5000 (23a) 76.5000 (23c) Effective ac 0.3343 0.3300 0.3258 0.3045 0.3003 0.2790 0.2790 0.2748 0.2875 0.3003 0.3088 0.3173 (25) K-value Element Gross Openings NetArea U-value AxU W/m2K 1.0536 1.4000 W/K 12.9071 2.6460 kJ/m2K kJ/K 12.2500 Window (Uw = 1.10) Door Heat Loss Floor 1 59.8500 12.3263 (28b) 0.2060 External Wall 1 Corridor wall External Roof 1 12.2500 20.5000 8.2500 0.1400 1.1550 31.6200 41.5200 155.3800 (29a) (30) (31) 1 8900 Total net area of external elements Aum(A, m2) (26)...(30) + (32) = 40.9381 Fabric heat loss, $W/K = Sum (A \times U)$ (33) 53.0200 18.3300 Party Wall 1 Party Ceilings 1 0.0000 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K Thermal bridges (Sum(L x Psi) calculated using Appendix K) Total fabric heat loss 250.0000 (35) 8.6490 (36) (33) + (36) = 49.5871 (37) Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$ Jan 17.1642 Feb 16.9459 Mar 16.7277 Apr 15.6365 Jul 14.3270 May 15.4182 Jun 14.3270 Aug 14.1088 Oct 15.4182 Nov 15.8547 Dec 16.2912 (38) (38)m 66.5330 66.3147 65.2235 65.0053 63.9141 63.9141 63.6958 64.3506 65.0053 Average = Sum(39)m / 12 = May 1.0861 Jun 1.0679 J111 Apr 1.0898 Aug 1.0643 Sep 1.0752 Oct 1.0861 1.1117 1.1007 (40) 1.0889 (40) HLP (average) 1.1153 1.1080 1.0679 1.0934 Days in month 31 (41) 31 28 31 30 31 30 31 31 30 31 30 4. Water heating energy requirements (kWh/year) Assumed occupancy Average daily hot water use (litres/day) 1.9774 (42) 81.1630 (43) Sep Мау Jul Aug Apr Jun Daily hot water use 89.2793 86.0328 82.7863 79.5398 76.2932 73.0467 73.0467 76.2932 79.5398 82.7863 86.0328 89.2793 (44) 108.1684 118.0743 Total = Sum(45)m = 128.2210 (45) 1277.0102 (45) 115.7967





CALCULAT	TION OF E	NERGY F	RATINGS	09 Jar	า 2014								
Distribution				15 6064	14 0000	10.0006				1.5 0050		10.0000	446
Water storage Store volume		17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	
b) If manuf Hot water s					lay)							0.0103	
Volume fact Temperature	or from Tabl factor from	le 2a m Table 2b			•							0.9283 0.5400	(52) (53)
Enter (49) or Total storage	loss		22 0025	22 2000	22 0025	22 2000	22 0025	22 0025	22 2000	22 0025	22 2000	0.7736	
If cylinder c	ontains dedi	21.6616 icated sola: 21.6616	r storage		23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	
Primary loss Total heat re	23.2624 quired for v	21.0112 water heati	23.2624	22.5120 ed for each	23.2624 n month	22.5120	23.2624		22.5120		22.5120		
Solar input	179.6435 0.0000		166.7367		147.2041		127.1748	0.0000	0.0000		0.0000	175.4659 0.0000 0.0000	(63)
Output from w		158.4695	166.7367	149.8967	147.2041	131.9780	127.1748			155.4133 h/year) = Su			
Heat gains fr		ating, kWh/1 72.6406		71.2151	71.0323	65.2572	64.3726	68.2931	67.4381	73.7619	75.8364	80.4294	(65)
5. Internal g	ains (see Ta	able 5 and	5a)										
Metabolic gai	ns (Table 5)		Mar			Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gain	118.6434	118.6434	118.6434		May 118.6434	118.6434	118.6434			118.6434		118.6434	(66)
Appliances ga	38.4615	34.1612	27.7817	21.0326	15.7221	13.2732	14.3422	18.6425	25.0220	31.7712	37.0816	39.5305	(67)
Cooking gains	(calculated	d in Append	ix L, equat	ion L15 or		see Table	5				229.1894	246.2004	
Pumps, fans	3.0000	3.0000	3.0000	3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	
Losses e.g. e Water heating	-79.0956	-79.0956			-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Total interna	109.9710	108.0962	104.2029	98.9099	95.4736	90.6350	86.5223	91.7918	93.6640	99.1423	105.3283	108.1040	(72)
		493.8845	476.8766	450.4961	423.6496	399.3512	384.9430	391.8401	406.8269	433.3928	462.9888	485.2244	(73)
6. Solar gain													
[Jan]				m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acces facto Table 6	ss or 6d	Gains W	
[Jan] North Southwest			7.3 4.9	m2 200 300	Table 6a W/m2 10.6334 36.7938	Speci or '	fic data Pable 6b 0.7000 0.7000	Specific or Tab: 0	data le 6c	Acces facto Table 6 0.770 0.770	or 6d 00		
North Southwest	100.6020	177.6358	7.3 4.9 262.1566	m2 200 300 360.8448	Table 6a W/m2 10.6334 36.7938	Speci or '	fic data Table 6b 0.7000 0.7000 430.0724	Specific or Tab: 0 0	data le 6c .8000 .8000	factor Table 6	200 00 121.5812	W 30.2068 70.3952 85.4255	(79) (83)
North Southwest Solar gains Total gains	100.6020 597.9889	177.6358 671.5203	7.3 4.9 262.1566 739.0331	m2 200 300 360.8448 811.3409	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934	Speci or 453.2670 852.6181	0.7000 0.7000 0.7000 430.0724 815.0154	Specific or Tab:	data le 6c .8000 .8000	factor Table 6	200 00 121.5812	W 30.2068 70.3952 85.4255	(79) (83)
North Southwest Solar gains Total gains Total gains Tramperature d	100.6020 597.9889 nal temperat	177.6358 671.5203 ture (heating periods	7.3 4.9 262.1566 739.0331	m2 200 300 360.8448 811.3409	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934	Speci or	0.7000 0.7000 0.7000 430.0724 815.0154	Specific or Tab:	data le 6c .8000 .8000	factor Table 6	200 00 121.5812	W 30.2068 70.3952 85.4255	(79) (83) (84)
North Southwest Solar gains Total gains	100.6020 597.9889 nal temperat	177.6358 671.5203 ture (heating periods	7.3 4.9 262.1566 739.0331 ang season) in the livi	m2 200 300 360.8448 811.3409	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934	Speci or	0.7000 0.7000 0.7000 430.0724 815.0154	Specific or Tab:	data le 6c .8000 .8000	factor Table 6	200 00 121.5812	W 30.2068 70.3952 85.4255 570.6499	(79) (83) (84)
North Southwest	100.6020 597.9889 nal temperat uring heatir actor for ge Jan 62.2648 5.1510	177.6358 671.5203 ture (heating periods ains for live Feb 62.4690 5.1646	7.3 4.9 262.1566 739.0331 in the livi ving area; Mar 62.6746 5.1783	m2 200 360.8448 811.3409 ng area froil, m (see Apr 63.7232 5.2482	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 om Table 9, 17 Table 9a) May 63.9371 5.2625	Speci or 453.2670 852.6181 Ph1 (C) Jun 65.0287 5.3352	Jul 65.0287 5.3352	Specific or Tab: 0 0 368.0272 759.8673 Aug 65.2515 5.3501	data de 6c .8000 .8000 295.5856 702.4125	factor Table 6 0.770 0.7	Nov 63.5107 5.2340	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060	(83) (84)
North Southwest	100.6020 597.9889 	177.6358 671.5203 ture (heating periods : ins for lifeb 62.4690 5.1646 0.9646	7.3 4.9 262.1566 739.0331 season) in the livi ving area, Mar 62.6746 5.1783 0.9263	m2 200 360.8448 811.3409 ang area froil, m (see Apr 63.7232 5.2482 0.8281	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 Dom Table 9, 17 Table 9a) May 63.9371 5.2625 0.6640	Speci or 453.2670 852.6181 Th1 (C) Jun 65.0287 5.3352 0.4748	Jul 65.0287 5.3352 0.3443	Specific or Tab: 0 0 368.0272 759.8673 Aug 65.2515 5.3501 0.3841	data le 6c .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105	factor Table 6 0.770 0.770 201.2412 634.6339 Oct 63.9371 5.2625 0.8656	Nov 63.5107 5.2340 0.9623	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843	(83) (84) (85)
North Southwest	100.6020 597.9889 mal temperaturing heating actor for gradies Jan 62.2648 5.1510 rea 0.9808 20.3217 19.9884	177.6358 671.5203 ture (heating periods ains for live Feb 62.4690 5.1646	7.3 4.9 262.1566 739.0331 in the livi ving area; Mar 62.6746 5.1783	m2 200 360.8448 811.3409 ng area froil, m (see Apr 63.7232 5.2482	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 mm Table 9a) May 63.9371 5.2625 0.6640 20.9114	Speci or 453.2670 852.6181 Ph1 (C) Jun 65.0287 5.3352	Jul 65.0287 5.3352	Specific or Tab: 0 0 368.0272 759.8673 Aug 65.2515 5.3501	data de 6c .8000 .8000 295.5856 702.4125	factor Table 6 0.770 0.7	Nov 63.5107 5.2340	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006	(83) (84) (85)
North Southwest	100.6020 597.9889 	177.6358 671.5203 Lure (heati: ng periods ains for li Feb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547	7.3 4.9 262.1566 739.0331 in the livi ving area, Mar 62.6746 5.1783 0.9263 20.6190	m2 200 360.8448 811.3409 ang area frc nil,m (see Apr 63.7232 5.2482 0.8281 20.8087	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 om Table 9a) May 63.9371 5.2625 0.6640 20.9114	Speci or 453.2670 852.6181 Th1 (C) Jun 65.0287 5.3352 0.4748 20.9440	Jul 65.0287 5.3352 0.3443 20.9483	Specific or Tab:	data le 6c .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340	Cot 63.9371 5.2625 0.8656 20.7975 20.0122 0.8246 19.7822	Nov 63.5107 5.2340 0.9623 20.0362 0.9501 19.4265	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.0858	(83) (84) (85) (86) (87) (88) (89) (90)
North Southwest	100.6020 597.9889 	177.6358 671.5203 Lure (heati: ng periods ains for li Feb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547	7.3 4.9 262.1566 739.0331 in the livi ving area, Mar 62.6746 5.1783 0.9263 20.6190 19.9943	m2 200 3300 360.8448 811.3409 mg area frc nil,m (see Apr 63.7232 5.2482 0.8281 20.8087 20.0092 0.7890	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 mm Table 9, 7 Table 9a) May 63.9371 5.2625 0.6640 20.9114 20.0122 0.6047	Speci or 453.2670 852.6181	Jul 65.0287 5.3352 0.3443 20.9483 20.0271 0.2686	Specific or Tab:	data le 6c .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340	Cot 63.9371 5.2625 0.8656 20.7975 20.0122 0.8246 19.7822 Living area	Nov 63.5107 5.2340 0.9623 20.0362 0.9501 19.4265	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.0858 0.4871 19.6775	(85) (86) (87) (88) (89) (90) (91)
North Southwest Solar gains Total gains Total gains Total gains Total gains Total gains Timperature d Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f	100.6020 597.9889 nal temperat uring heatir actor for ga Jan 62.2648 5.1510 rea 0.9808 20.3217 19.9884 house 0.9753 19.1062 raction 19.6982 djustment	177.6358 671.5203 ture (heating periods and periods for lipeb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547 19.2843	7.3 4.9 262.1566 739.0331 in the livi ving area; Mar 62.6746 5.1783 0.9263 20.6190 19.9943 0.9068 19.5271	m2 200 360.8448 811.3409 mg area froil, m (see Apr 63.7232 5.2482 0.8281 20.8087 20.0092 0.7890 19.7862	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 om Table 9, Table 9a) May 63.9371 5.2625 0.6640 20.9114 20.0122 0.6047 19.9050	Speci or 453.2670 852.6181 Fh1 (C) Jun 65.0287 5.3352 0.4748 20.9440 20.0271 0.4048 19.9496	Jul 65.0287 5.3352 0.3443 20.9483 20.0271 0.2686 19.9523	Aug 65.2515 5.3501 0.3841 20.9479 20.0301 0.3039 19.9553	data le 6c .8000 .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340 fLA =	Oct 63,9371 5.2625 0.8656 20.7975 20.1222 0.8246 19,7822 Living area 20.2767	Nov 63.5107 5.2340 0.9623 20.5353 20.0062 0.9501 19.4265 a/(4) =	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.0858 0.4871 19.6775 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest	100.6020 597.9889 	177.6358 671.5203 Lure (heati: ng periods ains for li Feb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547 19.2843 19.8499	7.3 4.9 262.1566 739.0331 season) in the livi ving area, Mar 62.6746 5.1783 0.9263 20.6190 19.9943 0.9068 19.5271 20.0589	m2 200 360.8448 811.3409 area fronil,m (see Apr 63.7232 5.2482 0.8281 20.8087 20.0092 0.7890 19.7862 20.2842	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 mm Table 9, 7 Table 9a) May 63.9371 5.2625 0.6640 20.9114 20.0122 0.6047 19.9050 20.3952 20.3952	Speci or	Jul 65.0287 5.3352 0.3443 20.9483 20.0271 0.2686 19.9523 20.4374	Aug 65.2515 5.3501 0.3841 20.9479 20.0301 0.3039 19.9553 20.4387	data le 6c .8000 .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340 fLA = 20.4195	Oct 63.9371 5.2625 0.8656 20.7975 20.0122 0.8246 19.7822 Living area 20.2767	Nov 63.5107 5.2340 0.9623 20.5353 20.0062 0.9501 19.4265 a / (4) = 19.9666	30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.0858 0.4871 19.6775 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Solar gains Total gains Total gains Total gains Total gains Total gains Themperature d Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a	100.6020 597.9889 anal temperatement of the second of the	177.6358 671.5203 ture (heati: ng periods ains for li- Peb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547 19.2843 19.8499 19.8499	7.3 4.9 262.1566 739.0331 ing season) in the liviting area, Mar 62.6746 5.1783 0.9263 20.6190 19.9943 0.9068 19.5271 20.0589 20.0589	m2 200 360.8448 811.3409 ang area frc nil, m (see Apr 63.7232 5.2482 0.8281 20.8087 20.0092 0.7890 19.7862 20.2842 20.2842	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 20.71 Table 9a) May 63.9371 5.2625 0.6640 20.9114 20.0122 0.6047 19.9050 20.3952 20.3952	Speci or 453.2670 852.6181 Fh1 (C) Jun 65.0287 5.3352 0.4748 20.9440 20.0271 0.4048 19.9496 20.4339 20.4339	Jul 65.0287 5.3352 0.3443 20.9483 20.0271 0.2686 19.9523 20.4374 20.4374	Aug 65.2515 5.3501 0.3841 20.9479 20.0301 0.3039 19.9553 20.4387 20.4387	data le 6c .8000 .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340 fLA = 20.4195	Oct 63.9371 5.2625 0.8656 20.7975 20.0122 0.8246 19.7822 Living area 20.2767	Nov 63.5107 5.2340 0.9623 20.5353 20.0062 0.9501 19.4265 a / (4) = 19.9666	30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.0858 0.4871 19.6775 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest	100.6020 597.9889 	177.6358 671.5203 cure (heati: ng periods ains for li Feb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547 19.2843 19.8499 19.8499	7.3 4.9 262.1566 739.0331 mg season) in the livi ving area, Mar 62.6746 5.1783 0.9263 20.6190 19.9943 0.9068 19.5271 20.0589 Mar	m2 200 360.8448 811.3409 area free nil,m (see Apr 63.7232 5.2482 0.8281 20.8087 20.0092 20.2842 20.2842	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 38863.5934 3971 5.2625 0.6640 20.9114 20.0122 0.6047 19.9050 20.3952 20.3952	Speci or	Jul 65.0287 5.3352 0.3443 20.9483 20.0271 0.2686 19.9523 20.4374 Jul	Aug 65.2515 5.3501 0.3841 20.9479 20.0301 0.3039 19.9553 20.4387	data le 6c .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340 fLA = 20.4195 20.4195	Factor Table 6 0.776 0.776 0.776 0.776 0.776 0.776 0.776 0.776 0.776 0.776 0.776 0.776 0.776 0.8246 19.7822 Living area 20.2767 20.2767	Nov 63.5107 5.2340 0.9623 20.5353 20.0062 0.9501 19.4265 a / (4) = 19.9666	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.0858 0.4871 19.6775 0.0000 19.6775	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest	100.6020 597.9889 	177.6358 671.5203 ture (heating periods ains for livel Feb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547 19.2843 19.8499 19.8499	7.3 4.9 262.1566 739.0331 in the liviving area, Mar 62.6746 5.1783 0.9263 20.6190 19.9943 0.9068 19.5271 20.0589 20.0589	m2 200 360.8448 811.3409 ang area from from from from from from from from	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 30	Speci or 453.2670 852.6181 Th1 (C) Jun 65.0287 5.3352 0.4748 20.9440 20.0271 0.4048 19.9496 20.4339 20.4339	Jul 65.0287 5.3352 0.3443 20.0271 0.2686 19.9523 20.4374 20.4374 Jul 0.3006	Aug 65.2515 5.3501 0.3841 20.4387 20.4387 20.4387	data le 6c .8000 .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340 fLA = 20.4195 20.4195	Cot 63.9371 5.2625 0.8656 20.7975 20.0122 1.2ving area 20.2767 20.2767	Nov 63.5107 5.2340 0.9623 20.5353 20.0062 0.9501 19.4265 a / (4) = 19.9666 19.9666	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.6875 0.0000 19.6775	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest	100.6020 597.9889	177.6358 671.5203 ture (heating periods ains for life) Feb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547 19.2843 19.8499 19.8499	7.3 4.9 262.1566 739.0331 Ing season) in the livitying area, Mar 62.6746 5.1783 0.9263 20.6190 19.9943 0.9068 19.5271 20.0589 20.0589 Mar 0.9082 671.1568 6.5000	m2 200 360.8448 811.3409 ang area from 1, m (see Apr 63.7232 5.2482 0.8281 20.8087 20.0092 0.7890 19.7862 20.2842 20.2842 Apr 0.8005 649.5054 8.9000	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 20.7311 5.2625 0.6640 20.9114 20.0122 0.6047 19.9050 20.3952 20.3952 May 0.6284 542.6576 11.7000	Speci or 453.2670 852.6181 Ph1 (C) Jun 65.0287 5.3352 0.4748 20.9440 20.0271 0.4048 19.9496 20.4339 20.4339 Jun 0.4343 370.3123	Jul 65.0287 5.3352 0.3443 20.9483 20.0271 0.2686 19.9523 20.4374 20.4374 Jul 0.3006 244.9827 16.6000	Aug 65.2515 5.3501 0.3841 20.9479 20.0301 9.9553 20.4387 20.4387 40.3379 256.7329 16.4000	data le 6c .8000 .8000 .8000 295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340 fLA = 20.4195 20.4195 Sep 0.5651 396.9288	factor Table 6 0.770 0.770 0.770 0ct 0.8246 19.7822 Living area 20.2767 0.8366 530.9180	Nov 63.5107 5.2340 0.9623 20.5353 20.0062 0.9501 19.9666 19.9666 19.9666	W 30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.6878 0.0000 19.6775 Dec 0.9779 558.0644	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North North Southwest 7. Mean inter Temperature d Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat	100.6020 597.9889 nal temperat uring heatir actor for ga Jan 62.2648 5.1510 rea 0.9808 20.3217 19.9884 house 0.9753 19.1062 raction 19.6982 djustment 19.6982 ing requirer Jan 0.9734 582.0598 4.3000 e W 1027.8506 1.0000 kWh 331.6684	177.6358 671.5203 Lure (heati: ng periods sins for li- Feb 62.4690 5.1646 0.9646 20.4456 19.9913 0.9547 19.2843 19.8499 19.8499 19.8499 19.8499 19.8499	7.3 4.9 262.1566 739.0331 in the livi ving area; Mar 20.0589 20.0589 Mar 0.9082 671.1588 6.5000 899.1573 1.0000	m2 200 360.8448 811.3409 area frenil,m (see Apr 63.7232 5.2482 0.8281 20.8087 20.0092 20.2842 20.2842 20.2842 Apr 0.8005 649.5054 8.9000 742.5166	Table 6a W/m2 10.6334 36.7938 439.9438 863.5934 3863	Speci or	Jul 65.0287 5.3352 0.3443 20.9483 20.0271 0.2686 19.9523 20.4374 20.4374 Jul 0.3006 244.9827 16.6000 245.2657	Aug 65.2515 5.3501 0.3841 20.9479 20.0301 0.3039 19.9553 20.4387 20.4387	data le 6c .8000 .8000 .295.5856 702.4125 Sep 64.5876 5.3058 0.6105 20.9307 20.0211 0.5326 19.9340 fLA = 20.4195 20.4195 Sep 0.5651 396.9288 14.1000 406.6616	Cot 63.9371 5.2625 0.8656 20.7975 20.0122 Living area 20.2767	Nov 63.5107 5.2340 0.9623 20.5353 20.0062 0.9501 19.4265 a / (4) = 19.9666 19.9666	30.2068 70.3952 85.4255 570.6499 21.0000 Dec 63.0899 5.2060 0.9843 20.3006 20.0002 0.9797 19.6775 0.0000 19.6775	(85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (97a) (98) (98)





CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooli													
Calculated for	June, July Jan	and August	t. See Table	e 10b Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp. Heat loss rate	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	600.7923 0.9627	472.9641 0.9832	484.0883 0.9746	0.0000	0.0000	0.0000	0.0000	
Jseful loss Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	578.3765 926.1437	465.0192 884.6250	471.7712 819.0018	0.0000	0.0000	0.0000	0.0000	
Month fracti Space cooling R	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	250.3924	312.1867	258.3395	0.0000	0.0000	0.0000	0.0000 820.9186	
cooled fraction		e 10b)							fC =	cooled area	4 / (4) =	0.6683	
pace cooling b	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling pace cooling p	0.0000	0.0000	0.0000	0.0000	0.0000	41.8367	52.1615	43.1645	0.0000	0.0000	0.0000	0.0000 137.1627 2.2918	(107)
a. Energy requ	uirements -	Individual	l heating s	ystems, inc	luding micr	o-CHP						0.0000	(201)
raction of spa fraction of spa fficiency of m fficiency of s space heating n cooling System	ace heat fro main space h secondary/su requirement	om main sys neating sys upplementar	stem(s) stem 1 (in : ry heating :	%) system, %	m (lable li	,						1.0000 249.9000 0.0000 578.7789 4.5000	(202) (206) (208) (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
pace heating m	331.6684			66.9680	16.7948	0.0000	0.0000	0.0000	0.0000	73.0006	206.5974	343.4044	(98)
pace heating e	249.9000	249.9000	249.9000	1) 249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)
pace heating f	fuel (main h 132.7204	neating sys 95.3591	67.8801	26.7979	6.7206	0.0000	0.0000	0.0000	0.0000	29.2119	82.6720	137.4167	(211)
ater heating m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
ater heating													
	179.6435		166.7367	149.8967	147.2041	131.9780	127.1748	138.9657	138.5371	155.4133	163.7951	175.4659	
	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 175.1000	
ater heating f	102.5948 fuel used	90.5023	95.2237	85.6063	84.0686	75.3730	72.6298	79.3636	79.1188	88.7569	93.5438	100.2090 1046.9905	
pace cooling f 221)m ooling nnual totals k	0.0000	0.0000	0.0000	0.0000	0.0000	9.2970	11.5915	9.5921	0.0000	0.0000	0.0000	0.0000 30.4806	
pace heating f pace heating f	fuel - main fuel - secor	ndary										578.7789 0.0000	
(BalancedWi mechanical v central heat otal electricity for	ithHeatRecov ventilation ting pump ity for the	rery, Datas fans (SFP above, kWh	= 0.	6250)	1.2500, SF	P = 0.6250)						118.6526 30.0000 148.6526 271.6969	(230c)
nergy saving/o			es (Appendi	ces M ,N an	d Q)							2076.5996	(238)
Oa. Fuel costs	s - using Ta	able 12 pri	ices										
Space heating - Space heating - Water heating of Space cooling Wechanical vent Pumps and fans Chergy for ligh Additional star	- secondary (other fuel) tilation far for heating	ns J						Fuel kWh/year 578.7789 0.0000 1046.9905 30.4806 118.6526 30.0000 271.6969		Fuel price p/kWh 13.1900 0.0000 13.1900 13.1900 13.1900 13.1900 13.1900		Fuel cost £/year 76.3409 0.0000 138.0981 4.0204 15.6503 3.9570 35.8368 0.0000	(240) (242) (247) (248) (249) (249) (250)
Energy saving/ V Unit otal energy co		technolog	ies					-429.0000		13.1900		-56.5851 217.3184	
la. SAP rating		al heating	g systems										
Inergy cost def	flator (Tabl								255) - 1255	\1 / E/A\ :	45.01	0.4200	
nergy cost fac AP value AP rating (Sec								[(200) X (256)] / [(4) +	43.U] =	0.8705 87.8563 88	





CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP band			В
12a. Carbon dioxide emissions - Individual heating systems incl			
Space heating - main system 1 Space heating - secondary Water heating (other fuel) Space and water heating Space cooling Pumps and fans Energy for lighting	Energy kWh/year 578.7789 0.0000 1046.9905 30.4806 148.6526 271.6969	Emission factor kg CO2/kWh 0.5190 0.0000 0.5190 0.5190 0.5190 0.5190	Emissions kg CO2/year 300.3862 (261) 0.0000 (263) 543.3881 (264) 843.7743 (265) 15.8194 (266) 77.1507 (267) 141.0107 (268)
Energy saving/generation technologies PV Unit Total kg/year CO2 emissions per m2 EI value EI rating EI band	-429.0000	0.5190	-222.6510 (269) 855.1042 (272) 14.2900 (273) 89.0716 89 (274) B
Calculation of stars for heating and DHW			
Main heating energy efficiency Main heating environmental impact Water heating energy efficiency Water heating environmental impact			s = 4 s = 2





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

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014 1. Overall dwelling dimensions Volume (m3) 155.6100 (1b) - (3b) (m) x 2.6000 (2b) 59.8500 (1b) Ground floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)Dwelling volume 59.8500 $(3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =$ 155.6100 (5) main secondary total m3 per hour heating 0 0 Number of chimneys Number of open flues Number of intermittent fans Number of passive vents Number of flueless gas fires 0 * 40 = 0 * 20 = 0 * 10 = 0.0000 (6b) 0.0000 (7a) 0.0000 0 * 40 = Air changes per hour Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0.0000 / (5) = 0.0000 (8) Pressure test Measured/design q50 0.2000 (18) Infiltration rate Number of sides sheltered 2 (19) - [0.075 x (19)] (21) = (18) x (20) Shelter factor Infiltration rate adjusted to include shelter factor May 3.9000 0.9750 Aug 3.4000 0.8500 Sep 3.4000 0.8500 4.3000 1.0750 4.1000 1.0250 4.1000 1.0250 3.8000 0.9500 3.7000 0.9250 3.6000 0.9000 4.0000 (22) 1.0000 (22a) Wind speed Wind factor Adj infilt rate 0.1828 0.1743 0.1743 0.1615 0.1658 0.1445 0.1445 0.1445 0.1573 0.1700 (22b) 0.1488 0.1530 Balanced mechanical ventilation with heat recovery

If mechanical ventilation:

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.5000 (23a) 76.5000 (23c) 0.2918 Effective ac 0.3003 0.2918 0.2790 0.2833 0.2620 0.2663 0.2620 0.2620 0.2748 0.2705 0.2875 (25) K-value Element Gross Openings NetArea U-value AxU W/m2K 1.0536 1.4000 W/K 12.9071 2.6460 kJ/m2K kJ/K 12.2500 Window (Uw = 1.10) Door Heat Loss Floor 1 59.8500 12.3263 (28b) 0.2060 External Wall 1 Corridor wall External Roof 1 12.2500 20.5000 8.2500 0.1400 1.1550 31.6200 41.5200 155.3800 (29a) (30) (31) 1 8900 Total net area of external elements Aum(A, m2) (26)...(30) + (32) = 40.9381 Fabric heat loss, W/K = Sum (A x U) (33) 53.0200 18.3300 Party Wall 1 Party Ceilings 1 0.0000 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K Thermal bridges (Sum(L x Psi) calculated using Appendix K) Total fabric heat loss 250.0000 (35) 8.6490 (36) (33) + (36) = 49.5871 (37) Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$ Jan 15.4182 Feb 14.9817 Mar 14.9817 Apr 14.3270 Jul 13.6723 May 14.5453 Jun 13.4540 Aug 13.4540 Nov 13.8905 Dec 14.7635 (38) (38)m 64.5688 63.9141 64.1323 63.0411 63.2593 63.0411 63.0411 63.6958 Average = Sum(39)m / 12 = Mar May 1.0716 J111 Apr 1.0679 Aug 1.0533 Sep 1.0533 1.0533 1.0752 (40) 1.0667 (40) HLP (average) 1.0861 1.0788 1.0788 1.0570 1.0643 1.0606 Days in month 31 (41) 31 28 31 30 31 30 31 31 30 31 30 4. Water heating energy requirements (kWh/year) Assumed occupancy Average daily hot water use (litres/day) 1.9774 (42) 81.1630 (43) Sep Jul Apr May Jun Aug Daily hot water use 89.2793 86.0328 82.7863 79.5398 76.2932 73.0467 73.0467 76.2932 79.5398 82.7863 86.0328 89.2793 (44) 108.1684 118.0743 Total = Sum(45)m = 128.2210 (45) 1277.0102 (45) 115.7967





CALCULAT	TION OF E	EPC COST	S, EMISS	IONS AN	D PRIMA	RY ENER	GY 0 9	Jan 2014					
Distribution				15 6064	14 0000	10.0006				1.5 0050		10.0000	(46)
Water storage Store volume		17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	
b) If manuf Hot water s					lav)							0.0103	
Volume fact Temperature	or from Tab	le 2a			1/							0.9283 0.5400	(52)
Enter (49) or Total storage	loss											0.7736	
If cylinder c	23.9825 ontains ded:	icated sola:	23.9825 r storage	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	
Primary loss Total heat re	23.2624 guired for	21.0010 21.0112 water heati	23.2624 ng calculat	22.5120 ed for each	23.2624 n month	22.5120		23.2624			22.5120		
Solar input	179.6435 0.0000	158.4695 0.0000	166.7367	149.8967 0.0000	147.2041	131.9780	127.1748	0.0000	0.0000		0.0000	175.4659 0.0000 0.0000	(63)
Output from w		158.4695	166.7367	149.8967	147.2041	131.9780	127.1748			155.4133 h/year) = Su			
Heat gains fr		ating, kWh/1 72.6406		71.2151	71.0323	65.2572	64.3726	68.2931	67.4381	73.7619	75.8364	80.4294	(65)
5. Internal g	ains (see Ta	able 5 and	5a)										
Metabolic gai	ns (Table 5)		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gain	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434			118.6434		118.6434	(66)
Appliances ga	38.4615 ins (calcula	34.1612 ated in App	27.7817 endix L, eq	21.0326 uation L13	15.7221 or L13a), a	13.2732 lso see Tab	14.3422 le 5	18.6425	25.0220	31.7712	37.0816	39.5305	(67)
Cooking gains	(calculated	d in Append	ix L, equat	ion L15 or		see Table	5			211.0897	229.1894	246.2004	
Pumps, fans Losses e.g. e	3.0000	3.0000	3.0000	3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	48.8417 3.0000	
Water heating	-79.0956	-79.0956			-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Total interna	109.9710	108.0962	104.2029	98.9099	95.4736	90.6350	86.5223	91.7918	93.6640	99.1423	105.3283	108.1040	(72)
	497.3869	493.8845	476.8766	450.4961	423.6496	399.3512	384.9430	391.8401	406.8269	433.3928	462.9888	485.2244	(73)
6. Solar gain													
[Jan]				m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acces facto Table 6	ss or 6d	Gains W	
[Jan] North Southwest			7.3 4.9	m2 200 300	Table 6a W/m2 11.5683 39.0225	Speci or	fic data Table 6b 0.7000 0.7000	Specific or Tab: 0	data le 6c	Acces facto Table (0.770	or 6d 00		
North Southwest	107.5218	171.0326	7.3 4.9 255.0993	m2 200 300 365.2187	Table 6a W/m2 11.5683 39.0225	Speci or '	fic data Table 6b 0.7000 0.7000 453.1853	Specific or Tab: 0 0 0 399.0462	data le 6c .8000 .8000	factor Table 6 0.770 0.770 212.1159	or 5d 00 00 134.3037	W 32.8626 74.6591 89.5721	(79) (83)
North Southwest Solar gains Total gains	107.5218 604.9087	171.0326 664.9171 ture (heati	7.3 4.9 255.0993 731.9759	m2 200 300 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116	Speci or 479.0060 878.3572	fic data Table 6b 0.7000 0.7000 453.1853 838.1283	Specific or Tab:	data le 6c .8000 .8000	factor Table 6 0.770 0.770 212.1159	or 5d 00 00 134.3037	W 32.8626 74.6591 89.5721	(79) (83)
North Southwest Solar gains Total gains Total gains Total gains	107.5218 604.9087 	171.0326 664.9171 ture (heati	7.3 4.9 255.0993 731.9759 ng season) in the livi	m2 200 300 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116	Speci or	fic data Table 6b 0.7000 0.7000 453.1853 838.1283	Specific or Tab:	data le 6c .8000 .8000	factor Table 6 0.770 0.770 212.1159	or 5d 00 00 134.3037	W 32.8626 74.6591 89.5721	(79) (83) (84)
North Southwest Solar gains Total gains 7. Mean inter	107.5218 604.9087 	171.0326 664.9171 ture (heati	7.3 4.9 255.0993 731.9759 ng season) in the livi	m2 200 300 365.2187 815.7148	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116	Speci or	fic data Table 6b 0.7000 0.7000 453.1853 838.1283	Specific or Tab:	data le 6c .8000 .8000	factor Table 6 0.770 0.770 212.1159	or 5d 00 00 134.3037	W 32.8626 74.6591 89.5721 574.7965	(79) (83) (84)
North Southwest Solar gains Total gains 7. Mean inter Temperature d	107.5218 604.9087 nal temperal uring heatin actor for gr Jan 63.9371 5.2625	171.0326 664.9171 ture (heating periods ains for live Feb 64.3693 5.2913	7.3 4.9 255.0993 731.9759 ng season) in the liviving area; Mar 64.3693 5.2913	m2 200 365.2187 815.7148 ang area fronii,m (see Apr 65.0287 5.3352	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9, 17 Table 9a) May 64.8074 5.3205	Speci or 479.0060 878.3572 Ph1 (C) Jun 65.9292 5.3953	Jul 65.7018 5.3801	Specific or Tab: 0 0 399.0462 790.8863 Aug 65.9292 5.3953	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953	fact. Table 6 0.77(0.77(212.1159 645.5087	Nov 65.4759 5.3651	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058	(79) (83) (84)
North Southwest	107.5218 604.9087 nal temperaturing heatinactor for graduor for graduor 5.2625 rea 0.9708	171.0326 664.9171 ture (heating periods : ains for life Feb 64.3693 5.2913 0.9515	7.3 4.9 255.0993 731.9759 aseason) in the livi ving area, Mar 64.3693 5.2913 0.8900	m2 200 365.2187 815.7148 ag area froil, m (see Apr 65.0287 5.3352 0.7452	Table 6a W/m2 11.5883 39.0225 435.0620 858.7116 mm Table 9, 7 Table 9a) May 64.8074 5.3205 0.5419	479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154	Jul 65.7018 5.3801 0.1811	Specific or Tab: 0 0 399.0462 790.8863 Aug 65.9292 5.3953 0.2072	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495	fact: Table 6 0.77(0.77(212.1159 645.5087	Nov 65, 4759 5,3651 0.9356	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759	(83) (84) (85)
North Southwest	107.5218 604.9087 nal temperaturing heatin actor for gr Jan 63.9371 5.2625 rea 0.9708 20.4556 20.0122	171.0326 664.9171 ture (heating periods ains for live Feb 64.3693 5.2913	7.3 4.9 255.0993 731.9759 ng season) in the liviving area; Mar 64.3693 5.2913	m2 200 365.2187 815.7148 ang area fronii,m (see Apr 65.0287 5.3352	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9a) May 64.8074 5.3205 0.5419 20.9379	Speci or 479.0060 878.3572 Ph1 (C) Jun 65.9292 5.3953	Jul 65.7018 5.3801	Specific or Tab: 0 0 399.0462 790.8863 Aug 65.9292 5.3953	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953	fact. Table 6 0.77(0.77(212.1159 645.5087	Nov 65.4759 5.3651	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058	(85) (86) (87)
North Southwest Solar gains Total gains 7. Mean inter Temperature d Utilisation f tau alpha util living a	107.5218 604.9087 nal temperaturing heatin actor for gr Jan 63.9371 5.2625 rea 0.9708 20.4556 20.0122	171.0326 664.9171 ture (heati: ng periods ains for li Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378	7.3 4.9 255.0993 731.9759 ing season) in the livi ving area, Mar 64.3693 5.2913 0.8900 20.7323	m2 200 365.2187 815.7148 ang area frail, m (see Apr 65.0287 5.3352 0.7452 20.8812	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 mm Table 9, 7 Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747	479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492	Jul 65.7018 5.3801 0.1811 20.9495	Specific or Tab: 0 0 399.0462 790.8863 Aug 65.9292 5.3953 0.2072 20.9496	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466	fact: Table 6 0.77(0.770 212.1159 645.5087	Nov 65.4759 5.3651 0.9356 20.6686	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357	(85) (86) (87) (88) (89)
North Southwest	107.5218 604.9087 nal temperal actor for gr Jan 63.9371 5.2625 rea 0.9708 20.4556 20.0122 house 0.9621 19.3177 raction 19.8719	171.0326 664.9171 ture (heati: ng periods ains for li Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378	7.3 4.9 255.0993 731.9759 Ing season) in the liviting area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613	m2 200 300 365.2187 815.7148 ang area froil,m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 mm Table 9, 7 Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747	479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084	Specific or Tab: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640	fact. Table 6 0.77(0.770 212.1159 645.5087 Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living area	Nov 65, 4759 5, 3651 0,0331 0,9149 19,6337	21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517	(85) (86) (87) (88) (89) (90) (91)
North Southwest Solar gains Total gains Themperature d Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f	107.5218 604.9087 mal temperal uring heatin actor for gr Jan 63.9371 5.2625 rea 20.4556 20.0122 house 0.9621 19.3177 raction 19.8719 djustment	171.0326 664.9171 ture (heating periods ains for life Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625	7.3 4.9 255.0993 731.9759 in the livi ving area; Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001	m2 200 365.2187 815.7148 ang area froil, m (see Apr Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884	Table 6a W/m2 11.5883 39.0225 435.0620 858.7116 om Table 9, Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418	Fh1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654	data le 6c .8000 .8000 .8000 .8000 .8000 .8000 .8000 .8000 .802 .8000 .8	fact. Table 6 0.77(0.770 212.1159 645.5087 Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living area	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a/(4) =	21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Solar gains Total gains 7. Mean inter Temperature d Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a	107.5218 604.9087 mal temperal uring heatin actor for gr Jan 63.9371 5.2625 rea 20.4556 20.0122 house 0.9621 19.3177 raction 19.8719 djustment	171.0326 664.9171 ture (heating periods ains for live Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625	7.3 4.9 255.0993 731.9759 255.0993 731.9759 25.2913 364.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028	m2 200 365.2187 815.7148 ang area from from from from from from from from	Table 6a W/m2 11.5883 39.0225 435.0620 858.7116 om Table 9, 17 Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269	3 Speci or 479.0060 878.3572 479.0060 878.3572 479.0060 878.3572 479.9652 20.0391 0.2467 19.9652 20.4445	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 fLA = 20.4426	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.9110 19.8973 Living area 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.91639 19.6337 a / (4) = 20.1378	21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest Solar gains Total gains 7. Mean inter Temperature d Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a	107.5218 604.9087 	171.0326 664.9171 ture (heati: ng periods ains for li- Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625 19.9951	7.3 4.9 255.0993 731.9759 ing season) in the liviting area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028	m2 200 365.2187 815.7148 ang area froil, m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884 20.3720 20.3720	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 om Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269	Fh1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431 20.4431	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448 20.4448	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 fLA = 20.4426	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.9110 19.8973 Living area 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.91639 19.6337 a / (4) = 20.1378	21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 0.0000	(85) (86) (87) (88) (89) (90) (91) (92)
North Southwest	107.5218 604.9087 	171.0326 664.9171 ture (heati:	7.3 4.9 255.0993 731.9759 In the livi ving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028	m2 200 365.2187 815.7148 815.7148 91.7	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 mm Table 9, 7 Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 May May	Speci or ' 479.0060 878.3572 Th1 (C) Jun 65.9292 5.3953 0.3154 20.9492 20.0391 0.2467 19.9652 20.4445 Jun Jun	Jul 65.7018 5.3801 0.1811 20.9495 20.04431 20.4431	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448	data le 6c .8000 .8000 316.8212 723.6481 Sep 65.9292 5.3953 0.4495 20.9466 20.0391 0.3682 19.9640 fLA = 20.4426 Sep	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living area 20.3771 20.3771	Nov 65.4759 5.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a / (4) = 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 0.0000 19.8517	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest	107.5218 604.9087 nal temperat 	171.0326 664.9171 ture (heating periods ains for lives Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625 19.9951 19.9951	7.3 4.9 255.0993 731.9759 In season) in the livi ving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028	m2 200 365.2187 815.7148 ang area from from from from from from from from	Table 6a W/m2 11.5883 39.0225 435.0620 858.7116 om Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269	Speci or 479.0060 878.3572	Jul 65.7018 5.3801 0.1811 20.4431 20.4431 Jul 0.1391	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448 20.4448	data le 6c .8000 .	fact. Table 6 0.77(0.77(212.1159 645.5087 Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living area 20.3771 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a / (4) = 20.1378 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 Dec 0.9670	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest Solar gains Total gains AMIT Th 2 util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat Month fracti	107.5218 604.9087 mal temperal 	171.0326 664.9171 ture (heati: ng periods ains for li- Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625 19.9951 19.9951	7.3 4.9 255.0993 731.9759 Ing season) in the liviving area, Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028 Mar 0.8672 634.7905 8.1000	m2 200 365.2187 815.7148 ang area fromil, m (see Apr 65.0287 5.3352 0.7452 20.8812 20.0271 0.6937 19.8884 20.3720 20.3720 Apr 0.7127 581.3971 10.6000	Table 6a W/m2 11.5883 39.0225 435.0620 858.7116 om Table 9, Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 20.4269	Speci or	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 20.4431 20.4431 Jul 6.580 18.6000	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448 20.4448 20.4448	data le 6c .8000 .	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 1.9.8973 Living area 20.3771 20.3771	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a / (4) = 20.1378	W 32.8626 74.6591 89.5721 574.7965 21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 Dec 0.9670 55.8134	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North Southwest	107.5218 604.9087	171.0326 664.9171 ture (heati: ng periods ains for li Feb 64.3693 5.2913 0.9515 20.5559 20.0181 0.9378 19.4625 19.9951 19.9951	7.3 4.9 255.0993 731.9759 in the livi ving area; Mar 64.3693 5.2913 0.8900 20.7323 20.0181 0.8613 19.7001 20.2028 20.2028 Mar 0.8672 634.7905 8.1000 781.4664 1.0000	m2 200 365.2187 815.7148 815.7148 815.7148 815.7148 815.7148 0.0281 20.0271 0.6937 19.8884 20.3720 20.3720 Apr 0.7127 581.3971 10.6000 624.5658	Table 6a W/m2 11.5683 39.0225 435.0620 858.7116 m Table 9a) May 64.8074 5.3205 0.5419 20.9379 20.0241 0.4747 19.9418 20.4269 May 0.5028 431.7826 13.6000 437.8266	Speci or	Jul 65.7018 5.3801 0.1811 20.9495 20.0361 0.1084 19.9622 20.4431 20.1391 116.5880 18.6000 116.5905	Aug 65.9292 5.3953 0.2072 20.9496 20.0391 0.1307 19.9654 20.4448 20.4448 20.1630 128.8980 128.8980 128.9040	data le 6c .8000 .	Oct 65.2515 5.3501 0.7719 20.8824 20.0301 0.7110 19.8973 Living area 20.3771 20.3771 Oct 0.7340 473.832 12.3000 514.4769	Nov 65.4759 5.3651 0.9356 20.6686 20.0331 0.9149 19.6337 a/(4) = 20.1378 Nov 0.9174 547.9783 8.5000 738.7370	21.0000 Dec 64.5876 5.3058 0.9759 20.4357 20.0211 0.9685 19.2973 0.4871 19.8517 0.0000 19.8517	(85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (97a) (98)





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

8c. Space cool	ing requireme	ent											
Calculated for	June, July	and August											
Ext. temp.	Jan 5.6000	Feb 6.1000	Mar 8.1000	Apr 10.6000	May 13.6000	Jun 16.6000	Jul 18.6000	Aug 18.4000	Sep 15.8000	0ct 12.3000	Nov 8.5000	Dec 5.6000	
Heat loss rate Utilisation Useful loss Total gains Month fracti	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	466.5041 0.9892 461.4815 956.2283 1.0000	341.6004 0.9968 340.5119 911.6401 1.0000	353.0302 0.9950 351.2730 855.2577 1.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	(101) (102) (103)
Space cooling Space cooling Cooled fractio	0.0000	0.0000	0.0000	0.0000	0.0000	356.2177	424.9194	374.9646	0.0000 fC =	0.0000 cooled area	0.0000	0.0000 1156.1018 0.6683	(104)
Intermittency		e 10b) 0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space cooling		0.0000	0.0000	0.0000	0.0000	59.5184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space cooling Space cooling												59.5184 0.9945	(107)
9a. Energy req	uirements -	Individual	l heating s	ystems, inc	luding micro	o-CHP							
Fraction of sp Fraction of sp Efficiency of Efficiency of Space heating Cooling System	ace heat from ace heat from main space he secondary/sup requirement	m secondar m main sys eating sys pplementar	ry/suppleme stem(s) stem 1 (in ry heating	ntary system %) system, %								0.0000 1.0000 249.9000 0.0000 409.3754 4.5000	(202) (206) (208) (211)
Space heating	Jan requirement	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	257.9058			31.0815	4.4967	0.0000	0.0000	0.0000	0.0000	30.2389	137.3462	268.8025	(98)
Space heating	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)
Water heating	103.2036	73.6417	43.6682	12.4376	1.7994	0.0000	0.0000	0.0000	0.0000	12.1004	54.9605	107.5640	(211)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating	requirement 179.6435	158.4695	166.7367	149.8967	147.2041	131.9780	127.1748	138.9657	138.5371	155.4133	163.7951	175.4659	(64)
Efficiency of (217)m	water heater 175.1000		175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 175.1000	
Fuel for water Water heating	102.5948	n/month 90.5023	95.2237	85.6063	84.0686	75.3730	72.6298	79.3636	79.1188	88.7569	93.5438	100.2090 1046.9905	
Space cooling (221)m Cooling		0.0000	0.0000	0.0000	0.0000	13.2263	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 13.2263	(221)
Annual totals Space heating Space heating	fuel - main :											409.3754 0.0000	
	ithHeatRecove ventilation : ting pump ity for the a	ery, Datas fans (SFP above, kWh	= 0. n/year	6250)	1.2500, SF	P = 0.6250)						118.6526 30.0000 148.6526 271.6969	(230c) (231)
Energy saving/ Total delivere			es (Appendi	ces M ,N and	d Q)							1889.9418	(238)
10a. Fuel cost													
Space heating Space heating Water heating Space cooling Mechanical ven Pumps and fans Energy for lig Additional sta	- main system - secondary (other fuel) tilation family for heating	n 1						Fuel kWh/year 409.3754 0.0000 1046.9905 13.2263 118.6526 30.0000 271.6969		Fuel price p/kWh 15.5400 0.0000 15.5400 15.5400 15.5400 15.5400 15.5400 15.5400		Fuel cost £/year 63.6169 0.0000 162.7023 2.0554 18.4386 4.6620 42.2217 0.0000	(240) (242) (247) (248) (249) (249) (249) (250)
Energy saving PV Unit Total energy c		technologi	les					-429.0000		15.5400		-66.6666 227.0304	(252) (255)
12a. Carbon di		ons - Indi	ividual hea	ting system:	s including	micro-CHP							
Space heating Space heating	- main system							Energy kWh/year 409.3754 0.0000		ion factor kg CO2/kWh 0.5190 0.0000	k	Emissions cg CO2/year 212.4659 0.0000	





CALCULATION OF EPC COSTS, E	MISSIONS	AND PRIN	/IAR	Y ENERGY 09	Jan 2014	1	
Water heating (other fuel)					1046.9905	0.5190	543.3881 (264)
Space and water heating Space cooling					13.2263		755.8539 (265)
Pumps and fans Energy for lighting					148.6526 271.6969		77.1507 (267)
Energy saving/generation technologies							
PV Unit Total kg/year					-429.0000	0.5190	-222.6510 (269) 758.2288 (272)
13a. Primary energy - Individual heatin							
					Energy	Primary energy factor	Primary energy
Space heating - main system 1					kWh/year 409.3754 0.0000	kg CO2/kWh 3.0700 0.0000	kWh/year 1256.7826 (261)
Space heating - secondary Water heating (other fuel) Space and water heating					1046.9905	3.0700	0.0000 (263) 3214.2609 (264) 4471.0436 (265)
Space cooling Pumps and fans					13.2263 148.6526		
Energy for lighting					271.6969	3.0700	834.1096 (268)
Energy saving/generation technologies PV Unit					-429.0000	3.0700	-1317.0300 (269)
Primary energy kWh/year Primary energy kWh/m2/year							4485.0915 (272) 74.9389 (273)
SAP 2012 EPC IMPROVEMENTS							
Current energy efficiency rating: Current environmental impact rating:				B 88 B 89			
current environmental impact lating.				B 09			
(For testing purposes):							
A B				Not considered Not considered			
C D				Not considered Not considered			
E Low energy lighting F G				Already installed Not considered Not considered			
H I				Not considered Not considered			
J K				Not considered Not considered			
M N Solar water heating				Not considered Not applicable			
O P				Not considered Not considered			
R S				Not considered Not considered			
T U Solar photovoltaic panels A2				Not considered Not applicable Not considered			
A2 A3 T2				Not considered Not considered			
W X				Not considered Not considered			
У J2				Not considered Not considered			
Q2 Z1				Not considered Not considered			
Z2 Z3				Not considered Not considered			
Z4 Z5 V2 Wind turbine				Not considered Not considered Not applicable			
L2 Q3				Not considered Not considered			
Õ3				Not considered			
Recommended measures: (none)	SAP change	Cost chang	е	CO2 change			
				Energy Environment	a 1		
Recommended measures	Typical an	nual savings		efficiency impact	41		
(none) Total Saving	s £0	0.00 k	g/m²				
Potential energy efficiency rating:				В 88			
Potential environmental impact rating: Fuel prices for cost data on this page Recommendation texts revision number 4.			ber 4	B 89 10 TEST (03 Apr 2017)		
Typical heating and lighting costs of t			Vall	ey):			
Electricity	Current £294	Potential £294		Saving			
Space heating	£87	£87	£0				





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

Space cooling	£2	£2	£0
Water heating	£163	£163	£0
Lighting	£42	£42	£0
Generated (PV)	-£67	-£67	£0
Total cost of fuels Total cost of uses Delivered energy Carbon dioxide emissions CO2 emissions per m² Primary energy	£227	£227	£0
	£227	£227	£0
	32 kWh/m ²	32 kWh/m ²	0 kWh/m ²
	0.8 tonnes	0.8 tonnes	0.0 tonnes
	13 kg/m ²	13 kg/m ²	0 kg/m ²
	75 kWh/m ²	75 kWh/m ²	0 kWh/m ²





CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014
No improvements selected / applicable





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

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING No improvements selected / applicable SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) Overheating Calculation Input Data Dwelling type Number of storeys Cross ventilation possible EndTerrace Flat SAP Region Front of dwelling faces Overshading Thermal mass parameter Thames Valley West Average or unknown 250.0 Night ventilation Ventilation rate during hot weather (ach) 6.00 (Windows fully open) Overheating Calculation 308.11 (P1) Summer ventilation heat loss coefficient Transmission heat loss coefficient Summer heat loss coefficient 49.59 (37) 357.69 (P2) Overhangs Orientation Ratio Z overhangs Overhang type North South West Solar shading Z blinds Solar access Z overhangs Z summer North 0.900 (P8) 0.900 (P8) South West 1.000 0.90 1.000 [Jul] Solar flux Shading Gains g Specific data Specific data Table 6a W/m2 or Table 6c or Table 6b 269.5634 268.1761 South West 0.8000 0.9000 total: 537.7395 Aug 469 Jun 573 538 (P3) Solar gains Internal gains Total summer gains 396 382 389 970 920 858 (P5) 2.71 Summer gain/loss ratio (P6) 17.90 0.25 20.72 Slight Summer external temperature
Thermal mass temperature increment (TMP = 250.0)
Threshold temperature
Likelihood of high internal temperature 0.25 20.45 Not significant Not significant Assessment of likelihood of high internal temperature: Slight

