



Energy Strategy Report



19-5503

28 Redington
Road,
Hampstead,
London,
NW3 7RB

August
2019

Quality Standards Control

The signatories below verify that this document has been prepared in accordance with our quality control requirements. These procedures do not affect the content and views expressed by the originator.

<i>Revision</i>	<i>Initial</i>	<i>Rev A</i>	<i>Rev B</i>	<i>Rev C</i>
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1. Executive Summary

This Energy Statement demonstrates the predicted energy performance and carbon dioxide emissions of the proposed development at **28 Redington Road, Hampstead, London, NW3 7RB** based on the information provided by the design team. The proposed development is **refurbishment and extension of a detached house in the London Borough of Camden**.

1.1. Policy Requirements

The Council requires new developments to incorporate sustainable design and construction measures. The table below summarises the local policy requirements for this minor development.

Policies	Requirements	Compliance Notes
Camden Local Policy CC1 8.8 and Planning Guidance Table 2a	Major residential refurbishment developments (10+ units or > 1000 sqm) will be required to demonstrate greatest possible reduction, meeting Building Regulation Part L1B.	The proposed development is classified as a major residential refurbishment (over 1000 sqm) and achieved an overall 69.7% carbon reduction via energy efficient measures, Ground Source Heat Pump and PV panels. Detailed strategies can be found in the table below and section 6-8 of this report.
	For the major residential refurbishment, a 20% carbon reduction from renewables are required at Be Green stage.	The proposed development achieved a 20.9% from the Ground Source Heat Pump and PV panels. Details can be found in section 8.2 of this report.
Camden Local Policy CC2	Extensions of 500sqm of residential floorspace to achieve "Excellent" in BREEAM domestic refurbishment.	The BREEAM pre-assessment has been produced in the appendix B of this report, showing "Excellent".
Camden Local Policy CC3 8.55	Refurbishments and other non-domestic development will be expected to meet BREEAM water efficiency credits.	Total 4 credits have been targeted in BREEAM Water 01 – 03 category. Details can be found in the BREEAM pre-assessment.

Table 1 Policy Requirements

1.2. Methodology and Strategies

The methodology used to determine the CO₂ emissions is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2). The below table shows the Energy Hierarchy and suggested strategies for the proposed development.

Stages	Strategies
BE LEAN Energy efficient design	• U-values better than Building Regulations Part L1B 2013 • Efficient hot water cylinder. • Natural ventilation with extract fans in wet rooms • Low water consumption • 100% Low energy lights
BE CLEAN District heat networks or CHP	• Not feasible on the site. Details are in Section 7.
BE GREEN On-site renewable technologies	• Ground Source Heat Pumps for underfloor heating. • 0.6kWp PV panels on South-East room. Details are in Section 8.2.

Table 2 Energy Hierarchy and suggested strategies

1.3. Assessment Results

After the application of all strategies based on the Energy Hierarchy, the regulated carbon dioxide emissions have been reduced as follows;

Energy Hierarchy		Carbon Emissions (Tonnes CO ₂ /yr.)	
		Regulated	Unregulated
BASELINE	Existing Building Emissions	52.13	4.94
BE LEAN	After energy demand reduction	19.96	4.94
BE CLEAN	After CHP/ Communal Heating	19.96	4.94
BE GREEN	After renewable energy	15.79	4.94

Table 3 Carbon Emissions after each stage of the proposed strategy

The carbon savings from each stage can be calculated based on the results above. The table below clearly shows that the development meets overall 69.7% carbon reduction including the 20% targeted reduction at Be Green stage.

Energy Hierarchy		Regulated Carbon Savings	
		Tonnes CO ₂ /yr	%
BE LEAN	After energy demand reduction	32.17	61.71 %
BE CLEAN	After heat network/ CHP	0	0 %
BE GREEN	After renewable energy	4.17	20.88 %
Total Cumulative Savings		36.34	69.70 %

Table 4 Carbon dioxide Emissions after each stage of the Energy Hierarchy

Figure 1 below illustrates the hierarchical approach adopted and the resultant reduction in overall CO₂ emissions.

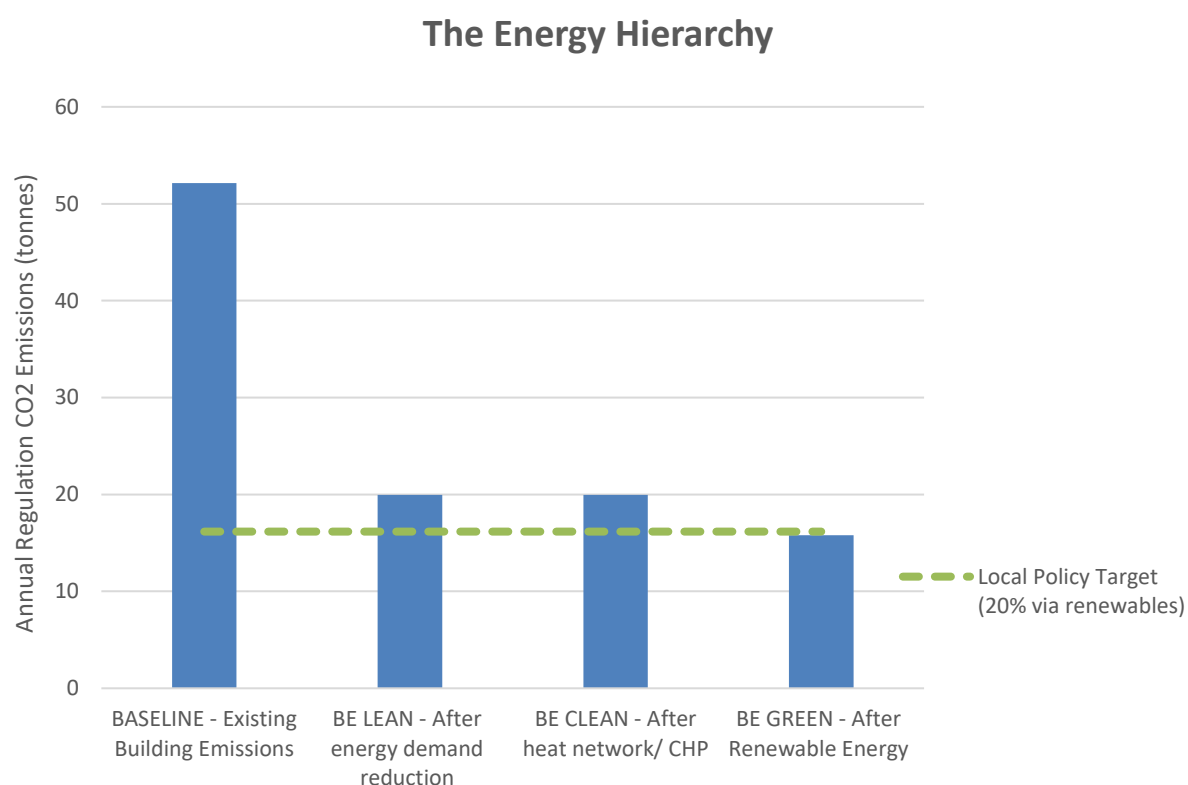
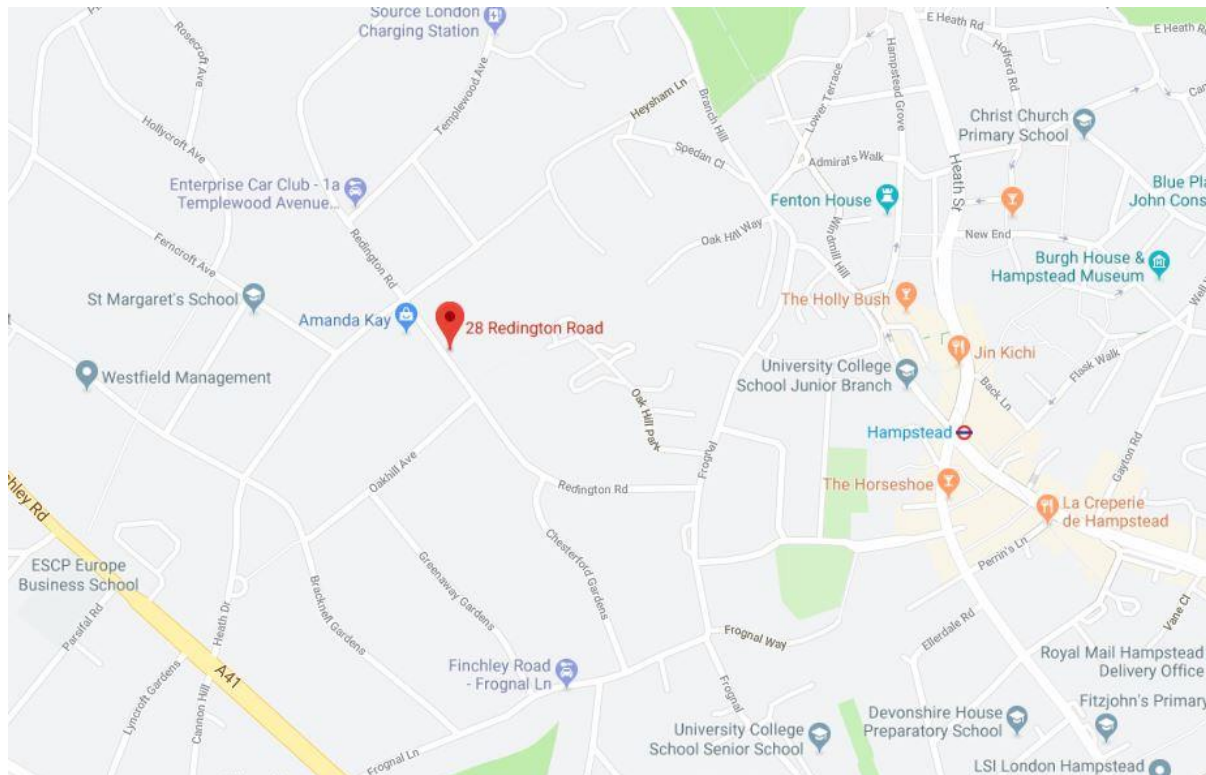


Figure 1 Carbon emissions in Energy Hierarchy

2. Introduction

This Energy Statement will be included as part of the planning application that addresses the environmental impact of the development. This report focuses on the energy strategy for the proposed scheme and how energy consumption and carbon emissions will be minimised and to meet the targeted carbon emissions in accordance with the London Plan and Local planning policy.

This development is to be located in the London Borough of Camden and it is in close proximity to Hampstead station (approx 0.5 miles to the South-East). The proposal is **refurbishment and extension of a detached house at 28 Redington Road, Hampstead, London, NW3 7RB.**



The Government approved software, i.e. FSAP 2012 has been utilised to carry out Standard Assessment Procedure (SAP) calculations. Syntegra received the architectural drawings and relevant documents, and they were used to undertake the energy assessments. The document references are listed in table below.

No.	Document Name	Format	Received Date
1	1384-28 Redington Road London, NW3 7RB (Issue Drawing 2015.10.02)	dwg	02/07//2019
2	28RR-100-BasementPlan	dwg	05/07/2019
4	28RR-101-GroundFloorPlan	dwg	05/07/2019
5	28RR-102-1stFloorPlan	dwg	05/07/2019
6	28RR-103-2ndFloorPlan	dwg	05/07/2019
7	28RR-104-RoofFloorPlan	dwg	05/07/2019
8	28RR-120-FrontElevation	dwg	05/07/2019
9	28RR-121-RearElevation	dwg	05/07/2019
10	28RR-122-NorthWestElevation	dwg	05/07/2019
11	28RR-123-SouthEastElevation	dwg	05/07/2019
12	28RR-140-SectionA	dwg	05/07/2019
13	28RR-141-SectionB	dwg	05/07/2019
14	28RR-142-SectionC	dwg	05/07/2019
15	28RR-143-SectionD	dwg	05/07/2019
16	28RR-144-SectionE	dwg	05/07/2019
17	OI1332760	dwg	05/07/2019

Table 5 The document list

3. Planning Policy

3.1. National Planning Policy Framework (February 2019)

The National Planning Policy Framework is a key part of our reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

3.2. The London Plan (March 2016)



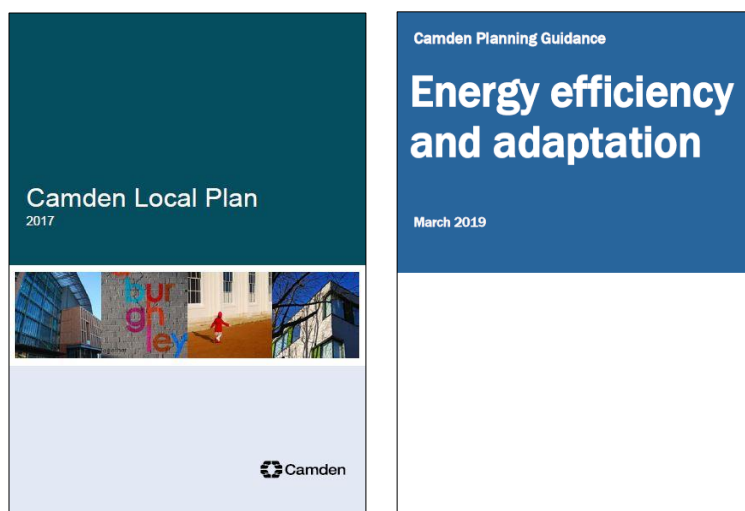
Policy 5.2, 5.4, 5.5, 5.6, & 5.7

According to Policy 5.2 all major new developments should show carbon emissions reduction through the Mayor's energy hierarchy (Be Lean, Be Clean and Be Green), unless it can be demonstrated that such provision is not feasible. From October 2016 Zero Carbon Standard apply to all new major residential development (10 or more units). This means that at least 35% of carbon reductions against a Building Regulations Part L 2013 must be achieved on-site, with the remaining emissions, up to 100%, to be offset through a contribution to the Council's Carbon Offset Fund. For the non-residential development, must achieve a 35% reduction in CO₂ emissions against a Building Regulations Part L 2013 baseline.

For retrofitting developments, it will be a challenge to meet these targets. However, available reductions in carbon emissions should be demonstrated along with water saving measures as per Policy 5.4.

Furthermore, intent must be shown for connecting to a Decentralised Energy Network and utilizing a Combined Heat & Power according to Policy 5.5 and 5.6. The Mayor and boroughs should in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from onsite renewable energy generation according to paragraph 5.42 of Policy 5.7

3.3. London Borough of Camden



Camden Local Plan (Adopted in 2017)

Policy CC1 Climate Change Mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

- a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
- b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
- a. ensure that the location of development and mix of land uses minimize the need to travel by car and help to support decentralized energy networks;
- b. support and encourage sensitive energy efficiency improvements to existing buildings;
- c. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
- d. expect all developments to optimize resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

- e. working with local organizations and developers to implement decentralized energy networks in the parts of Camden most likely to support them;
- f. protecting existing decentralized energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
- g. requiring all major developments to assess the feasibility of connecting to an existing decentralized energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as;

- a. the protection of existing green spaces and promoting new appropriate green infrastructure;
- b. not increasing, and wherever possible reducing, surfaces and use of Sustainable Drainage Systems;
- c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
- d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

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

- e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;
- f. encourage new build residential development to use the Home Quality Mark and Passivhouse design standards;
- g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve “excellent” in BREEAM domestic refurbishment; and
- h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve “excellent” in BREEAM assessments and encouraging zero carbon in new development from 2019.

Policy CC3 Water and Flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

- a. incorporate water efficiency measures;
- b. avoid harm to the water environment and improve water quality;
- c. consider the impact of development in areas at risk of flooding (including drainage);
- d. incorporate flood resilient measures in areas prone to flooding;
- e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and
- f. not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

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8.55 Developments must be designed to be water efficient. This can be achieved through the installation of water efficient fittings and appliances (which can help reduce energy consumption as well as water consumption) and by capturing and re-using rainwater and grey water on-site. Residential developments will be expected to meet the requirement of 110 litres per person per day (including 5 litres for external water use). Refurbishments and other non-domestic development will be expected to meet BREEAM water efficiency credits. Major developments and high or intense water use developments, such as hotels, hostels and student housing, should include a grey water and rainwater harvesting system. Where such a system is not feasible or practical, developers must demonstrate to the Council's satisfaction that this is the case.

Camden Planning Guidance (Adopted in March 2019)

Table 2a Energy reduction targets, domestic

Development should comply with these standards/provide this information	Residential New Build (assessed under L1A)			Residential Refurbishment (assessed under L1B)		
	Major (10+ units or >1,000 sqm new floor space)	Medium (5-9 units, >500sq.m and <1,000 sqm new floor space)	Minor All new dwellings (up to 4 units and <500 sqm new floor space)	Major (10+ units or >1,000 sqm)	Medium (5-9 units, >500sq.m and <1,000 sqm)	Minor (up to 4 units and <500 sqm)
Energy and carbon reduction targets						
Overall carbon reduction targets:	Zero Carbon (minimum 35% reduction beyond Part L on site) (London Plan 5.2, Local Plan CC1)	19% below Part L of 2013 Building Regulations (Local Plan	19% below Part L of 2013 Building Regulations (Local Plan	Greatest possible reduction - meeting Part L1B for retained thermal	Greatest possible reduction - meeting Part L1B for retained thermal	Greatest possible reduction - meeting Part L1B for retained thermal
		CC1)	CC1)	elements (London Plan 5.4, Local Plan CC1)	elements (London Plan 5.4, Local Plan CC1)	elements (London Plan 5.4, Local Plan CC1)
Reduction in CO2 from onsite renewables (after all other energy efficiency measures have been incorporated)	20% (London Plan 5.7, Local Plan CC1)	20% (London Plan 5.7, Local Plan CC1)	Incorporate renewables where feasible	20% (London Plan 5.4, 5.7, Local Plan CC1)	20% (London Plan 5.4, 5.7, Local Plan CC1)	20% (London Plan 5.4, 5.7, Local Plan CC1)

4. Assessment Methodology

4.1. Mayor's Energy Hierarchy

The energy hierarchy is a classification of different methods to improve energy performance in a parallel sequence. This includes primarily a focus on reducing energy use by avoiding unnecessary use, to then improving the efficiency of energy systems to minimise loss, this is followed by exploiting renewable energy sources and then low carbon energy solutions for energy needs and finally, any remaining demand can be catered for by conventional fuel sources.

The Mayor's Energy Strategy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. These guiding principles have been reordered since the publication of the Mayor's Energy Strategy in Feb 2004 and the adopted replacement London Plan 2011 with further alterations in 2015 stating that the following hierarchy should be used to assess applications:

- **BE LEAN** – By using less energy and taking into account the further energy efficiency measure in comparison to the baseline building.
- **BE CLEAN** – By supplying energy efficiently. The clean building looks at further carbon dioxide emission savings over the lean building by taking into consideration the use of decentralise energy via CHP.
- **BE GREEN** – By integrating renewable energy into the scheme which can further reduce the carbon dioxide emission rate.

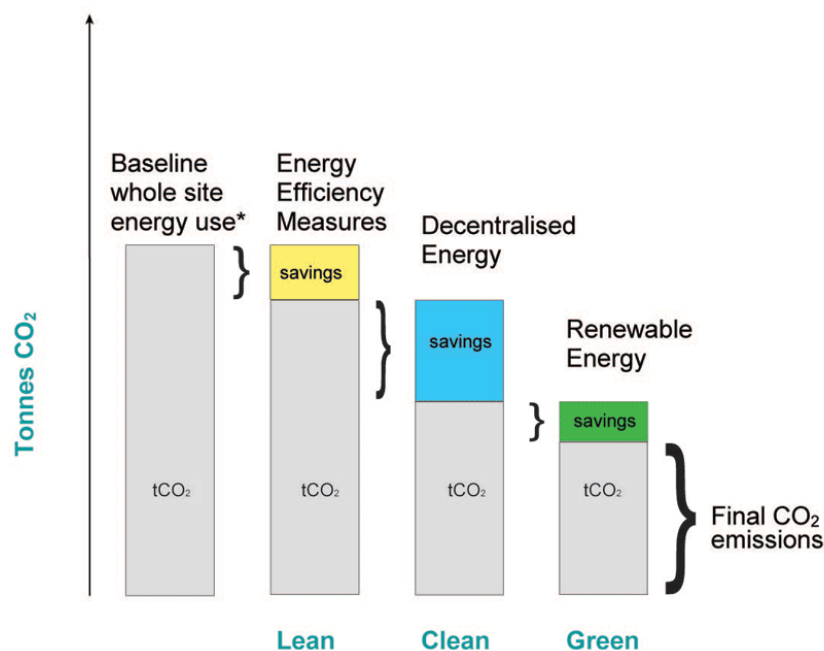


Figure 2 The Energy Hierarchy

5. Baseline – Target Emission Rate

The baseline (known as Target Emission Rate), as calculated in line with the Building Regulation 2013, is the maximum amount of carbon dioxide a dwelling or non-residential unit is allowed to emit. The Target Emission Rate (TER) includes carbon dioxide emissions which are covered by Part L of the Building Regulations, known as regulated emissions (space and water heating, ventilation, lighting, pumps, fans & controls). The baseline energy uses and resulting CO₂ emissions rates of the development have been assessed using the Government approved software.

In regard to the conversion/ refurbishment area, the baseline energy use and CO₂ emissions for the development are calculated based on the notional existing building conditions in accordance with GLA Guidance on preparing energy assessments. The inputs were gathered during the site survey or assumed by the Reduced Data SAP (RdSAP) when the data was not available. The existing building conditions are summarised in the table below.

		Existing Specifications (Age band B set by SAP 2012 Appendix S)
U-value (W/m ² K)	Wall	2.1 (solid brick as built)
	Window	3.1 (double glazing)
	Rooflight	3.1 (double glazing)
	Floor	1.2 (as built/ insulation unknown)
	Roof	2.3 (flat/ pitched)
	Door	3.0
Air Permeability (m ³ /h.m ² at 50 Pa)		15
Heating System		Gas combi boiler with radiators
Hot Water System		From gas combi boiler
Lighting		0% Low Energy Light
Ventilation		Natural ventilation with extract fans in wet room

Table 6 Existing Specifications used for energy assessment

The 'baseline' regulated CO₂ emission for the development is presented in the tables below:

BASELINE

BASELINE	Regulated CO ₂ Emissions (Tonnes CO ₂ /yr)
28 Redington Road	52.13

Table 7 Regulated Carbon Emissions at Baseline

6. BE LEAN – Energy Efficient Design

This section outlines the energy efficient measures taken in order to minimise the building's energy demand and therefore reduce energy use and CO₂ emissions further than the Baseline requirements (Building Regulations 2013 Part L compliance).

6.1. Passive Design Measures

- Enhanced Building Elements

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the build. The heat loss of different building element is dependent upon their U-value and air tightness. Therefore, better U-values and air permeability than the minimum values set in the Part L 2013 have been suggested in this development. Please see below more specifically.

		Part L1B 2013 min. required values		Proposed building values	
		New	Upgrade	New	Upgrade
U-value (W/m ² K)	Wall	0.28	0.3 – 0.55	0.28	0.3
	Window	1.6		1.6	
	Roof lights	1.6		1.6	
	Floor	0.22	0.25	0.22	0.25
	Roof	0.16 – 0.18		0.16	
	Door	1.8		1.8	
Air Permeability (m ³ /h.m ² at 50 Pa)		-		15	

Table 8 Proposed building elements

- Orientation & Natural Daylighting

Passive solar gain reduces the amount of energy required for space heating during the winter months. The houses are positioned having front roads and rear gardens, which can maximise the passive solar gains into the building throughout the day. Moreover, the internal layout, windows, and roof lights have been designed to improve daylighting in all habitable spaces, as a way of improving the health and wellbeing of occupants.

- **Solar Shading**

The dwelling will incorporate internal blinds or curtains to reduce the solar heat coming into the dwelling, and thus can reduce the cooling demand during summer.

- **Natural Ventilation**

A natural ventilation strategy has been adopted with extract fans in wet rooms; toilets, bathrooms, kitchen and utility. Therefore, higher energy consumption and CO₂ emissions due to mechanical ventilation can be avoided.

6.2. Active Design Measures

- **Heating and Hot Water System**

At the 'BE LEAN' stage, condensing gas boiler (89.5% efficiency) have been examined for space heating and hot water. Detailed specifications used at BE LEAN stage are in the table below.

Please note that the system below has been used only for carbon emissions calculation at BE LEAN stage as per GLA Guidance on energy assessment. The suggested system will be mentioned at BE GREEN stage as a renewable technology (GSHP) has been suggested – Section 8.2.

Systems	General Specification	Controls/ Other inputs
Heating	Condensing gas boiler with radiators (efficiency of 89.5%)	• Time and temperature zone control by suitable arrangement of plumbing and electrical services • Boiler interlocked • Fan flued
Hot-water	From gas boiler	• Cylinder – 300 litres • Loss factor - 1.9 kWh/day • Cylinder in heated space • Cylinderstat • Primary pipe work insulated

Table 9 Heating and Hot water systems

- **High Efficiency Lighting**

The proposed light fittings will be low energy efficient fittings. These can be T5 fluorescent fittings with high frequency ballasts, or LED fittings. The suggested specifications should be reviewed at detailed design stage with electric engineers.

The following table demonstrates the reduction in CO₂ emissions from the energy efficiency measures mentioned above. As shown in the table below, the carbon reduction of **61.71%** can be achieved on the site at BE LEAN stage against the existing building emissions.

BE LEAN STAGE

	Regulated CO ₂ Emissions (Tonnes CO ₂ /yr)		Carbon Reduction (%)
	BASELINE	BE LEAN	
28 Redington Road	52.13	19.96	61.71 %

Table 10 Regulated Carbon Emissions at Be Lean Stage

7. BE CLEAN – CHP & Decentralised Energy Networks

The Energy Hierarchy encourages the use of a CHP system and the connection to District Heating system to reduce CO₂ emissions further.

7.1. Decentralised Energy Network

The Mayor's Energy Strategy favours community heating systems because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions; and
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The feasibility of connecting into an existing heating network or providing the building with its own combined heat and power plant has been assessed alongside the **London Heat Map Study for the London Borough of Camden** as part of this assessment. The study identifies that the site is not located near the existing/ potential district heating networks. This is demonstrated clearly from the London Heat Map (<http://www.londonheatmap.org.uk>) snapshot below.

London Heat Map

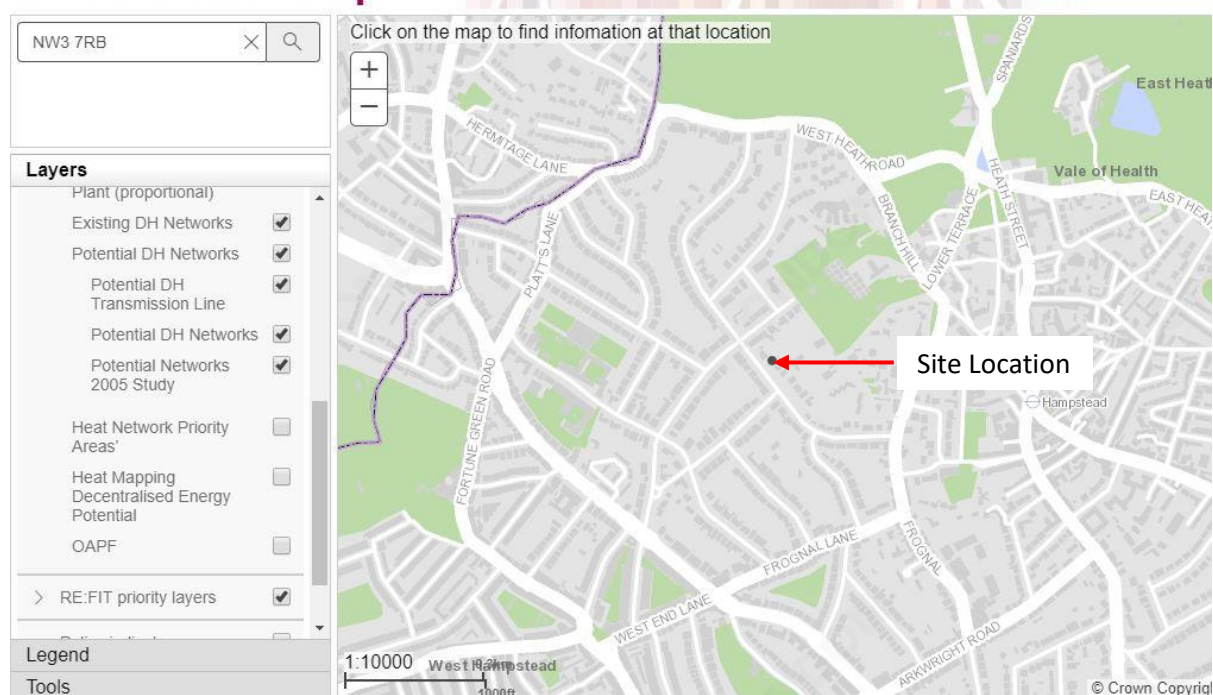


Figure 3 London Heat Map near the site

Moreover, the London heat map below identifies existing DH networks in more broaden area, and it could not find any existing DH networks (in yellow) within 1Km radius from the property. The costs involved in extending the existing DH network would outweigh the advantages in this small development. **Therefore, utilisation of the DH network has not been a feasible option for this development.**

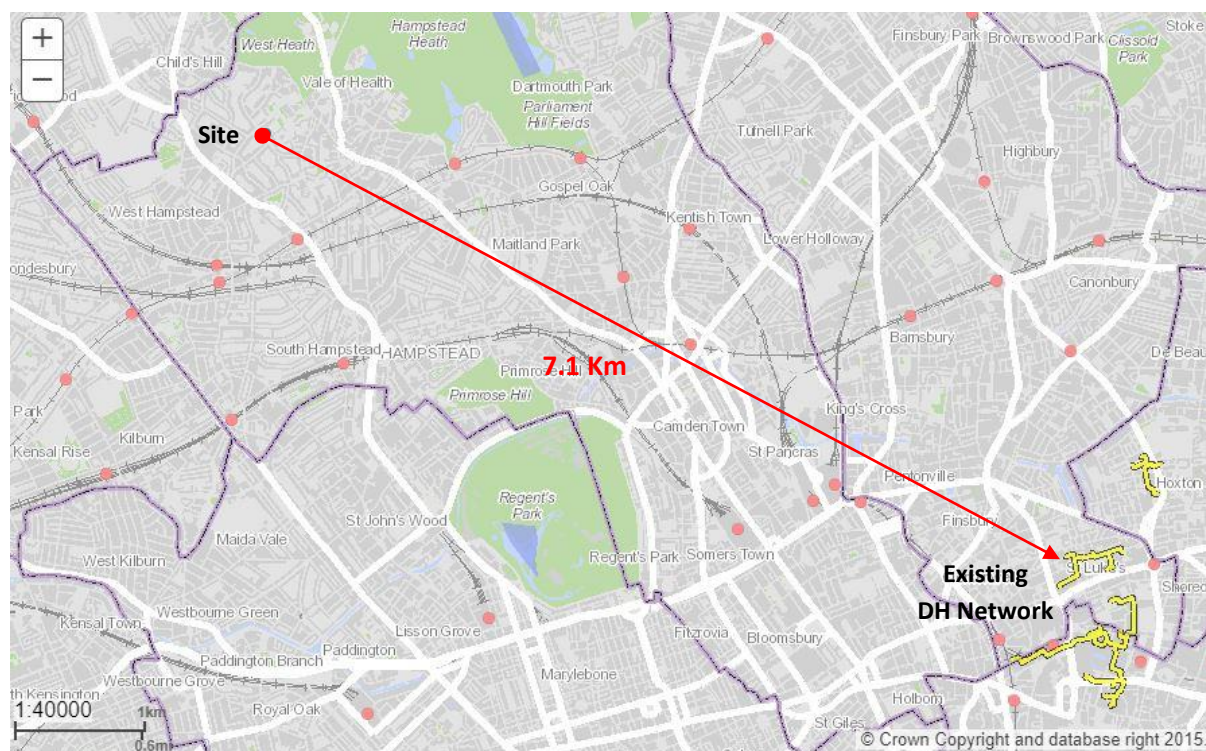


Figure 4 Existing DH Network near the site

7.2. CHP

The Energy Hierarchy identifies the combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. Also, it encourages the creation of district heating systems supplied by CHP. The implementation of a CHP strategy should be decided according to good practice design. Key factors for the efficient implementation of the CHP system are:

- Development with high heating load for the majority of the year.
- CHP operation based on maximum heat load for minimum 10 hours per day.
- CHP operation at maximum capacity of 90% of its operating period.

To ensure that CHP is financially viable it is essential that the unit is selected to meet the base heat load and that this load is maintained over a large proportion of the day (a figure of 14 – 17 hours per day is often quoted subject to the load profiles and gas and electricity prices) to ensure that the additional costs (maintenance) associated with running a CHP unit can be recovered. This need to run the CHP plant, as far as possible continuously makes the building load profile of prime importance when reviewing the viability of such solutions and in particular the summer time heat load profile. To enable the CHP plant to run continuously when it is operating, a thermal store is often used so that excess CHP capacity can be used to generate hot water for use at a later time.

Since this development consists of only one dwelling that does not require high heating loads, installing the CHP system would not be beneficial given the cost. According to the Local Plan Policy LP22, developments of 50 units or more will need to provide an assessment of the provision of CHP. **Hence the CHP system has not been considered for this development at BE CLEAN stage.**

8. BE GREEN – Renewable Energy

In this section the viable renewable energy technologies that could reduce the development's CO₂ emissions are examined. In determining the appropriate renewable technology for the site, the following factors were considered;

- Renewable energy resource or fuel availability of the LZC technology on the site.
- Space limitations due to building design and urban location of the site.
- Capital, operating and maintenance cost.
- Planning Permission
- Implementation with regards the overall M&E design strategy for building type
- Available Grants

The table below summarises the various low zero carbon technologies considered for the projects, and we have identified that **Ground Source Heat Pumps and PV panels** would be the most appropriate option in this development.

Technology	Local Planning Requirements	Carbon Payback	Grants/ Funding	Feasibility
Air Source Heat Pumps (ASHP)	Noise Issues from External units	High	Renewable Heat Incentive (RHI)	MEDIUM
Solar Thermal	Spatial and Shadowing	Low	Renewable Heat Incentive (RHI)	MEDIUM
Photovoltaic (PV)	Spatial and Shadowing	High	-	HIGH
Ground Source Heat Pumps (GSHP)	Spatial issues for boring holes and noise	Medium	Renewable Heat Incentive (RHI)	HIGH
Biomass	Spatial requirement for fuel storage and biomass odour	High	Renewable Heat Incentive (RHI)	LOW
Wind Power	Extensive planning requirements for noise and local biodiversity	Low	-	LOW
Hydro Power	Extensive planning requirements for noise and water quality	None	-	ZERO

Table 11 Feasibility Study of LZC Technologies

8.1. Non-feasible Technology

- Air Source Heat Pumps (ASHP)**

ASHP can meet the space heating demands on site efficiently in comparison with gas boilers. Although this low carbon technology consumes electricity to operate due to higher efficiency the heat output is much greater. However, the efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. Moreover, any noise associated with the external units could potentially be an issue at night due to the proximity of the neighboring residential buildings. Therefore, the use of ASHP is not a suitable option for this development.

- Solar Thermal**

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is at its most effective during the summer months. Therefore, this system would require additional plumbing and space for hot water storage, incurring additional financial cost. Moreover, the amount of carbon offset from the system is generally lower than other technologies. Therefore, this technology is deemed to be unsuitable for this development.

- Hydro power**

Although River Thames is close to the site, there is no river or lake within the development site boundaries. Therefore, small scale hydro-electric will not be studied any further because of the location and the spatial limitations of the development.

- Wind Power**

Wind turbines need extensive planning requirements and they are only feasible at consistent wind speed. Moreover, since the development is located in an urban area, the site does not have sufficient wind speed to operate wind turbine at the height of 10 meters as shown below (<http://www.renew-reuse-recycle.com/noabl.pl?n=503>). Hence this option has been discounted.

Estimated average windspeeds around NW3 7..

Wind speed at 10m above ground level (m/s)			Wind speed at 25m above ground level (m/s)			Wind speed at 45m above ground level (m/s)		
5	5.5	5.8	5.8	6.3	6.5	6.3	6.7	6.9
5	5.7	5.9	5.8	6.4	6.6	6.3	6.8	7
4.9	5.3	5.6	5.7	6	6.3	6.2	6.5	6.7

Squares surrounding the central square correspond to wind speeds for surrounding grid squares. Power generated is related to windspeed by a cubic ratio. That means if you halve the windspeed, the power goes down by a factor of 8 (which is $2 \times 2 \times 2$). A quarter of the windspeed gives you a 64^{th} of

the power (4 x 4 x 4). As a rough guide, if your turbine is rated at producing 1KW at 12m/s then it will produce 125W at 6m/s and 15W at 3m/s.

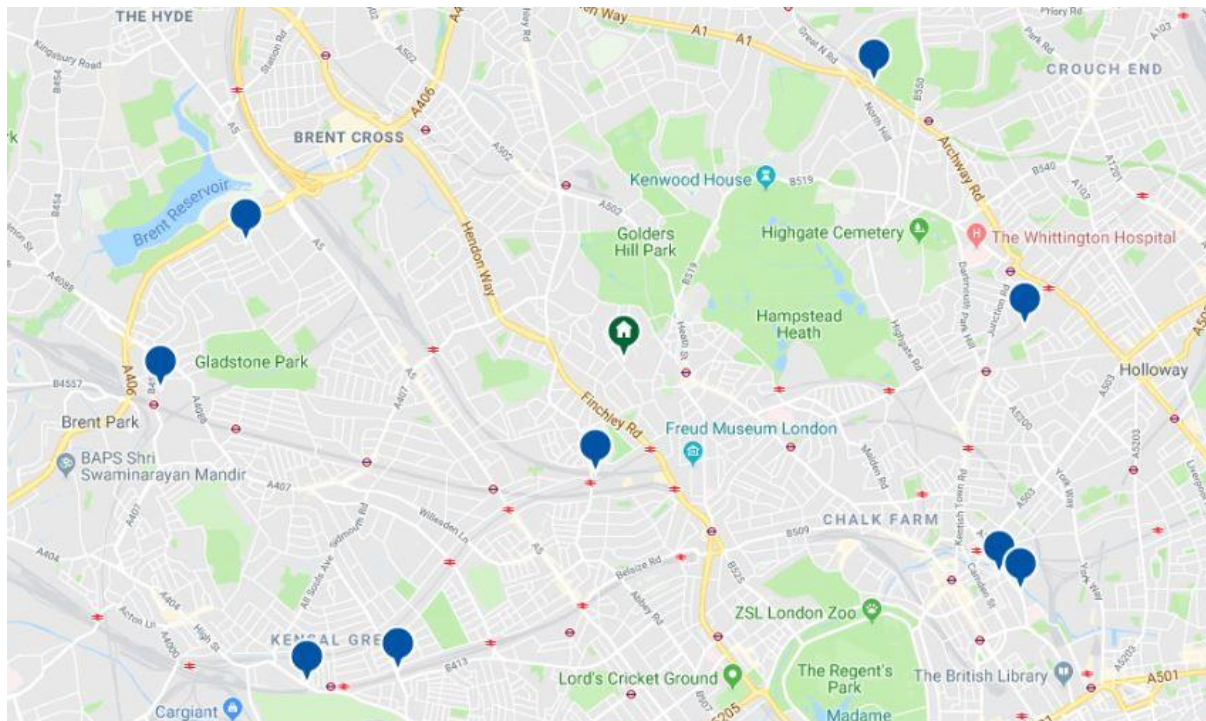
Please note that bear in mind that the NOABL windspeed dataset used here is a model of windspeeds across the country, assuming completely flat terrain. It isn't a database of measured windspeeds. Other factors such as hills, houses, trees and other obstructions in your vicinity need to be considered as well as they can have a significant effect. If you're thinking about installing a wind turbine, you should perform your own windspeed measurements using an anemometer to determine what the actual figures are.

- **Biomass**

A biomass system designed for this development would be fueled by wood pellets which have a high energy content. However, a biomass system would not be an appropriate technology for the site for the following reasons:

- The burning of wood pellets releases substantially more NOx emissions when compared to similar gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would further impact on the air quality in this area.
- the lack of spaces for pellet boiler and storage on the site.
- Pellets would need to be transported from local pellet suppliers, which causes carbon emissions to the air.

However, if the biomass system is considered at detailed design stage, local suppliers can be found near the site as shown in the map below (<http://biomass-suppliers-list.service.gov.uk>).



Company name	Postcode	Contact	Fuel Supplied	Telephone
Travis Perkins Trading Co. Ltd	NW6 1SD	www.travisperkins.co.uk johnny.farmer@travisperkins.co.uk	Pellets	020 7794 8151
Wolseley UK Ltd	N6 4JD	www.draincenter.co.uk qdn.Highgate@wolseley.co.uk	Pellets	0208 3400793
Travis Perkins Trading Co. Ltd	NW10 3NB	www.travisperkins.co.uk lee.gilmore@travisperkins.co.uk	Pellets	020 8964 9000
Wolseley UK Ltd	NW2 7LZ	www.plumbcenter.co.uk YH.StaplesCorner@wolseley.co.uk	Pellets	0208 8309106
Travis Perkins Trading Co. Ltd	N19 5UN	www.travisperkins.co.uk toby.duncan@travisperkins.co.uk	Pellets	0207 561 0516
Wolseley UK Ltd	NW1 0BY	www.plumbcenter.co.uk FFP.Camden@wolseley.co.uk	Pellets	0207 4240957
Travis Perkins Trading Co. Ltd	NW10 5NY	www.travisperkins.co.uk daniel.mccafferty@travisperkins.co.uk	Pellets	0208 969 2000
Travis Perkins Trading Co. Ltd	W2 6NA	www.travisperkins.co.uk liam.clancy@travisperkins.co.uk	Pellets	020 7262 6602
Travis Perkins Trading Co. Ltd	NW1 0PT	www.travisperkins.co.uk sean.mahon@travisperkins.co.uk	Pellets	0207 380 6480
Travis Perkins Trading Co. Ltd	NW10 1RZ	www.travisperkins.co.uk phil.pilditch@travisperkins.co.uk	Pellets	0208 4386 715

8.2. Proposed Technology

• Ground Source Heat Pumps (GSHP)

Ground-source heat pumps (GSHPs) operate similarly to ASHPs, except that the ground serves as the heat source. As the ground remains at relatively stable temperatures throughout the year, SCOPs may be consistently high at above 5.0, producing low-carbon heat suitable for space heating and domestic hot water. Ground loops or boreholes are required, especially on a small footprint where unusually deep boreholes would be required to meet heating demand.

The specifications used for this energy assessment are below, however the mechanical engineer should be reviewed the specification during the design development.

Systems	General Specification	Controls/ Other inputs
Heating	Ground Source Heat Pumps for underfloor heating (170% efficiency)	- Flow temperature $\leq 35^{\circ}\text{C}$ - Control – Programmer and at least two room thermostats - MCS certified
Hot Water	Electric immersion cylinder	300 litres with the loss factor of 1.9 kWh/day - Cylinder in heated space - Cylinderstat

Table 12 Be Green Stage systems

Tariffs that apply for domestic Renewable Heat Incentive (RHI) are as shown in the table below based on the following link. <https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/tariffs-and-payments-domestic-rhi/current-future-tariffs>

Tariff name	Applications submitted	Tariff Rate
Ground Source Heat Pumps	01/07/2019 – 30/09/2019	20.89 pence per kWh
	01/10/2019 – 30/12/2019	If any new tariff changes are to be made due to digression, the announcement by BEIS would be made by 1 August 2019

Table 13 GSHP RHI

- **Photovoltaic (PV)**

Based on the feasibility study above, PV would be the most suitable renewable technology for the following reasons:

- The installation of PV is much simpler when compared to other renewable technologies
- There is sufficient roof space available to install enough PV modules to have a significant impact on carbon emissions of the development
- PV panels sited on the roof within an urban area are less visually intrusive when compared to wind turbines

The PV system capacity for the whole development depends upon the selection of the heating system. Therefore, the amount of PV relating to the proposed heating system option is outlined below:

GSHP + 0.6 kWh PV

Orientation	South-East	Number of Panels	3 panels
Panel Tilt	45°	Power Output	200 W per panel
Overshading	Less than 20 percent	Annual Output	Approximately 482 kWh

Table 14 Suggested PV details

For the 0.6kWp system, 3 panels (200W per panel) would to be installed at 45° on the South-East roof. The proposed PV panels are subject to further consideration at detailed design stage. In order to qualify both the installer and the equipment, the system must be certified under the Microgeneration Certification Scheme (MCS).

Given the proposed LZC technologies on the site (**GSHP and PV**), the overall CO₂ reduction at BE GREEN stage can be calculated as shown below. And, it can be seen that the overall CO₂ reduction via on-site renewables is **20.88%** against the BE LEAN stage.

BE GREEN stage

	Regulated CO ₂ Emissions (Tonnes CO ₂ /yr)		Carbon Reduction (%)
	BE LEAN	BE GREEN	
28 Redington Road	19.96	15.79	20.88 %

Table 15 Regulated Energy Use and Carbon Reduction at Be Green Stage

9. Conclusion

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at **28 Redington Road, Hampstead, London, NW3 7RB**, based on the information provided by the design team.

In line with the local Council's three step energy hierarchy, the regulated CO₂ emissions for the development have been reduced by **69.7% including a 20.9% via renewable technologies**.

The table below clearly shows that the development meets the planning requirements.

Energy Hierarchy		Regulated Carbon Savings	
		Tonnes CO ₂ /yr	%
BE LEAN	After energy demand reduction	32.17	61.71 %
BE CLEAN	After heat network/ CHP	0	0 %
BE GREEN	After renewable energy	4.17	20.88 %
Total Cumulative Savings		36.34	69.70 %

Table 16 Carbon dioxide Emissions after each stage of the Energy Hierarchy

10. Appendix A – SAP Reports

Block Compliance WorkSheet: 28 Redington Road

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP

Software Version:

Version: 1.0.4.18

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Existing - BASELINE (TER)	52.02	12.96	193.4	60.6	1002.21
Proposed - BE LEAN	19.94	12.93	81.9	60.6	1002.21
Proposed - BE GREEN	15.76	19.59	81.9	60.6	1002.21

Calculation Summary

Total Floor Area	3006.63
Average TER	15.16
Average DER	29.24
Average DFEE	119.07
Average TFEE	60.60
Compliance	Fail
% Improvement DER TER	N/A
% Improvement DFEE TFEE	N/A

DER WorkSheet: New extension to existing dwelling

User Details:

Assessor Name: Su Lee **Stroma Number:** STRO031315
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.18

Property Address: Proposed - BE GREEN

Address : 28, Redington Road, LONDON, NW3 7RB

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Basement	235.61 (1a)	x	2.5 (2a)	=	589.03 (3a)
Ground floor	362.55 (1b)	x	3.16 (2b)	=	1145.66 (3b)
First floor	236.76 (1c)	x	3.06 (2c)	=	724.49 (3c)
Second floor	167.29 (1d)	x	3.01 (2d)	=	503.54 (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	1002.21 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	2962.71 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							18	x 10 =	180 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	180	÷ (5) =	0.06 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.81 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.69 (21)
Infiltration rate modified for monthly wind speed			

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

DER WorkSheet: New extension to existing dwelling

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.88	0.86	0.84	0.76	0.74	0.65	0.65	0.64	0.69	0.74	0.78	0.81
--	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

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

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

(24d)m=	0.89	0.87	0.86	0.79	0.77	0.71	0.71	0.7	0.74	0.77	0.8	0.83	(24d)
---------	------	------	------	------	------	------	------	-----	------	------	-----	------	-------

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

(25)m=	0.89	0.87	0.86	0.79	0.77	0.71	0.71	0.7	0.74	0.77	0.8	0.83	(25)
--------	------	------	------	------	------	------	------	-----	------	------	-----	------	------

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			1.89	x 1.8	= 3.402		(26)
Doors Type 2			2.32	x 1.8	= 4.176		(26)
Windows Type 1			0.67	x1/[1/(1.6)+ 0.04]	= 1.01		(27)
Windows Type 2			1.09	x1/[1/(1.6)+ 0.04]	= 1.64		(27)
Windows Type 3			0.95	x1/[1/(1.6)+ 0.04]	= 1.43		(27)
Windows Type 4			0.95	x1/[1/(1.6)+ 0.04]	= 1.43		(27)
Windows Type 5			0.95	x1/[1/(1.6)+ 0.04]	= 1.43		(27)
Windows Type 6			2.22	x1/[1/(1.6)+ 0.04]	= 3.34		(27)
Windows Type 7			0.84	x1/[1/(1.6)+ 0.04]	= 1.26		(27)
Windows Type 8			0.84	x1/[1/(1.6)+ 0.04]	= 1.26		(27)
Windows Type 9			0.67	x1/[1/(1.6)+ 0.04]	= 1.01		(27)
Windows Type 10			0.84	x1/[1/(1.6)+ 0.04]	= 1.26		(27)
Windows Type 11			0.84	x1/[1/(1.6)+ 0.04]	= 1.26		(27)
Windows Type 12			0.84	x1/[1/(1.6)+ 0.04]	= 1.26		(27)

DER WorkSheet: New extension to existing dwelling

Windows Type 13	1.4	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.11	(27)
Windows Type 14	1.4	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.11	(27)
Windows Type 15	1.4	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.11	(27)
Windows Type 16	2.23	$\times 1/\sqrt[1]{(1.6) + 0.04}$	3.35	(27)
Windows Type 17	1.39	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.09	(27)
Windows Type 18	7.702	$\times 1/\sqrt[1]{(1.6) + 0.04}$	11.58	(27)
Windows Type 19	9.22	$\times 1/\sqrt[1]{(1.6) + 0.04}$	13.86	(27)
Windows Type 20	5.15	$\times 1/\sqrt[1]{(1.6) + 0.04}$	7.74	(27)
Windows Type 21	9.49	$\times 1/\sqrt[1]{(1.6) + 0.04}$	14.27	(27)
Windows Type 22	2.1	$\times 1/\sqrt[1]{(1.6) + 0.04}$	3.16	(27)
Windows Type 23	3.93	$\times 1/\sqrt[1]{(1.6) + 0.04}$	5.91	(27)
Windows Type 24	2.61	$\times 1/\sqrt[1]{(1.6) + 0.04}$	3.92	(27)
Windows Type 25	6.83	$\times 1/\sqrt[1]{(1.6) + 0.04}$	10.27	(27)
Windows Type 26	2.9	$\times 1/\sqrt[1]{(1.6) + 0.04}$	4.36	(27)
Windows Type 27	1.68	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.53	(27)
Windows Type 28	1.68	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.53	(27)
Windows Type 29	1.68	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.53	(27)
Windows Type 30	1.89	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.84	(27)
Windows Type 31	7.43	$\times 1/\sqrt[1]{(1.6) + 0.04}$	11.17	(27)
Windows Type 32	1.81	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.72	(27)
Windows Type 33	1.81	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.72	(27)
Windows Type 34	8.28	$\times 1/\sqrt[1]{(1.6) + 0.04}$	12.45	(27)
Windows Type 35	5.69	$\times 1/\sqrt[1]{(1.6) + 0.04}$	8.56	(27)
Windows Type 36	2.68	$\times 1/\sqrt[1]{(1.6) + 0.04}$	4.03	(27)
Windows Type 37	2.33	$\times 1/\sqrt[1]{(1.6) + 0.04}$	3.5	(27)
Windows Type 38	4.04	$\times 1/\sqrt[1]{(1.6) + 0.04}$	6.08	(27)
Windows Type 39	4.04	$\times 1/\sqrt[1]{(1.6) + 0.04}$	6.08	(27)
Windows Type 40	1.16	$\times 1/\sqrt[1]{(1.6) + 0.04}$	1.74	(27)
Windows Type 41	1.16	$\times 1/\sqrt[1]{(1.6) + 0.04}$	1.74	(27)
Windows Type 42	4.99	$\times 1/\sqrt[1]{(1.6) + 0.04}$	7.5	(27)
Windows Type 43	2.06	$\times 1/\sqrt[1]{(1.6) + 0.04}$	3.1	(27)
Rooflights Type 1	1.08	$\times 1/\sqrt[1]{(1.6) + 0.04}$	1.728	(27b)
Rooflights Type 2	1.08	$\times 1/\sqrt[1]{(1.6) + 0.04}$	1.728	(27b)
Rooflights Type 3	1.08	$\times 1/\sqrt[1]{(1.6) + 0.04}$	1.728	(27b)
Rooflights Type 4	0.98	$\times 1/\sqrt[1]{(1.6) + 0.04}$	1.568	(27b)
Rooflights Type 5	0.86	$\times 1/\sqrt[1]{(1.6) + 0.04}$	1.376	(27b)
Rooflights Type 6	0.49	$\times 1/\sqrt[1]{(1.6) + 0.04}$	0.784	(27b)
Rooflights Type 7	0.49	$\times 1/\sqrt[1]{(1.6) + 0.04}$	0.784	(27b)
Rooflights Type 8	1.38	$\times 1/\sqrt[1]{(1.6) + 0.04}$	2.208	(27b)

DER WorkSheet: New extension to existing dwelling

Rooflights Type 9			2.36	$\times 1/[1/(1.6) + 0.04]$	=	3.776			(27b)
Floor Type 1			235.61	$\times$	0.25	=	58.9025		(28)
Floor Type 2			58.41	$\times$	0.25	=	14.6025		(28)
Floor Type 3			43.88	$\times$	0.25	=	10.97		(28)
Floor Type 4			30.08	$\times$	0.22	=	6.6176		(28)
Walls Type1	39.83	0	39.83	$\times$	0.28	=	11.15		(29)
Walls Type2	74.6	0	74.6	$\times$	0.3	=	22.38		(29)
Walls Type3	82.62	0	82.62	$\times$	0.3	=	24.79		(29)
Walls Type4	15.7	12.3	3.4	$\times$	0.28	=	0.95		(29)
Walls Type5	181.23	47.31	133.92	$\times$	0.28	=	37.5		(29)
Walls Type6	151.49	13.43	138.06	$\times$	0.3	=	41.42		(29)
Walls Type7	122.82	13.51	109.31	$\times$	0.28	=	30.61		(29)
Walls Type8	82.7	33.42	49.28	$\times$	0.3	=	14.78		(29)
Walls Type9	58.8	10.4	48.4	$\times$	0.28	=	13.55		(29)
Walls Type10	73.15	10	63.15	$\times$	0.3	=	18.94		(29)
Walls Type11	7.3	0	7.3	$\times$	0.28	=	2.04		(29)
Roof Type1	7.3	0	7.3	$\times$	0.16	=	1.17		(30)
Roof Type2	9.01	0	9.01	$\times$	0.16	=	1.44		(30)
Roof Type3	62.97	0	62.97	$\times$	0.16	=	10.08		(30)
Roof Type4	60.25	0	60.25	$\times$	0.16	=	9.64		(30)
Roof Type5	53.15	7.56	45.59	$\times$	0.16	=	7.29		(30)
Roof Type6	13.83	0	13.83	$\times$	0.16	=	2.21		(30)
Roof Type7	89.11	6.93	82.18	$\times$	0.16	=	13.15		(30)
Roof Type8	68.32	0	68.32	$\times$	0.16	=	10.93		(30)
Roof Type9	20.39	0.49	19.9	$\times$	0.16	=	3.18		(30)
Roof Type10	19.18	0	19.18	$\times$	0.16	=	3.07		(30)
Total area of elements, m ²			1661.72						(31)

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

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

Fabric heat loss, W/K = S (A x U)	(26)...(30) + (32) =	606.23	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		249.26	(36)
<i>if details of thermal bridging are not known (36) = 0.05 x (31)</i>			
Total fabric heat loss	(33) + (36) =	855.49	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	866.26	851.6	837.24	769.76	757.14	698.37	698.37	687.49	721.01	757.14	782.68	809.38	(38)

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

(39)m=	1721.75	1707.09	1692.73	1625.25	1612.63	1553.86	1553.86	1542.98	1576.5	1612.63	1638.17	1664.87		
Average = Sum(39) _{1...12} /12=													1625.19	(39)

DER WorkSheet: New extension to existing dwelling

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.72	1.7	1.69	1.62	1.61	1.55	1.55	1.54	1.57	1.61	1.63	1.66		
	Average = Sum(40) _{1...12} /12=												1.62	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

4.04

(42)

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

if TFA ≤ 13.9, N = 1

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

130.26

(43)

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

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

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

(44)m=	143.29	138.08	132.87	127.66	122.45	117.24	117.24	122.45	127.66	132.87	138.08	143.29		
	Total = Sum(44) _{1...12} =												1563.17	(44)

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

(45)m=	212.5	185.85	191.78	167.2	160.43	138.44	128.29	147.21	148.97	173.61	189.51	205.79		
	Total = Sum(45) _{1...12} =												2049.56	(45)

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

(46)m=	31.87	27.88	28.77	25.08	24.06	20.77	19.24	22.08	22.35	26.04	28.43	30.87		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

300

(47)

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

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

Water storage loss:

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

1.9

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

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

1.14

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

1.14

(55)

Water storage loss calculated for each month

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

(56)m=	35.34	31.92	35.34	34.2	35.34	34.2	35.34	35.34	34.2	35.34	34.2	35.34		(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

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

(57)m=	35.34	31.92	35.34	34.2	35.34	34.2	35.34	35.34	34.2	35.34	34.2	35.34		(57)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New extension to existing dwelling

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

(61)m=

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

 (61)

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

(62)m=

247.84	217.77	227.12	201.4	195.77	172.64	163.63	182.55	183.17	208.95	223.71	241.13
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

 (62)

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

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

(63)m=

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

 (63)

Output from water heater

(64)m=

247.84	217.77	227.12	201.4	195.77	172.64	163.63	182.55	183.17	208.95	223.71	241.13
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12}

2465.66

 (64)

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

(65)m=

98.93	87.33	92.04	82.95	81.62	73.39	70.93	77.22	76.89	86	90.37	96.7
-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	------

 (65)

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

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
202.24	202.24	202.24	202.24	202.24	202.24	202.24	202.24	202.24	202.24	202.24	202.24

 (66)

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

(67)m=

85.67	76.09	61.88	46.85	35.02	29.56	31.95	41.52	55.73	70.77	82.6	88.05
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (67)

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

(68)m=

912.89	922.36	898.49	847.67	783.52	723.23	682.95	673.48	697.35	748.17	812.32	872.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

43.22	43.22	43.22	43.22	43.22	43.22	43.22	43.22	43.22	43.22	43.22	43.22
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

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

 (70)

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

(71)m=

-161.79	-161.79	-161.79	-161.79	-161.79	-161.79	-161.79	-161.79	-161.79	-161.79	-161.79	-161.79
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m=

132.97	129.96	123.71	115.21	109.7	101.93	95.33	103.79	106.79	115.59	125.51	129.97
--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------

 (72)

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

(73)m=

1218.2	1215.08	1170.75	1096.41	1014.91	941.4	896.9	905.46	946.55	1021.19	1107.1	1177.3
--------	---------	---------	---------	---------	-------	-------	--------	--------	---------	--------	--------

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.81</td></tr></table>	1.81	x	<table><tr><td>10.63</td></tr></table>	10.63	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>7.1</td></tr></table> (74)	7.1
0.77																		
1.81																		
10.63																		
0.76																		
0.7																		
7.1																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.81</td></tr></table>	1.81	x	<table><tr><td>20.32</td></tr></table>	20.32	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>13.56</td></tr></table> (74)	13.56
0.77																		
1.81																		
20.32																		
0.76																		
0.7																		
13.56																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.81</td></tr></table>	1.81	x	<table><tr><td>34.53</td></tr></table>	34.53	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>23.04</td></tr></table> (74)	23.04
0.77																		
1.81																		
34.53																		
0.76																		
0.7																		
23.04																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.81</td></tr></table>	1.81	x	<table><tr><td>55.46</td></tr></table>	55.46	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>37.01</td></tr></table> (74)	37.01
0.77																		
1.81																		
55.46																		
0.76																		
0.7																		
37.01																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.81</td></tr></table>	1.81	x	<table><tr><td>74.72</td></tr></table>	74.72	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>49.86</td></tr></table> (74)	49.86
0.77																		
1.81																		
74.72																		
0.76																		
0.7																		
49.86																		

DER WorkSheet: New extension to existing dwelling

North	0.9x	0.77	x	1.81	x	79.99	x	0.76	x	0.7	=	53.37	(74)
North	0.9x	0.77	x	1.81	x	74.68	x	0.76	x	0.7	=	49.83	(74)
North	0.9x	0.77	x	1.81	x	59.25	x	0.76	x	0.7	=	39.54	(74)
North	0.9x	0.77	x	1.81	x	41.52	x	0.76	x	0.7	=	27.7	(74)
North	0.9x	0.77	x	1.81	x	24.19	x	0.76	x	0.7	=	16.14	(74)
North	0.9x	0.77	x	1.81	x	13.12	x	0.76	x	0.7	=	8.75	(74)
North	0.9x	0.77	x	1.81	x	8.86	x	0.76	x	0.7	=	5.92	(74)
Northeast	0.9x	0.77	x	9.22	x	11.28	x	0.76	x	0.7	=	38.35	(75)
Northeast	0.9x	0.77	x	9.49	x	11.28	x	0.76	x	0.7	=	39.48	(75)
Northeast	0.9x	0.77	x	2.61	x	11.28	x	0.76	x	0.7	=	10.86	(75)
Northeast	0.9x	0.77	x	7.43	x	11.28	x	0.76	x	0.7	=	30.91	(75)
Northeast	0.9x	0.77	x	8.28	x	11.28	x	0.76	x	0.7	=	34.44	(75)
Northeast	0.9x	0.77	x	5.69	x	11.28	x	0.76	x	0.7	=	23.67	(75)
Northeast	0.9x	0.77	x	4.04	x	11.28	x	0.76	x	0.7	=	16.81	(75)
Northeast	0.9x	0.77	x	4.04	x	11.28	x	0.76	x	0.7	=	16.81	(75)
Northeast	0.9x	0.77	x	4.99	x	11.28	x	0.76	x	0.7	=	20.76	(75)
Northeast	0.9x	0.77	x	9.22	x	22.97	x	0.76	x	0.7	=	78.07	(75)
Northeast	0.9x	0.77	x	9.49	x	22.97	x	0.76	x	0.7	=	80.35	(75)
Northeast	0.9x	0.77	x	2.61	x	22.97	x	0.76	x	0.7	=	22.1	(75)
Northeast	0.9x	0.77	x	7.43	x	22.97	x	0.76	x	0.7	=	62.91	(75)
Northeast	0.9x	0.77	x	8.28	x	22.97	x	0.76	x	0.7	=	70.11	(75)
Northeast	0.9x	0.77	x	5.69	x	22.97	x	0.76	x	0.7	=	48.18	(75)
Northeast	0.9x	0.77	x	4.04	x	22.97	x	0.76	x	0.7	=	34.21	(75)
Northeast	0.9x	0.77	x	4.04	x	22.97	x	0.76	x	0.7	=	34.21	(75)
Northeast	0.9x	0.77	x	4.99	x	22.97	x	0.76	x	0.7	=	42.25	(75)
Northeast	0.9x	0.77	x	9.22	x	41.38	x	0.76	x	0.7	=	140.65	(75)
Northeast	0.9x	0.77	x	9.49	x	41.38	x	0.76	x	0.7	=	144.77	(75)
Northeast	0.9x	0.77	x	2.61	x	41.38	x	0.76	x	0.7	=	39.82	(75)
Northeast	0.9x	0.77	x	7.43	x	41.38	x	0.76	x	0.7	=	113.35	(75)
Northeast	0.9x	0.77	x	8.28	x	41.38	x	0.76	x	0.7	=	126.31	(75)
Northeast	0.9x	0.77	x	5.69	x	41.38	x	0.76	x	0.7	=	86.8	(75)
Northeast	0.9x	0.77	x	4.04	x	41.38	x	0.76	x	0.7	=	61.63	(75)
Northeast	0.9x	0.77	x	4.04	x	41.38	x	0.76	x	0.7	=	61.63	(75)
Northeast	0.9x	0.77	x	4.99	x	41.38	x	0.76	x	0.7	=	76.12	(75)
Northeast	0.9x	0.77	x	9.22	x	67.96	x	0.76	x	0.7	=	230.99	(75)
Northeast	0.9x	0.77	x	9.49	x	67.96	x	0.76	x	0.7	=	237.76	(75)
Northeast	0.9x	0.77	x	2.61	x	67.96	x	0.76	x	0.7	=	65.39	(75)
Northeast	0.9x	0.77	x	7.43	x	67.96	x	0.76	x	0.7	=	186.15	(75)
Northeast	0.9x	0.77	x	8.28	x	67.96	x	0.76	x	0.7	=	207.44	(75)
Northeast	0.9x	0.77	x	5.69	x	67.96	x	0.76	x	0.7	=	142.56	(75)
Northeast	0.9x	0.77	x	4.04	x	67.96	x	0.76	x	0.7	=	101.22	(75)

DER WorkSheet: New extension to existing dwelling

Northeast 0.9x	0.77	x	4.04	x	67.96	x	0.76	x	0.7	=	101.22	(75)
Northeast 0.9x	0.77	x	4.99	x	67.96	x	0.76	x	0.7	=	125.02	(75)
Northeast 0.9x	0.77	x	9.22	x	91.35	x	0.76	x	0.7	=	310.5	(75)
Northeast 0.9x	0.77	x	9.49	x	91.35	x	0.76	x	0.7	=	319.6	(75)
Northeast 0.9x	0.77	x	2.61	x	91.35	x	0.76	x	0.7	=	87.9	(75)
Northeast 0.9x	0.77	x	7.43	x	91.35	x	0.76	x	0.7	=	250.22	(75)
Northeast 0.9x	0.77	x	8.28	x	91.35	x	0.76	x	0.7	=	278.85	(75)
Northeast 0.9x	0.77	x	5.69	x	91.35	x	0.76	x	0.7	=	191.62	(75)
Northeast 0.9x	0.77	x	4.04	x	91.35	x	0.76	x	0.7	=	136.06	(75)
Northeast 0.9x	0.77	x	4.04	x	91.35	x	0.76	x	0.7	=	136.06	(75)
Northeast 0.9x	0.77	x	4.99	x	91.35	x	0.76	x	0.7	=	168.05	(75)
Northeast 0.9x	0.77	x	9.22	x	97.38	x	0.76	x	0.7	=	331.03	(75)
Northeast 0.9x	0.77	x	9.49	x	97.38	x	0.76	x	0.7	=	340.72	(75)
Northeast 0.9x	0.77	x	2.61	x	97.38	x	0.76	x	0.7	=	93.71	(75)
Northeast 0.9x	0.77	x	7.43	x	97.38	x	0.76	x	0.7	=	266.76	(75)
Northeast 0.9x	0.77	x	8.28	x	97.38	x	0.76	x	0.7	=	297.28	(75)
Northeast 0.9x	0.77	x	5.69	x	97.38	x	0.76	x	0.7	=	204.29	(75)
Northeast 0.9x	0.77	x	4.04	x	97.38	x	0.76	x	0.7	=	145.05	(75)
Northeast 0.9x	0.77	x	4.04	x	97.38	x	0.76	x	0.7	=	145.05	(75)
Northeast 0.9x	0.77	x	4.99	x	97.38	x	0.76	x	0.7	=	179.16	(75)
Northeast 0.9x	0.77	x	9.22	x	91.1	x	0.76	x	0.7	=	309.67	(75)
Northeast 0.9x	0.77	x	9.49	x	91.1	x	0.76	x	0.7	=	318.74	(75)
Northeast 0.9x	0.77	x	2.61	x	91.1	x	0.76	x	0.7	=	87.66	(75)
Northeast 0.9x	0.77	x	7.43	x	91.1	x	0.76	x	0.7	=	249.55	(75)
Northeast 0.9x	0.77	x	8.28	x	91.1	x	0.76	x	0.7	=	278.1	(75)
Northeast 0.9x	0.77	x	5.69	x	91.1	x	0.76	x	0.7	=	191.11	(75)
Northeast 0.9x	0.77	x	4.04	x	91.1	x	0.76	x	0.7	=	135.69	(75)
Northeast 0.9x	0.77	x	4.04	x	91.1	x	0.76	x	0.7	=	135.69	(75)
Northeast 0.9x	0.77	x	4.99	x	91.1	x	0.76	x	0.7	=	167.6	(75)
Northeast 0.9x	0.77	x	9.22	x	72.63	x	0.76	x	0.7	=	246.87	(75)
Northeast 0.9x	0.77	x	9.49	x	72.63	x	0.76	x	0.7	=	254.1	(75)
Northeast 0.9x	0.77	x	2.61	x	72.63	x	0.76	x	0.7	=	69.88	(75)
Northeast 0.9x	0.77	x	7.43	x	72.63	x	0.76	x	0.7	=	198.94	(75)
Northeast 0.9x	0.77	x	8.28	x	72.63	x	0.76	x	0.7	=	221.7	(75)
Northeast 0.9x	0.77	x	5.69	x	72.63	x	0.76	x	0.7	=	152.35	(75)
Northeast 0.9x	0.77	x	4.04	x	72.63	x	0.76	x	0.7	=	108.17	(75)
Northeast 0.9x	0.77	x	4.04	x	72.63	x	0.76	x	0.7	=	108.17	(75)
Northeast 0.9x	0.77	x	4.99	x	72.63	x	0.76	x	0.7	=	133.61	(75)
Northeast 0.9x	0.77	x	9.22	x	50.42	x	0.76	x	0.7	=	171.39	(75)
Northeast 0.9x	0.77	x	9.49	x	50.42	x	0.76	x	0.7	=	176.41	(75)
Northeast 0.9x	0.77	x	2.61	x	50.42	x	0.76	x	0.7	=	48.52	(75)

DER WorkSheet: New extension to existing dwelling

Northeast	0.9x	0.77	x	7.43	x	50.42	x	0.76	x	0.7	=	138.12	(75)
Northeast	0.9x	0.77	x	8.28	x	50.42	x	0.76	x	0.7	=	153.92	(75)
Northeast	0.9x	0.77	x	5.69	x	50.42	x	0.76	x	0.7	=	105.77	(75)
Northeast	0.9x	0.77	x	4.04	x	50.42	x	0.76	x	0.7	=	75.1	(75)
Northeast	0.9x	0.77	x	4.04	x	50.42	x	0.76	x	0.7	=	75.1	(75)
Northeast	0.9x	0.77	x	4.99	x	50.42	x	0.76	x	0.7	=	92.76	(75)
Northeast	0.9x	0.77	x	9.22	x	28.07	x	0.76	x	0.7	=	95.41	(75)
Northeast	0.9x	0.77	x	9.49	x	28.07	x	0.76	x	0.7	=	98.2	(75)
Northeast	0.9x	0.77	x	2.61	x	28.07	x	0.76	x	0.7	=	27.01	(75)
Northeast	0.9x	0.77	x	7.43	x	28.07	x	0.76	x	0.7	=	76.88	(75)
Northeast	0.9x	0.77	x	8.28	x	28.07	x	0.76	x	0.7	=	85.68	(75)
Northeast	0.9x	0.77	x	5.69	x	28.07	x	0.76	x	0.7	=	58.88	(75)
Northeast	0.9x	0.77	x	4.04	x	28.07	x	0.76	x	0.7	=	41.8	(75)
Northeast	0.9x	0.77	x	4.04	x	28.07	x	0.76	x	0.7	=	41.8	(75)
Northeast	0.9x	0.77	x	4.99	x	28.07	x	0.76	x	0.7	=	51.64	(75)
Northeast	0.9x	0.77	x	9.22	x	14.2	x	0.76	x	0.7	=	48.26	(75)
Northeast	0.9x	0.77	x	9.49	x	14.2	x	0.76	x	0.7	=	49.67	(75)
Northeast	0.9x	0.77	x	2.61	x	14.2	x	0.76	x	0.7	=	13.66	(75)
Northeast	0.9x	0.77	x	7.43	x	14.2	x	0.76	x	0.7	=	38.89	(75)
Northeast	0.9x	0.77	x	8.28	x	14.2	x	0.76	x	0.7	=	43.34	(75)
Northeast	0.9x	0.77	x	5.69	x	14.2	x	0.76	x	0.7	=	29.78	(75)
Northeast	0.9x	0.77	x	4.04	x	14.2	x	0.76	x	0.7	=	21.15	(75)
Northeast	0.9x	0.77	x	4.04	x	14.2	x	0.76	x	0.7	=	21.15	(75)
Northeast	0.9x	0.77	x	4.99	x	14.2	x	0.76	x	0.7	=	26.12	(75)
Northeast	0.9x	0.77	x	9.22	x	9.21	x	0.76	x	0.7	=	31.32	(75)
Northeast	0.9x	0.77	x	9.49	x	9.21	x	0.76	x	0.7	=	32.24	(75)
Northeast	0.9x	0.77	x	2.61	x	9.21	x	0.76	x	0.7	=	8.87	(75)
Northeast	0.9x	0.77	x	7.43	x	9.21	x	0.76	x	0.7	=	25.24	(75)
Northeast	0.9x	0.77	x	8.28	x	9.21	x	0.76	x	0.7	=	28.13	(75)
Northeast	0.9x	0.77	x	5.69	x	9.21	x	0.76	x	0.7	=	19.33	(75)
Northeast	0.9x	0.77	x	4.04	x	9.21	x	0.76	x	0.7	=	13.72	(75)
Northeast	0.9x	0.77	x	4.04	x	9.21	x	0.76	x	0.7	=	13.72	(75)
Northeast	0.9x	0.77	x	4.99	x	9.21	x	0.76	x	0.7	=	16.95	(75)
East	0.9x	0.77	x	1.81	x	19.64	x	0.76	x	0.7	=	13.11	(76)
East	0.9x	0.77	x	1.81	x	38.42	x	0.76	x	0.7	=	25.64	(76)
East	0.9x	0.77	x	1.81	x	63.27	x	0.76	x	0.7	=	42.22	(76)
East	0.9x	0.77	x	1.81	x	92.28	x	0.76	x	0.7	=	61.58	(76)
East	0.9x	0.77	x	1.81	x	113.09	x	0.76	x	0.7	=	75.47	(76)
East	0.9x	0.77	x	1.81	x	115.77	x	0.76	x	0.7	=	77.25	(76)
East	0.9x	0.77	x	1.81	x	110.22	x	0.76	x	0.7	=	73.55	(76)
East	0.9x	0.77	x	1.81	x	94.68	x	0.76	x	0.7	=	63.18	(76)

DER WorkSheet: New extension to existing dwelling

East	0.9x	0.77	x	1.81	x	73.59	x	0.76	x	0.7	=	49.11	(76)
East	0.9x	0.77	x	1.81	x	45.59	x	0.76	x	0.7	=	30.42	(76)
East	0.9x	0.77	x	1.81	x	24.49	x	0.76	x	0.7	=	16.34	(76)
East	0.9x	0.77	x	1.81	x	16.15	x	0.76	x	0.7	=	10.78	(76)
Southeast	0.9x	0.54	x	0.67	x	36.79	x	0.76	x	0.7	=	6.37	(77)
Southeast	0.9x	0.77	x	5.15	x	36.79	x	0.76	x	0.7	=	69.86	(77)
Southeast	0.9x	0.77	x	2.33	x	36.79	x	0.76	x	0.7	=	31.61	(77)
Southeast	0.9x	0.77	x	1.16	x	36.79	x	0.76	x	0.7	=	15.74	(77)
Southeast	0.9x	0.54	x	2.06	x	36.79	x	0.76	x	0.7	=	19.6	(77)
Southeast	0.9x	0.54	x	0.67	x	62.67	x	0.76	x	0.7	=	10.86	(77)
Southeast	0.9x	0.77	x	5.15	x	62.67	x	0.76	x	0.7	=	119	(77)
Southeast	0.9x	0.77	x	2.33	x	62.67	x	0.76	x	0.7	=	53.84	(77)
Southeast	0.9x	0.77	x	1.16	x	62.67	x	0.76	x	0.7	=	26.8	(77)
Southeast	0.9x	0.54	x	2.06	x	62.67	x	0.76	x	0.7	=	33.38	(77)
Southeast	0.9x	0.54	x	0.67	x	85.75	x	0.76	x	0.7	=	14.85	(77)
Southeast	0.9x	0.77	x	5.15	x	85.75	x	0.76	x	0.7	=	162.82	(77)
Southeast	0.9x	0.77	x	2.33	x	85.75	x	0.76	x	0.7	=	73.66	(77)
Southeast	0.9x	0.77	x	1.16	x	85.75	x	0.76	x	0.7	=	36.67	(77)
Southeast	0.9x	0.54	x	2.06	x	85.75	x	0.76	x	0.7	=	45.67	(77)
Southeast	0.9x	0.54	x	0.67	x	106.25	x	0.76	x	0.7	=	18.41	(77)
Southeast	0.9x	0.77	x	5.15	x	106.25	x	0.76	x	0.7	=	201.74	(77)
Southeast	0.9x	0.77	x	2.33	x	106.25	x	0.76	x	0.7	=	91.27	(77)
Southeast	0.9x	0.77	x	1.16	x	106.25	x	0.76	x	0.7	=	45.44	(77)
Southeast	0.9x	0.54	x	2.06	x	106.25	x	0.76	x	0.7	=	56.59	(77)
Southeast	0.9x	0.54	x	0.67	x	119.01	x	0.76	x	0.7	=	20.62	(77)
Southeast	0.9x	0.77	x	5.15	x	119.01	x	0.76	x	0.7	=	225.96	(77)
Southeast	0.9x	0.77	x	2.33	x	119.01	x	0.76	x	0.7	=	102.23	(77)
Southeast	0.9x	0.77	x	1.16	x	119.01	x	0.76	x	0.7	=	50.9	(77)
Southeast	0.9x	0.54	x	2.06	x	119.01	x	0.76	x	0.7	=	63.39	(77)
Southeast	0.9x	0.54	x	0.67	x	118.15	x	0.76	x	0.7	=	20.47	(77)
Southeast	0.9x	0.77	x	5.15	x	118.15	x	0.76	x	0.7	=	224.33	(77)
Southeast	0.9x	0.77	x	2.33	x	118.15	x	0.76	x	0.7	=	101.49	(77)
Southeast	0.9x	0.77	x	1.16	x	118.15	x	0.76	x	0.7	=	50.53	(77)
Southeast	0.9x	0.54	x	2.06	x	118.15	x	0.76	x	0.7	=	62.93	(77)
Southeast	0.9x	0.54	x	0.67	x	113.91	x	0.76	x	0.7	=	19.73	(77)
Southeast	0.9x	0.77	x	5.15	x	113.91	x	0.76	x	0.7	=	216.28	(77)
Southeast	0.9x	0.77	x	2.33	x	113.91	x	0.76	x	0.7	=	97.85	(77)
Southeast	0.9x	0.77	x	1.16	x	113.91	x	0.76	x	0.7	=	48.71	(77)
Southeast	0.9x	0.54	x	2.06	x	113.91	x	0.76	x	0.7	=	60.67	(77)
Southeast	0.9x	0.54	x	0.67	x	104.39	x	0.76	x	0.7	=	18.08	(77)
Southeast	0.9x	0.77	x	5.15	x	104.39	x	0.76	x	0.7	=	198.2	(77)

DER WorkSheet: New extension to existing dwelling

Southeast	0.9x	0.77	x	2.33	x	104.39	x	0.76	x	0.7	=	89.67	(77)
Southeast	0.9x	0.77	x	1.16	x	104.39	x	0.76	x	0.7	=	44.64	(77)
Southeast	0.9x	0.54	x	2.06	x	104.39	x	0.76	x	0.7	=	55.6	(77)
Southeast	0.9x	0.54	x	0.67	x	92.85	x	0.76	x	0.7	=	16.08	(77)
Southeast	0.9x	0.77	x	5.15	x	92.85	x	0.76	x	0.7	=	176.3	(77)
Southeast	0.9x	0.77	x	2.33	x	92.85	x	0.76	x	0.7	=	79.76	(77)
Southeast	0.9x	0.77	x	1.16	x	92.85	x	0.76	x	0.7	=	39.71	(77)
Southeast	0.9x	0.54	x	2.06	x	92.85	x	0.76	x	0.7	=	49.45	(77)
Southeast	0.9x	0.54	x	0.67	x	69.27	x	0.76	x	0.7	=	12	(77)
Southeast	0.9x	0.77	x	5.15	x	69.27	x	0.76	x	0.7	=	131.52	(77)
Southeast	0.9x	0.77	x	2.33	x	69.27	x	0.76	x	0.7	=	59.5	(77)
Southeast	0.9x	0.77	x	1.16	x	69.27	x	0.76	x	0.7	=	29.62	(77)
Southeast	0.9x	0.54	x	2.06	x	69.27	x	0.76	x	0.7	=	36.89	(77)
Southeast	0.9x	0.54	x	0.67	x	44.07	x	0.76	x	0.7	=	7.63	(77)
Southeast	0.9x	0.77	x	5.15	x	44.07	x	0.76	x	0.7	=	83.68	(77)
Southeast	0.9x	0.77	x	2.33	x	44.07	x	0.76	x	0.7	=	37.86	(77)
Southeast	0.9x	0.77	x	1.16	x	44.07	x	0.76	x	0.7	=	18.85	(77)
Southeast	0.9x	0.54	x	2.06	x	44.07	x	0.76	x	0.7	=	23.47	(77)
Southeast	0.9x	0.54	x	0.67	x	31.49	x	0.76	x	0.7	=	5.45	(77)
Southeast	0.9x	0.77	x	5.15	x	31.49	x	0.76	x	0.7	=	59.79	(77)
Southeast	0.9x	0.77	x	2.33	x	31.49	x	0.76	x	0.7	=	27.05	(77)
Southeast	0.9x	0.77	x	1.16	x	31.49	x	0.76	x	0.7	=	13.47	(77)
Southeast	0.9x	0.54	x	2.06	x	31.49	x	0.76	x	0.7	=	16.77	(77)
South	0.9x	0.54	x	0.95	x	46.75	x	0.76	x	0.7	=	11.48	(78)
South	0.9x	0.54	x	0.84	x	46.75	x	0.76	x	0.7	=	10.15	(78)
South	0.9x	0.77	x	0.84	x	46.75	x	0.76	x	0.7	=	14.48	(78)
South	0.9x	0.77	x	1.4	x	46.75	x	0.76	x	0.7	=	24.13	(78)
South	0.9x	0.77	x	1.68	x	46.75	x	0.76	x	0.7	=	28.96	(78)
South	0.9x	0.54	x	0.95	x	76.57	x	0.76	x	0.7	=	18.81	(78)
South	0.9x	0.54	x	0.84	x	76.57	x	0.76	x	0.7	=	16.63	(78)
South	0.9x	0.77	x	0.84	x	76.57	x	0.76	x	0.7	=	23.71	(78)
South	0.9x	0.77	x	1.4	x	76.57	x	0.76	x	0.7	=	39.52	(78)
South	0.9x	0.77	x	1.68	x	76.57	x	0.76	x	0.7	=	47.42	(78)
South	0.9x	0.54	x	0.95	x	97.53	x	0.76	x	0.7	=	23.96	(78)
South	0.9x	0.54	x	0.84	x	97.53	x	0.76	x	0.7	=	21.18	(78)
South	0.9x	0.77	x	0.84	x	97.53	x	0.76	x	0.7	=	30.21	(78)
South	0.9x	0.77	x	1.4	x	97.53	x	0.76	x	0.7	=	50.34	(78)
South	0.9x	0.77	x	1.68	x	97.53	x	0.76	x	0.7	=	60.41	(78)
South	0.9x	0.54	x	0.95	x	110.23	x	0.76	x	0.7	=	27.08	(78)
South	0.9x	0.54	x	0.84	x	110.23	x	0.76	x	0.7	=	23.94	(78)
South	0.9x	0.77	x	0.84	x	110.23	x	0.76	x	0.7	=	34.14	(78)

DER WorkSheet: New extension to existing dwelling

South	0.9x	0.77	x	1.4	x	110.23	x	0.76	x	0.7	=	56.9	(78)
South	0.9x	0.77	x	1.68	x	110.23	x	0.76	x	0.7	=	68.28	(78)
South	0.9x	0.54	x	0.95	x	114.87	x	0.76	x	0.7	=	28.22	(78)
South	0.9x	0.54	x	0.84	x	114.87	x	0.76	x	0.7	=	24.95	(78)
South	0.9x	0.77	x	0.84	x	114.87	x	0.76	x	0.7	=	35.57	(78)
South	0.9x	0.77	x	1.4	x	114.87	x	0.76	x	0.7	=	59.29	(78)
South	0.9x	0.77	x	1.68	x	114.87	x	0.76	x	0.7	=	71.15	(78)
South	0.9x	0.54	x	0.95	x	110.55	x	0.76	x	0.7	=	27.15	(78)
South	0.9x	0.54	x	0.84	x	110.55	x	0.76	x	0.7	=	24.01	(78)
South	0.9x	0.77	x	0.84	x	110.55	x	0.76	x	0.7	=	34.24	(78)
South	0.9x	0.77	x	1.4	x	110.55	x	0.76	x	0.7	=	57.06	(78)
South	0.9x	0.77	x	1.68	x	110.55	x	0.76	x	0.7	=	68.47	(78)
South	0.9x	0.54	x	0.95	x	108.01	x	0.76	x	0.7	=	26.53	(78)
South	0.9x	0.54	x	0.84	x	108.01	x	0.76	x	0.7	=	23.46	(78)
South	0.9x	0.77	x	0.84	x	108.01	x	0.76	x	0.7	=	33.45	(78)
South	0.9x	0.77	x	1.4	x	108.01	x	0.76	x	0.7	=	55.75	(78)
South	0.9x	0.77	x	1.68	x	108.01	x	0.76	x	0.7	=	66.9	(78)
South	0.9x	0.54	x	0.95	x	104.89	x	0.76	x	0.7	=	25.76	(78)
South	0.9x	0.54	x	0.84	x	104.89	x	0.76	x	0.7	=	22.78	(78)
South	0.9x	0.77	x	0.84	x	104.89	x	0.76	x	0.7	=	32.48	(78)
South	0.9x	0.77	x	1.4	x	104.89	x	0.76	x	0.7	=	54.14	(78)
South	0.9x	0.77	x	1.68	x	104.89	x	0.76	x	0.7	=	64.97	(78)
South	0.9x	0.54	x	0.95	x	101.89	x	0.76	x	0.7	=	25.03	(78)
South	0.9x	0.54	x	0.84	x	101.89	x	0.76	x	0.7	=	22.13	(78)
South	0.9x	0.77	x	0.84	x	101.89	x	0.76	x	0.7	=	31.55	(78)
South	0.9x	0.77	x	1.4	x	101.89	x	0.76	x	0.7	=	52.59	(78)
South	0.9x	0.77	x	1.68	x	101.89	x	0.76	x	0.7	=	63.11	(78)
South	0.9x	0.54	x	0.95	x	82.59	x	0.76	x	0.7	=	20.29	(78)
South	0.9x	0.54	x	0.84	x	82.59	x	0.76	x	0.7	=	17.94	(78)
South	0.9x	0.77	x	0.84	x	82.59	x	0.76	x	0.7	=	25.58	(78)
South	0.9x	0.77	x	1.4	x	82.59	x	0.76	x	0.7	=	42.63	(78)
South	0.9x	0.77	x	1.68	x	82.59	x	0.76	x	0.7	=	51.15	(78)
South	0.9x	0.54	x	0.95	x	55.42	x	0.76	x	0.7	=	13.61	(78)
South	0.9x	0.54	x	0.84	x	55.42	x	0.76	x	0.7	=	12.04	(78)
South	0.9x	0.77	x	0.84	x	55.42	x	0.76	x	0.7	=	17.16	(78)
South	0.9x	0.77	x	1.4	x	55.42	x	0.76	x	0.7	=	28.6	(78)
South	0.9x	0.77	x	1.68	x	55.42	x	0.76	x	0.7	=	34.32	(78)
South	0.9x	0.54	x	0.95	x	40.4	x	0.76	x	0.7	=	9.92	(78)
South	0.9x	0.54	x	0.84	x	40.4	x	0.76	x	0.7	=	8.77	(78)
South	0.9x	0.77	x	0.84	x	40.4	x	0.76	x	0.7	=	12.51	(78)
South	0.9x	0.77	x	1.4	x	40.4	x	0.76	x	0.7	=	20.85	(78)

DER WorkSheet: New extension to existing dwelling

South	0.9x	0.77	x	1.68	x	40.4	x	0.76	x	0.7	=	25.02	(78)
Southwest	0.9x	0.54	x	0.95	x	36.79		0.76	x	0.7	=	27.11	(79)
Southwest	0.9x	0.54	x	2.22	x	36.79		0.76	x	0.7	=	21.12	(79)
Southwest	0.9x	0.54	x	0.67	x	36.79		0.76	x	0.7	=	12.75	(79)
Southwest	0.9x	0.77	x	0.84	x	36.79		0.76	x	0.7	=	34.18	(79)
Southwest	0.9x	0.77	x	1.4	x	36.79		0.76	x	0.7	=	56.97	(79)
Southwest	0.9x	0.77	x	2.23	x	36.79		0.76	x	0.7	=	30.25	(79)
Southwest	0.9x	0.77	x	6.83	x	36.79		0.76	x	0.7	=	92.65	(79)
Southwest	0.9x	0.77	x	2.9	x	36.79		0.76	x	0.7	=	39.34	(79)
Southwest	0.9x	0.77	x	1.68	x	36.79		0.76	x	0.7	=	68.37	(79)
Southwest	0.9x	0.77	x	2.68	x	36.79		0.76	x	0.7	=	36.35	(79)
Southwest	0.9x	0.54	x	0.95	x	62.67		0.76	x	0.7	=	46.18	(79)
Southwest	0.9x	0.54	x	2.22	x	62.67		0.76	x	0.7	=	35.97	(79)
Southwest	0.9x	0.54	x	0.67	x	62.67		0.76	x	0.7	=	21.71	(79)
Southwest	0.9x	0.77	x	0.84	x	62.67		0.76	x	0.7	=	58.23	(79)
Southwest	0.9x	0.77	x	1.4	x	62.67		0.76	x	0.7	=	97.05	(79)
Southwest	0.9x	0.77	x	2.23	x	62.67		0.76	x	0.7	=	51.53	(79)
Southwest	0.9x	0.77	x	6.83	x	62.67		0.76	x	0.7	=	157.82	(79)
Southwest	0.9x	0.77	x	2.9	x	62.67		0.76	x	0.7	=	67.01	(79)
Southwest	0.9x	0.77	x	1.68	x	62.67		0.76	x	0.7	=	116.46	(79)
Southwest	0.9x	0.77	x	2.68	x	62.67		0.76	x	0.7	=	61.92	(79)
Southwest	0.9x	0.54	x	0.95	x	85.75		0.76	x	0.7	=	63.19	(79)
Southwest	0.9x	0.54	x	2.22	x	85.75		0.76	x	0.7	=	49.22	(79)
Southwest	0.9x	0.54	x	0.67	x	85.75		0.76	x	0.7	=	29.71	(79)
Southwest	0.9x	0.77	x	0.84	x	85.75		0.76	x	0.7	=	79.67	(79)
Southwest	0.9x	0.77	x	1.4	x	85.75		0.76	x	0.7	=	132.78	(79)
Southwest	0.9x	0.77	x	2.23	x	85.75		0.76	x	0.7	=	70.5	(79)
Southwest	0.9x	0.77	x	6.83	x	85.75		0.76	x	0.7	=	215.93	(79)
Southwest	0.9x	0.77	x	2.9	x	85.75		0.76	x	0.7	=	91.68	(79)
Southwest	0.9x	0.77	x	1.68	x	85.75		0.76	x	0.7	=	159.34	(79)
Southwest	0.9x	0.77	x	2.68	x	85.75		0.76	x	0.7	=	84.73	(79)
Southwest	0.9x	0.54	x	0.95	x	106.25		0.76	x	0.7	=	78.29	(79)
Southwest	0.9x	0.54	x	2.22	x	106.25		0.76	x	0.7	=	60.99	(79)
Southwest	0.9x	0.54	x	0.67	x	106.25		0.76	x	0.7	=	36.81	(79)
Southwest	0.9x	0.77	x	0.84	x	106.25		0.76	x	0.7	=	98.71	(79)
Southwest	0.9x	0.77	x	1.4	x	106.25		0.76	x	0.7	=	164.52	(79)
Southwest	0.9x	0.77	x	2.23	x	106.25		0.76	x	0.7	=	87.35	(79)
Southwest	0.9x	0.77	x	6.83	x	106.25		0.76	x	0.7	=	267.55	(79)
Southwest	0.9x	0.77	x	2.9	x	106.25		0.76	x	0.7	=	113.6	(79)
Southwest	0.9x	0.77	x	1.68	x	106.25		0.76	x	0.7	=	197.43	(79)
Southwest	0.9x	0.77	x	2.68	x	106.25		0.76	x	0.7	=	104.98	(79)

DER WorkSheet: New extension to existing dwelling

Southwest0.9x	0.54	x	0.95	x	119.01	0.76	x	0.7	=	87.7	(79)
Southwest0.9x	0.54	x	2.22	x	119.01	0.76	x	0.7	=	68.31	(79)
Southwest0.9x	0.54	x	0.67	x	119.01	0.76	x	0.7	=	41.23	(79)
Southwest0.9x	0.77	x	0.84	x	119.01	0.76	x	0.7	=	110.57	(79)
Southwest0.9x	0.77	x	1.4	x	119.01	0.76	x	0.7	=	184.28	(79)
Southwest0.9x	0.77	x	2.23	x	119.01	0.76	x	0.7	=	97.84	(79)
Southwest0.9x	0.77	x	6.83	x	119.01	0.76	x	0.7	=	299.68	(79)
Southwest0.9x	0.77	x	2.9	x	119.01	0.76	x	0.7	=	127.24	(79)
Southwest0.9x	0.77	x	1.68	x	119.01	0.76	x	0.7	=	221.14	(79)
Southwest0.9x	0.77	x	2.68	x	119.01	0.76	x	0.7	=	117.59	(79)
Southwest0.9x	0.54	x	0.95	x	118.15	0.76	x	0.7	=	87.06	(79)
Southwest0.9x	0.54	x	2.22	x	118.15	0.76	x	0.7	=	67.82	(79)
Southwest0.9x	0.54	x	0.67	x	118.15	0.76	x	0.7	=	40.93	(79)
Southwest0.9x	0.77	x	0.84	x	118.15	0.76	x	0.7	=	109.77	(79)
Southwest0.9x	0.77	x	1.4	x	118.15	0.76	x	0.7	=	182.95	(79)
Southwest0.9x	0.77	x	2.23	x	118.15	0.76	x	0.7	=	97.14	(79)
Southwest0.9x	0.77	x	6.83	x	118.15	0.76	x	0.7	=	297.51	(79)
Southwest0.9x	0.77	x	2.9	x	118.15	0.76	x	0.7	=	126.32	(79)
Southwest0.9x	0.77	x	1.68	x	118.15	0.76	x	0.7	=	219.54	(79)
Southwest0.9x	0.77	x	2.68	x	118.15	0.76	x	0.7	=	116.74	(79)
Southwest0.9x	0.54	x	0.95	x	113.91	0.76	x	0.7	=	83.94	(79)
Southwest0.9x	0.54	x	2.22	x	113.91	0.76	x	0.7	=	65.38	(79)
Southwest0.9x	0.54	x	0.67	x	113.91	0.76	x	0.7	=	39.46	(79)
Southwest0.9x	0.77	x	0.84	x	113.91	0.76	x	0.7	=	105.83	(79)
Southwest0.9x	0.77	x	1.4	x	113.91	0.76	x	0.7	=	176.38	(79)
Southwest0.9x	0.77	x	2.23	x	113.91	0.76	x	0.7	=	93.65	(79)
Southwest0.9x	0.77	x	6.83	x	113.91	0.76	x	0.7	=	286.83	(79)
Southwest0.9x	0.77	x	2.9	x	113.91	0.76	x	0.7	=	121.79	(79)
Southwest0.9x	0.77	x	1.68	x	113.91	0.76	x	0.7	=	211.66	(79)
Southwest0.9x	0.77	x	2.68	x	113.91	0.76	x	0.7	=	112.55	(79)
Southwest0.9x	0.54	x	0.95	x	104.39	0.76	x	0.7	=	76.92	(79)
Southwest0.9x	0.54	x	2.22	x	104.39	0.76	x	0.7	=	59.92	(79)
Southwest0.9x	0.54	x	0.67	x	104.39	0.76	x	0.7	=	36.17	(79)
Southwest0.9x	0.77	x	0.84	x	104.39	0.76	x	0.7	=	96.99	(79)
Southwest0.9x	0.77	x	1.4	x	104.39	0.76	x	0.7	=	161.64	(79)
Southwest0.9x	0.77	x	2.23	x	104.39	0.76	x	0.7	=	85.82	(79)
Southwest0.9x	0.77	x	6.83	x	104.39	0.76	x	0.7	=	262.86	(79)
Southwest0.9x	0.77	x	2.9	x	104.39	0.76	x	0.7	=	111.61	(79)
Southwest0.9x	0.77	x	1.68	x	104.39	0.76	x	0.7	=	193.97	(79)
Southwest0.9x	0.77	x	2.68	x	104.39	0.76	x	0.7	=	103.14	(79)
Southwest0.9x	0.54	x	0.95	x	92.85	0.76	x	0.7	=	68.42	(79)

DER WorkSheet: New extension to existing dwelling

Southwest	0.9x	0.54	x	2.22	x	92.85	0.76	x	0.7	=	53.3	(79)	
Southwest	0.9x	0.54	x	0.67	x	92.85	0.76	x	0.7	=	32.17	(79)	
Southwest	0.9x	0.77	x	0.84	x	92.85	0.76	x	0.7	=	86.27	(79)	
Southwest	0.9x	0.77	x	1.4	x	92.85	0.76	x	0.7	=	143.78	(79)	
Southwest	0.9x	0.77	x	2.23	x	92.85	0.76	x	0.7	=	76.34	(79)	
Southwest	0.9x	0.77	x	6.83	x	92.85	0.76	x	0.7	=	233.81	(79)	
Southwest	0.9x	0.77	x	2.9	x	92.85	0.76	x	0.7	=	99.27	(79)	
Southwest	0.9x	0.77	x	1.68	x	92.85	0.76	x	0.7	=	172.53	(79)	
Southwest	0.9x	0.77	x	2.68	x	92.85	0.76	x	0.7	=	91.74	(79)	
Southwest	0.9x	0.54	x	0.95	x	69.27	0.76	x	0.7	=	51.04	(79)	
Southwest	0.9x	0.54	x	2.22	x	69.27	0.76	x	0.7	=	39.76	(79)	
Southwest	0.9x	0.54	x	0.67	x	69.27	0.76	x	0.7	=	24	(79)	
Southwest	0.9x	0.77	x	0.84	x	69.27	0.76	x	0.7	=	64.35	(79)	
Southwest	0.9x	0.77	x	1.4	x	69.27	0.76	x	0.7	=	107.26	(79)	
Southwest	0.9x	0.77	x	2.23	x	69.27	0.76	x	0.7	=	56.95	(79)	
Southwest	0.9x	0.77	x	6.83	x	69.27	0.76	x	0.7	=	174.42	(79)	
Southwest	0.9x	0.77	x	2.9	x	69.27	0.76	x	0.7	=	74.06	(79)	
Southwest	0.9x	0.77	x	1.68	x	69.27	0.76	x	0.7	=	128.71	(79)	
Southwest	0.9x	0.77	x	2.68	x	69.27	0.76	x	0.7	=	68.44	(79)	
Southwest	0.9x	0.54	x	0.95	x	44.07	0.76	x	0.7	=	32.47	(79)	
Southwest	0.9x	0.54	x	2.22	x	44.07	0.76	x	0.7	=	25.3	(79)	
Southwest	0.9x	0.54	x	0.67	x	44.07	0.76	x	0.7	=	15.27	(79)	
Southwest	0.9x	0.77	x	0.84	x	44.07	0.76	x	0.7	=	40.94	(79)	
Southwest	0.9x	0.77	x	1.4	x	44.07	0.76	x	0.7	=	68.24	(79)	
Southwest	0.9x	0.77	x	2.23	x	44.07	0.76	x	0.7	=	36.23	(79)	
Southwest	0.9x	0.77	x	6.83	x	44.07	0.76	x	0.7	=	110.97	(79)	
Southwest	0.9x	0.77	x	2.9	x	44.07	0.76	x	0.7	=	47.12	(79)	
Southwest	0.9x	0.77	x	1.68	x	44.07	0.76	x	0.7	=	81.89	(79)	
Southwest	0.9x	0.77	x	2.68	x	44.07	0.76	x	0.7	=	43.54	(79)	
Southwest	0.9x	0.54	x	0.95	x	31.49	0.76	x	0.7	=	23.2	(79)	
Southwest	0.9x	0.54	x	2.22	x	31.49	0.76	x	0.7	=	18.07	(79)	
Southwest	0.9x	0.54	x	0.67	x	31.49	0.76	x	0.7	=	10.91	(79)	
Southwest	0.9x	0.77	x	0.84	x	31.49	0.76	x	0.7	=	29.25	(79)	
Southwest	0.9x	0.77	x	1.4	x	31.49	0.76	x	0.7	=	48.76	(79)	
Southwest	0.9x	0.77	x	2.23	x	31.49	0.76	x	0.7	=	25.89	(79)	
Southwest	0.9x	0.77	x	6.83	x	31.49	0.76	x	0.7	=	79.29	(79)	
Southwest	0.9x	0.77	x	2.9	x	31.49	0.76	x	0.7	=	33.67	(79)	
Southwest	0.9x	0.77	x	1.68	x	31.49	0.76	x	0.7	=	58.51	(79)	
Southwest	0.9x	0.77	x	2.68	x	31.49	0.76	x	0.7	=	31.11	(79)	
West	0.9x	0.54	x	0.95	x	19.64	x	0.76	x	0.7	=	4.82	(80)
West	0.9x	0.54	x	0.84	x	19.64	x	0.76	x	0.7	=	4.27	(80)

DER WorkSheet: New extension to existing dwelling

West	0.9x	0.77	x	0.84	x	19.64	x	0.76	x	0.7	=	6.08	(80)
West	0.9x	0.77	x	1.4	x	19.64	x	0.76	x	0.7	=	10.14	(80)
West	0.9x	0.77	x	1.68	x	19.64	x	0.76	x	0.7	=	12.16	(80)
West	0.9x	0.54	x	0.95	x	38.42	x	0.76	x	0.7	=	9.44	(80)
West	0.9x	0.54	x	0.84	x	38.42	x	0.76	x	0.7	=	8.34	(80)
West	0.9x	0.77	x	0.84	x	38.42	x	0.76	x	0.7	=	11.9	(80)
West	0.9x	0.77	x	1.4	x	38.42	x	0.76	x	0.7	=	19.83	(80)
West	0.9x	0.77	x	1.68	x	38.42	x	0.76	x	0.7	=	23.8	(80)
West	0.9x	0.54	x	0.95	x	63.27	x	0.76	x	0.7	=	15.54	(80)
West	0.9x	0.54	x	0.84	x	63.27	x	0.76	x	0.7	=	13.74	(80)
West	0.9x	0.77	x	0.84	x	63.27	x	0.76	x	0.7	=	19.59	(80)
West	0.9x	0.77	x	1.4	x	63.27	x	0.76	x	0.7	=	32.66	(80)
West	0.9x	0.77	x	1.68	x	63.27	x	0.76	x	0.7	=	39.19	(80)
West	0.9x	0.54	x	0.95	x	92.28	x	0.76	x	0.7	=	22.67	(80)
West	0.9x	0.54	x	0.84	x	92.28	x	0.76	x	0.7	=	20.04	(80)
West	0.9x	0.77	x	0.84	x	92.28	x	0.76	x	0.7	=	28.58	(80)
West	0.9x	0.77	x	1.4	x	92.28	x	0.76	x	0.7	=	47.63	(80)
West	0.9x	0.77	x	1.68	x	92.28	x	0.76	x	0.7	=	57.16	(80)
West	0.9x	0.54	x	0.95	x	113.09	x	0.76	x	0.7	=	27.78	(80)
West	0.9x	0.54	x	0.84	x	113.09	x	0.76	x	0.7	=	24.56	(80)
West	0.9x	0.77	x	0.84	x	113.09	x	0.76	x	0.7	=	35.02	(80)
West	0.9x	0.77	x	1.4	x	113.09	x	0.76	x	0.7	=	58.37	(80)
West	0.9x	0.77	x	1.68	x	113.09	x	0.76	x	0.7	=	70.05	(80)
West	0.9x	0.54	x	0.95	x	115.77	x	0.76	x	0.7	=	28.44	(80)
West	0.9x	0.54	x	0.84	x	115.77	x	0.76	x	0.7	=	25.14	(80)
West	0.9x	0.77	x	0.84	x	115.77	x	0.76	x	0.7	=	35.85	(80)
West	0.9x	0.77	x	1.4	x	115.77	x	0.76	x	0.7	=	59.75	(80)
West	0.9x	0.77	x	1.68	x	115.77	x	0.76	x	0.7	=	71.71	(80)
West	0.9x	0.54	x	0.95	x	110.22	x	0.76	x	0.7	=	27.07	(80)
West	0.9x	0.54	x	0.84	x	110.22	x	0.76	x	0.7	=	23.94	(80)
West	0.9x	0.77	x	0.84	x	110.22	x	0.76	x	0.7	=	34.13	(80)
West	0.9x	0.77	x	1.4	x	110.22	x	0.76	x	0.7	=	56.89	(80)
West	0.9x	0.77	x	1.68	x	110.22	x	0.76	x	0.7	=	68.27	(80)
West	0.9x	0.54	x	0.95	x	94.68	x	0.76	x	0.7	=	23.25	(80)
West	0.9x	0.54	x	0.84	x	94.68	x	0.76	x	0.7	=	20.56	(80)
West	0.9x	0.77	x	0.84	x	94.68	x	0.76	x	0.7	=	29.32	(80)
West	0.9x	0.77	x	1.4	x	94.68	x	0.76	x	0.7	=	48.87	(80)
West	0.9x	0.77	x	1.68	x	94.68	x	0.76	x	0.7	=	58.64	(80)
West	0.9x	0.54	x	0.95	x	73.59	x	0.76	x	0.7	=	18.08	(80)
West	0.9x	0.54	x	0.84	x	73.59	x	0.76	x	0.7	=	15.98	(80)
West	0.9x	0.77	x	0.84	x	73.59	x	0.76	x	0.7	=	22.79	(80)

DER WorkSheet: New extension to existing dwelling

West	0.9x	0.77	x	1.4	x	73.59	x	0.76	x	0.7	=	37.98	(80)
West	0.9x	0.77	x	1.68	x	73.59	x	0.76	x	0.7	=	45.58	(80)
West	0.9x	0.54	x	0.95	x	45.59	x	0.76	x	0.7	=	11.2	(80)
West	0.9x	0.54	x	0.84	x	45.59	x	0.76	x	0.7	=	9.9	(80)
West	0.9x	0.77	x	0.84	x	45.59	x	0.76	x	0.7	=	14.12	(80)
West	0.9x	0.77	x	1.4	x	45.59	x	0.76	x	0.7	=	23.53	(80)
West	0.9x	0.77	x	1.68	x	45.59	x	0.76	x	0.7	=	28.24	(80)
West	0.9x	0.54	x	0.95	x	24.49	x	0.76	x	0.7	=	6.02	(80)
West	0.9x	0.54	x	0.84	x	24.49	x	0.76	x	0.7	=	5.32	(80)
West	0.9x	0.77	x	0.84	x	24.49	x	0.76	x	0.7	=	7.58	(80)
West	0.9x	0.77	x	1.4	x	24.49	x	0.76	x	0.7	=	12.64	(80)
West	0.9x	0.77	x	1.68	x	24.49	x	0.76	x	0.7	=	15.17	(80)
West	0.9x	0.54	x	0.95	x	16.15	x	0.76	x	0.7	=	3.97	(80)
West	0.9x	0.54	x	0.84	x	16.15	x	0.76	x	0.7	=	3.51	(80)
West	0.9x	0.77	x	0.84	x	16.15	x	0.76	x	0.7	=	5	(80)
West	0.9x	0.77	x	1.4	x	16.15	x	0.76	x	0.7	=	8.34	(80)
West	0.9x	0.77	x	1.68	x	16.15	x	0.76	x	0.7	=	10	(80)
Northwest	0.9x	0.54	x	1.09	x	11.28	x	0.76	x	0.7	=	3.18	(81)
Northwest	0.9x	0.77	x	1.39	x	11.28	x	0.76	x	0.7	=	5.78	(81)
Northwest	0.9x	0.77	x	7.7	x	11.28	x	0.76	x	0.7	=	32.04	(81)
Northwest	0.9x	0.77	x	2.1	x	11.28	x	0.76	x	0.7	=	8.74	(81)
Northwest	0.9x	0.77	x	3.93	x	11.28	x	0.76	x	0.7	=	16.35	(81)
Northwest	0.9x	0.77	x	1.89	x	11.28	x	0.76	x	0.7	=	15.72	(81)
Northwest	0.9x	0.77	x	1.16	x	11.28	x	0.76	x	0.7	=	4.83	(81)
Northwest	0.9x	0.54	x	1.09	x	22.97	x	0.76	x	0.7	=	6.47	(81)
Northwest	0.9x	0.77	x	1.39	x	22.97	x	0.76	x	0.7	=	11.77	(81)
Northwest	0.9x	0.77	x	7.7	x	22.97	x	0.76	x	0.7	=	65.22	(81)
Northwest	0.9x	0.77	x	2.1	x	22.97	x	0.76	x	0.7	=	17.78	(81)
Northwest	0.9x	0.77	x	3.93	x	22.97	x	0.76	x	0.7	=	33.28	(81)
Northwest	0.9x	0.77	x	1.89	x	22.97	x	0.76	x	0.7	=	32.01	(81)
Northwest	0.9x	0.77	x	1.16	x	22.97	x	0.76	x	0.7	=	9.82	(81)
Northwest	0.9x	0.54	x	1.09	x	41.38	x	0.76	x	0.7	=	11.66	(81)
Northwest	0.9x	0.77	x	1.39	x	41.38	x	0.76	x	0.7	=	21.2	(81)
Northwest	0.9x	0.77	x	7.7	x	41.38	x	0.76	x	0.7	=	117.5	(81)
Northwest	0.9x	0.77	x	2.1	x	41.38	x	0.76	x	0.7	=	32.04	(81)
Northwest	0.9x	0.77	x	3.93	x	41.38	x	0.76	x	0.7	=	59.95	(81)
Northwest	0.9x	0.77	x	1.89	x	41.38	x	0.76	x	0.7	=	57.67	(81)
Northwest	0.9x	0.77	x	1.16	x	41.38	x	0.76	x	0.7	=	17.7	(81)
Northwest	0.9x	0.54	x	1.09	x	67.96	x	0.76	x	0.7	=	19.15	(81)
Northwest	0.9x	0.77	x	1.39	x	67.96	x	0.76	x	0.7	=	34.82	(81)
Northwest	0.9x	0.77	x	7.7	x	67.96	x	0.76	x	0.7	=	192.96	(81)

DER WorkSheet: New extension to existing dwelling

Northwest 0.9x	0.77	x	2.1	x	67.96	x	0.76	x	0.7	=	52.61	(81)
Northwest 0.9x	0.77	x	3.93	x	67.96	x	0.76	x	0.7	=	98.46	(81)
Northwest 0.9x	0.77	x	1.89	x	67.96	x	0.76	x	0.7	=	94.7	(81)
Northwest 0.9x	0.77	x	1.16	x	67.96	x	0.76	x	0.7	=	29.06	(81)
Northwest 0.9x	0.54	x	1.09	x	91.35	x	0.76	x	0.7	=	25.74	(81)
Northwest 0.9x	0.77	x	1.39	x	91.35	x	0.76	x	0.7	=	46.81	(81)
Northwest 0.9x	0.77	x	7.7	x	91.35	x	0.76	x	0.7	=	259.38	(81)
Northwest 0.9x	0.77	x	2.1	x	91.35	x	0.76	x	0.7	=	70.72	(81)
Northwest 0.9x	0.77	x	3.93	x	91.35	x	0.76	x	0.7	=	132.35	(81)
Northwest 0.9x	0.77	x	1.89	x	91.35	x	0.76	x	0.7	=	127.3	(81)
Northwest 0.9x	0.77	x	1.16	x	91.35	x	0.76	x	0.7	=	39.07	(81)
Northwest 0.9x	0.54	x	1.09	x	97.38	x	0.76	x	0.7	=	27.45	(81)
Northwest 0.9x	0.77	x	1.39	x	97.38	x	0.76	x	0.7	=	49.91	(81)
Northwest 0.9x	0.77	x	7.7	x	97.38	x	0.76	x	0.7	=	276.53	(81)
Northwest 0.9x	0.77	x	2.1	x	97.38	x	0.76	x	0.7	=	75.4	(81)
Northwest 0.9x	0.77	x	3.93	x	97.38	x	0.76	x	0.7	=	141.1	(81)
Northwest 0.9x	0.77	x	1.89	x	97.38	x	0.76	x	0.7	=	135.71	(81)
Northwest 0.9x	0.77	x	1.16	x	97.38	x	0.76	x	0.7	=	41.65	(81)
Northwest 0.9x	0.54	x	1.09	x	91.1	x	0.76	x	0.7	=	25.67	(81)
Northwest 0.9x	0.77	x	1.39	x	91.1	x	0.76	x	0.7	=	46.69	(81)
Northwest 0.9x	0.77	x	7.7	x	91.1	x	0.76	x	0.7	=	258.69	(81)
Northwest 0.9x	0.77	x	2.1	x	91.1	x	0.76	x	0.7	=	70.53	(81)
Northwest 0.9x	0.77	x	3.93	x	91.1	x	0.76	x	0.7	=	132	(81)
Northwest 0.9x	0.77	x	1.89	x	91.1	x	0.76	x	0.7	=	126.96	(81)
Northwest 0.9x	0.77	x	1.16	x	91.1	x	0.76	x	0.7	=	38.96	(81)
Northwest 0.9x	0.54	x	1.09	x	72.63	x	0.76	x	0.7	=	20.47	(81)
Northwest 0.9x	0.77	x	1.39	x	72.63	x	0.76	x	0.7	=	37.22	(81)
Northwest 0.9x	0.77	x	7.7	x	72.63	x	0.76	x	0.7	=	206.23	(81)
Northwest 0.9x	0.77	x	2.1	x	72.63	x	0.76	x	0.7	=	56.23	(81)
Northwest 0.9x	0.77	x	3.93	x	72.63	x	0.76	x	0.7	=	105.23	(81)
Northwest 0.9x	0.77	x	1.89	x	72.63	x	0.76	x	0.7	=	101.21	(81)
Northwest 0.9x	0.77	x	1.16	x	72.63	x	0.76	x	0.7	=	31.06	(81)
Northwest 0.9x	0.54	x	1.09	x	50.42	x	0.76	x	0.7	=	14.21	(81)
Northwest 0.9x	0.77	x	1.39	x	50.42	x	0.76	x	0.7	=	25.84	(81)
Northwest 0.9x	0.77	x	7.7	x	50.42	x	0.76	x	0.7	=	143.17	(81)
Northwest 0.9x	0.77	x	2.1	x	50.42	x	0.76	x	0.7	=	39.04	(81)
Northwest 0.9x	0.77	x	3.93	x	50.42	x	0.76	x	0.7	=	73.05	(81)
Northwest 0.9x	0.77	x	1.89	x	50.42	x	0.76	x	0.7	=	70.27	(81)
Northwest 0.9x	0.77	x	1.16	x	50.42	x	0.76	x	0.7	=	21.56	(81)
Northwest 0.9x	0.54	x	1.09	x	28.07	x	0.76	x	0.7	=	7.91	(81)
Northwest 0.9x	0.77	x	1.39	x	28.07	x	0.76	x	0.7	=	14.38	(81)

DER WorkSheet: New extension to existing dwelling

Northwest 0.9x	0.77	x	7.7	x	28.07	x	0.76	x	0.7	=	79.7	(81)
Northwest 0.9x	0.77	x	2.1	x	28.07	x	0.76	x	0.7	=	21.73	(81)
Northwest 0.9x	0.77	x	3.93	x	28.07	x	0.76	x	0.7	=	40.67	(81)
Northwest 0.9x	0.77	x	1.89	x	28.07	x	0.76	x	0.7	=	39.11	(81)
Northwest 0.9x	0.77	x	1.16	x	28.07	x	0.76	x	0.7	=	12	(81)
Northwest 0.9x	0.54	x	1.09	x	14.2	x	0.76	x	0.7	=	4	(81)
Northwest 0.9x	0.77	x	1.39	x	14.2	x	0.76	x	0.7	=	7.28	(81)
Northwest 0.9x	0.77	x	7.7	x	14.2	x	0.76	x	0.7	=	40.31	(81)
Northwest 0.9x	0.77	x	2.1	x	14.2	x	0.76	x	0.7	=	10.99	(81)
Northwest 0.9x	0.77	x	3.93	x	14.2	x	0.76	x	0.7	=	20.57	(81)
Northwest 0.9x	0.77	x	1.89	x	14.2	x	0.76	x	0.7	=	19.78	(81)
Northwest 0.9x	0.77	x	1.16	x	14.2	x	0.76	x	0.7	=	6.07	(81)
Northwest 0.9x	0.54	x	1.09	x	9.21	x	0.76	x	0.7	=	2.6	(81)
Northwest 0.9x	0.77	x	1.39	x	9.21	x	0.76	x	0.7	=	4.72	(81)
Northwest 0.9x	0.77	x	7.7	x	9.21	x	0.76	x	0.7	=	26.16	(81)
Northwest 0.9x	0.77	x	2.1	x	9.21	x	0.76	x	0.7	=	7.13	(81)
Northwest 0.9x	0.77	x	3.93	x	9.21	x	0.76	x	0.7	=	13.35	(81)
Northwest 0.9x	0.77	x	1.89	x	9.21	x	0.76	x	0.7	=	12.84	(81)
Northwest 0.9x	0.77	x	1.16	x	9.21	x	0.76	x	0.7	=	3.94	(81)
Rooflights 0.9x	1	x	1.08	x	26	x	0.76	x	0.7	=	40.33	(82)
Rooflights 0.9x	1	x	1.08	x	26	x	0.76	x	0.7	=	40.33	(82)
Rooflights 0.9x	1	x	1.08	x	26	x	0.76	x	0.7	=	13.44	(82)
Rooflights 0.9x	1	x	0.98	x	40.65	x	0.76	x	0.7	=	19.07	(82)
Rooflights 0.9x	1	x	0.86	x	15.57	x	0.76	x	0.7	=	12.82	(82)
Rooflights 0.9x	1	x	0.49	x	15.92	x	0.76	x	0.7	=	3.73	(82)
Rooflights 0.9x	1	x	0.49	x	15.92	x	0.76	x	0.7	=	3.73	(82)
Rooflights 0.9x	1	x	1.38	x	40.5	x	0.76	x	0.7	=	26.76	(82)
Rooflights 0.9x	1	x	2.36	x	40.5	x	0.76	x	0.7	=	45.77	(82)
Rooflights 0.9x	1	x	1.08	x	54	x	0.76	x	0.7	=	83.77	(82)
Rooflights 0.9x	1	x	1.08	x	54	x	0.76	x	0.7	=	83.77	(82)
Rooflights 0.9x	1	x	1.08	x	54	x	0.76	x	0.7	=	27.92	(82)
Rooflights 0.9x	1	x	0.98	x	73.74	x	0.76	x	0.7	=	34.6	(82)
Rooflights 0.9x	1	x	0.86	x	31.61	x	0.76	x	0.7	=	26.03	(82)
Rooflights 0.9x	1	x	0.49	x	32.51	x	0.76	x	0.7	=	7.63	(82)
Rooflights 0.9x	1	x	0.49	x	32.51	x	0.76	x	0.7	=	7.63	(82)
Rooflights 0.9x	1	x	1.38	x	73.74	x	0.76	x	0.7	=	48.73	(82)
Rooflights 0.9x	1	x	2.36	x	73.74	x	0.76	x	0.7	=	83.33	(82)
Rooflights 0.9x	1	x	1.08	x	96	x	0.76	x	0.7	=	148.93	(82)
Rooflights 0.9x	1	x	1.08	x	96	x	0.76	x	0.7	=	148.93	(82)
Rooflights 0.9x	1	x	1.08	x	96	x	0.76	x	0.7	=	49.64	(82)
Rooflights 0.9x	1	x	0.98	x	110.48	x	0.76	x	0.7	=	51.84	(82)

DER WorkSheet: New extension to existing dwelling

Rooflights 0.9x	1	x	0.86	x	57.49	x	0.76	x	0.7	=	47.34	(82)
Rooflights 0.9x	1	x	0.49	x	59.5	x	0.76	x	0.7	=	13.96	(82)
Rooflights 0.9x	1	x	0.49	x	59.5	x	0.76	x	0.7	=	13.96	(82)
Rooflights 0.9x	1	x	1.38	x	111.06	x	0.76	x	0.7	=	73.38	(82)
Rooflights 0.9x	1	x	2.36	x	111.06	x	0.76	x	0.7	=	125.49	(82)
Rooflights 0.9x	1	x	1.08	x	150	x	0.76	x	0.7	=	232.7	(82)
Rooflights 0.9x	1	x	1.08	x	150	x	0.76	x	0.7	=	232.7	(82)
Rooflights 0.9x	1	x	1.08	x	150	x	0.76	x	0.7	=	77.57	(82)
Rooflights 0.9x	1	x	0.98	x	149.12	x	0.76	x	0.7	=	69.97	(82)
Rooflights 0.9x	1	x	0.86	x	96.26	x	0.76	x	0.7	=	79.28	(82)
Rooflights 0.9x	1	x	0.49	x	100.03	x	0.76	x	0.7	=	23.47	(82)
Rooflights 0.9x	1	x	0.49	x	100.03	x	0.76	x	0.7	=	23.47	(82)
Rooflights 0.9x	1	x	1.38	x	150.59	x	0.76	x	0.7	=	99.5	(82)
Rooflights 0.9x	1	x	2.36	x	150.59	x	0.76	x	0.7	=	170.16	(82)
Rooflights 0.9x	1	x	1.08	x	192	x	0.76	x	0.7	=	297.85	(82)
Rooflights 0.9x	1	x	1.08	x	192	x	0.76	x	0.7	=	297.85	(82)
Rooflights 0.9x	1	x	1.08	x	192	x	0.76	x	0.7	=	99.28	(82)
Rooflights 0.9x	1	x	0.98	x	175.41	x	0.76	x	0.7	=	82.31	(82)
Rooflights 0.9x	1	x	0.86	x	131.51	x	0.76	x	0.7	=	108.31	(82)
Rooflights 0.9x	1	x	0.49	x	136.88	x	0.76	x	0.7	=	32.11	(82)
Rooflights 0.9x	1	x	0.49	x	136.88	x	0.76	x	0.7	=	32.11	(82)
Rooflights 0.9x	1	x	1.38	x	177.61	x	0.76	x	0.7	=	117.35	(82)
Rooflights 0.9x	1	x	2.36	x	177.61	x	0.76	x	0.7	=	200.69	(82)
Rooflights 0.9x	1	x	1.08	x	200	x	0.76	x	0.7	=	310.26	(82)
Rooflights 0.9x	1	x	1.08	x	200	x	0.76	x	0.7	=	310.26	(82)
Rooflights 0.9x	1	x	1.08	x	200	x	0.76	x	0.7	=	103.42	(82)
Rooflights 0.9x	1	x	0.98	x	177.08	x	0.76	x	0.7	=	83.09	(82)
Rooflights 0.9x	1	x	0.86	x	141.21	x	0.76	x	0.7	=	116.29	(82)
Rooflights 0.9x	1	x	0.49	x	147.03	x	0.76	x	0.7	=	34.49	(82)
Rooflights 0.9x	1	x	0.49	x	147.03	x	0.76	x	0.7	=	34.49	(82)
Rooflights 0.9x	1	x	1.38	x	179.47	x	0.76	x	0.7	=	118.58	(82)
Rooflights 0.9x	1	x	2.36	x	179.47	x	0.76	x	0.7	=	202.79	(82)
Rooflights 0.9x	1	x	1.08	x	189	x	0.76	x	0.7	=	293.2	(82)
Rooflights 0.9x	1	x	1.08	x	189	x	0.76	x	0.7	=	293.2	(82)
Rooflights 0.9x	1	x	1.08	x	189	x	0.76	x	0.7	=	97.73	(82)
Rooflights 0.9x	1	x	0.98	x	169.56	x	0.76	x	0.7	=	79.56	(82)
Rooflights 0.9x	1	x	0.86	x	131.69	x	0.76	x	0.7	=	108.45	(82)
Rooflights 0.9x	1	x	0.49	x	137.1	x	0.76	x	0.7	=	32.17	(82)
Rooflights 0.9x	1	x	0.49	x	137.1	x	0.76	x	0.7	=	32.17	(82)
Rooflights 0.9x	1	x	1.38	x	171.77	x	0.76	x	0.7	=	113.5	(82)
Rooflights 0.9x	1	x	2.36	x	171.77	x	0.76	x	0.7	=	194.1	(82)

DER WorkSheet: New extension to existing dwelling

Rooflights 0.9x	1	x	1.08	x	157	x	0.76	x	0.7	=	243.56	(82)
Rooflights 0.9x	1	x	1.08	x	157	x	0.76	x	0.7	=	243.56	(82)
Rooflights 0.9x	1	x	1.08	x	157	x	0.76	x	0.7	=	81.19	(82)
Rooflights 0.9x	1	x	0.98	x	149.99	x	0.76	x	0.7	=	70.38	(82)
Rooflights 0.9x	1	x	0.86	x	103.62	x	0.76	x	0.7	=	85.33	(82)
Rooflights 0.9x	1	x	0.49	x	107.76	x	0.76	x	0.7	=	25.28	(82)
Rooflights 0.9x	1	x	0.49	x	107.76	x	0.76	x	0.7	=	25.28	(82)
Rooflights 0.9x	1	x	1.38	x	151.65	x	0.76	x	0.7	=	100.21	(82)
Rooflights 0.9x	1	x	2.36	x	151.65	x	0.76	x	0.7	=	171.37	(82)
Rooflights 0.9x	1	x	1.08	x	115	x	0.76	x	0.7	=	178.4	(82)
Rooflights 0.9x	1	x	1.08	x	115	x	0.76	x	0.7	=	178.4	(82)
Rooflights 0.9x	1	x	1.08	x	115	x	0.76	x	0.7	=	59.47	(82)
Rooflights 0.9x	1	x	0.98	x	124.13	x	0.76	x	0.7	=	58.24	(82)
Rooflights 0.9x	1	x	0.86	x	70.56	x	0.76	x	0.7	=	58.11	(82)
Rooflights 0.9x	1	x	0.49	x	73.17	x	0.76	x	0.7	=	17.17	(82)
Rooflights 0.9x	1	x	0.49	x	73.17	x	0.76	x	0.7	=	17.17	(82)
Rooflights 0.9x	1	x	1.38	x	125.02	x	0.76	x	0.7	=	82.61	(82)
Rooflights 0.9x	1	x	2.36	x	125.02	x	0.76	x	0.7	=	141.27	(82)
Rooflights 0.9x	1	x	1.08	x	66	x	0.76	x	0.7	=	102.39	(82)
Rooflights 0.9x	1	x	1.08	x	66	x	0.76	x	0.7	=	102.39	(82)
Rooflights 0.9x	1	x	1.08	x	66	x	0.76	x	0.7	=	34.13	(82)
Rooflights 0.9x	1	x	0.98	x	84.31	x	0.76	x	0.7	=	39.56	(82)
Rooflights 0.9x	1	x	0.86	x	38.7	x	0.76	x	0.7	=	31.87	(82)
Rooflights 0.9x	1	x	0.49	x	39.91	x	0.76	x	0.7	=	9.36	(82)
Rooflights 0.9x	1	x	0.49	x	39.91	x	0.76	x	0.7	=	9.36	(82)
Rooflights 0.9x	1	x	1.38	x	84.48	x	0.76	x	0.7	=	55.82	(82)
Rooflights 0.9x	1	x	2.36	x	84.48	x	0.76	x	0.7	=	95.46	(82)
Rooflights 0.9x	1	x	1.08	x	33	x	0.76	x	0.7	=	51.19	(82)
Rooflights 0.9x	1	x	1.08	x	33	x	0.76	x	0.7	=	51.19	(82)
Rooflights 0.9x	1	x	1.08	x	33	x	0.76	x	0.7	=	17.06	(82)
Rooflights 0.9x	1	x	0.98	x	49.56	x	0.76	x	0.7	=	23.26	(82)
Rooflights 0.9x	1	x	0.86	x	19.56	x	0.76	x	0.7	=	16.1	(82)
Rooflights 0.9x	1	x	0.49	x	20.03	x	0.76	x	0.7	=	4.7	(82)
Rooflights 0.9x	1	x	0.49	x	20.03	x	0.76	x	0.7	=	4.7	(82)
Rooflights 0.9x	1	x	1.38	x	49.44	x	0.76	x	0.7	=	32.67	(82)
Rooflights 0.9x	1	x	2.36	x	49.44	x	0.76	x	0.7	=	55.86	(82)
Rooflights 0.9x	1	x	1.08	x	21	x	0.76	x	0.7	=	32.58	(82)
Rooflights 0.9x	1	x	1.08	x	21	x	0.76	x	0.7	=	32.58	(82)
Rooflights 0.9x	1	x	1.08	x	21	x	0.76	x	0.7	=	10.86	(82)
Rooflights 0.9x	1	x	0.98	x	34.19	x	0.76	x	0.7	=	16.04	(82)
Rooflights 0.9x	1	x	0.86	x	12.74	x	0.76	x	0.7	=	10.49	(82)

DER WorkSheet: New extension to existing dwelling

Rooflights 0.9x	1	x	0.49	x	13.01	x	0.76	x	0.7	=	3.05	(82)
Rooflights 0.9x	1	x	0.49	x	13.01	x	0.76	x	0.7	=	3.05	(82)
Rooflights 0.9x	1	x	1.38	x	34.03	x	0.76	x	0.7	=	22.49	(82)
Rooflights 0.9x	1	x	2.36	x	34.03	x	0.76	x	0.7	=	38.45	(82)

Solar gains in watts, calculated for each month

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

(83)m=	1233.85	2268.48	3524.8	5037.01	6227.04	6432.45	6097.85	5176.36	4045.59	2622.79	1508.78	1035.63	(83)
--------	---------	---------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

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

(84)m=	2452.05	3483.57	4695.55	6133.42	7241.95	7373.84	6994.75	6081.82	4992.14	3643.98	2615.88	2212.94	(84)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.9	0.79	0.86	0.97	1	1	1	(86)

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

(87)m=	19.25	19.39	19.66	20.05	20.41	20.71	20.85	20.81	20.54	20.08	19.63	19.27	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.53	19.54	19.55	19.6	19.61	19.65	19.65	19.66	19.63	19.61	19.59	19.57	(88)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	1	0.99	0.95	0.82	0.62	0.72	0.95	1	1	1	(89)
--------	---	---	---	------	------	------	------	------	------	---	---	---	------

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

(90)m=	17.94	18.09	18.36	18.79	19.16	19.47	19.56	19.55	19.3	18.83	18.37	17.99	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.08 (91)

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

(92)m=	18.05	18.2	18.47	18.89	19.26	19.57	19.66	19.65	19.4	18.93	18.47	18.1	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	------

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

(93)m=	18.05	18.2	18.47	18.89	19.26	19.57	19.66	19.65	19.4	18.93	18.47	18.1	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	1	1	0.99	0.94	0.82	0.63	0.72	0.94	1	1	1	(94)
--------	---	---	---	------	------	------	------	------	------	---	---	---	------

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

(95)m=	2451.55	3480.79	4680.32	6043.24	6817.61	6025.31	4372.07	4356.92	4706.5	3627.07	2614.66	2212.66	(95)
--------	---------	---------	---------	---------	---------	---------	---------	---------	--------	---------	---------	---------	------

Monthly average external temperature from Table 8

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

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

(97)m=	23666.31	22698.1	20254.87	16243.66	12184.49	7715.43	4754.8	5010.97	8360.22	13433	18619.19	23135.64	(97)
--------	----------	---------	----------	----------	----------	---------	--------	---------	---------	-------	----------	----------	------

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

(98)m=	15783.79	12914.04	11587.46	7344.3	3992.96	0	0	0	0	7295.61	11523.26	15566.7	(98)
--------	----------	----------	----------	--------	---------	---	---	---	---	---------	----------	---------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 86008.11 (98)

Space heating requirement in kWh/m²/year

85.82 (99)

DER WorkSheet: New extension to existing dwelling

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		319.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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

Space heating requirement (calculated above)

15783.79	12914.04	11587.46	7344.3	3992.96	0	0	0	0	7295.61	11523.26	15566.7
----------	----------	----------	--------	---------	---	---	---	---	---------	----------	---------

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

4937.06	4039.42	3624.48	2297.25	1248.97	0	0	0	0	2282.02	3604.4	4869.16
---------	---------	---------	---------	---------	---	---	---	---	---------	--------	---------

Total (kWh/year) =Sum(211)_{1...5,10...12}= 26902.76 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m x (201)] } x 100 ÷ (208)

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

Total (kWh/year) =Sum(215)_{1...5,10...12}= 0 (215)

Water heating

Output from water heater (calculated above)

247.84	217.77	227.12	201.4	195.77	172.64	163.63	182.55	183.17	208.95	223.71	241.13
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 100 (216)

(217)m= 100 100 100 100 100 100 100 100 100 100 100 100 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	247.84	217.77	227.12	201.4	195.77	172.64	163.63	182.55	183.17	208.95	223.71	241.13
---------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2465.66 (219)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	26902.76	
Water heating fuel used	2465.66	

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 30 (231)

Electricity for lighting 1512.93 (232)

Electricity generated by PVs -481.92 (233)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	=	13962.53 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	1279.68 (264)
Space and water heating	(261) + (262) + (263) + (264) =			15242.21 (265)

DER WorkSheet: New extension to existing dwelling

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	785.21	(268)
Energy saving/generation technologies Item 1		0.519	=	-250.12	(269)
Total CO2, kg/year	sum of (265)...(271) =			15792.87	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			15.76	(273)
EI rating (section 14)				80	(274)

11. Appendix B – BREEAM Pre-assessment

Building name	28 Redington Road, London NW3 7RB
Indicative Building Score	70.83%
Indicative Building Rating	BREEAM Excellent

This assessment and indicative BREEAM rating is not a formal certified BREEAM assessment or rating and must not be communicated as such. The score presented is indicative of a dwelling's potential performance and is based on a simplified pre-formal BREEAM assessment and unverified commitments given at an early stage in the design process.

	Issue	Credits Available	Indicative Credits Achieved	Weighting	Section Score
Management	Man 01	3	3	12%	8.73%
	Man 02	2	1		
	Man 03	1	1		
	Man 04	2	1		
	Man 05	1	1		
	Man 06	2	1		

Health and Wellbeing	Hea 01	2	0	17%	8.50%
	Hea 02	4	1		
	Hea 03	1	1		
	Hea 04	2	1		
	Hea 05	2	2		
	Hea 06	1	1		

Energy	Ene 01	6	3.5	43%	35.59%
	Ene 02	4	3.5		
	Ene 03	7	7		
	Ene 04	2	0		
	Ene 05	2	2		
	Ene 06	1	1		
	Ene 07	2	2		
	Ene 08	2	2		
	Ene 09	2	2		
	Ene 10	1	1		

Water	Wat 01	3	2	11%	8.80%
	Wat 02	1	1		
	Wat 03	1	1		

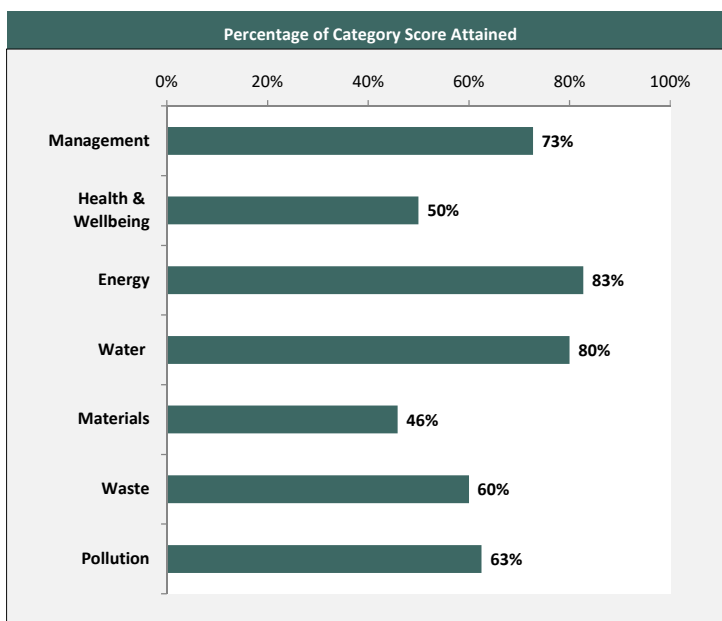
Materials	Mat 01	25	10	8%	3.67%
	Mat 02	15	8		
	Mat 03	8	4		

Waste	Was 01	2	2	3%	1.80%
	Was 02	3	1		

Pollution	Pol 01	3	2	6%	3.75%
	Pol 02	3	1		
	Pol 02	2	2		

Innovation	10	0	N/A	0.00%
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	Minimum Standards				
	Pass	Good	Very Good	Excellent	Outstanding
Ene 02	✓	✓	✓	✓	✓
Wat 01	✓	✓	✓	✓	✗
Hea 05	✓	✓	✓	✓	✓
Hea 06	✓	✓	✓	✓	✓
Pol 03	✓	✓	✓	✓	✓
Mat 02	✓	✓	✓	✓	✓



BREEAM UK Domestic Refurbishment 2014 Pre-Assessment Estimator v0.1



This assessment and indicative BREEAM rating is not a formal certified BREEAM assessment or rating and must not be communicated as such. The score presented is indicative of a dwelling's potential performance and is based on a simplified pre-formal BREEAM assessment and unverified commitments given at an early stage in the design process.

Building name				28 Redington Road, London NW3 7RB		
Indicative building score (%)				70.83%		
Indicative BREEAM rating				BREEAM Excellent		
Management	Health & Wellbeing	Energy	Water	Materials	Waste	Pollution

	Minimum Standards				
	Pass	Good	Very Good	Excellent	Outstanding
Ene 02	✓	✓	✓	✓	✗
Wat 01	✓	✓	✓	✓	✓
Hea 05	✓	✓	✓	✓	✓
Hea 06	✓	✓	✓	✓	✓
Pol 03	✓	✓	✓	✓	✓
Mat 02	✓	✓	✓	✓	✓

INNOVATION	Section Weighting: 10%	Indicative Section Score: 0.00%
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Comments

MANAGEMENT	Section Weighting: 12%	Indicative Section Score: 8.73%
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Man 01 Home Users Guide				
No. of BREEAM credits available	3	Available contribution to overall score	3.27%	
No. of BREEAM innovation credits	0	Minimum Standards applicable:	No	

Assessment Criteria	Indicative Credits
Where a Home Users Guide be provided to all dwellings, covering all issues set out in the 'Users Guide Contents list', three credits may be awarded	3

Comments

Man 02 Responsible Construction Practices				
No. of BREEAM credits available	2	Available contribution to overall score:	2.18%	
No. of BREEAM innovation credits	1	Minimum Standards applicable:	No	

Assessment Criteria	Indicative Credits
Where a compliant considerate construction scheme will be used, credits are awarded depending on the score achieved as outlined below:	1

Large Scale - project with more than 5 units

	One Credit	Two Credits
Considerate Constructors Scheme	Score of 25-34 with a score of 5 in each section	Score of 35-39 with a score of 7 in each section
Alternative Compliant Scheme	Compliance	Beyond Compliance

Small Scale - project with 5 units or fewer

	One Credit	Two Credits
Considerate Constructors Scheme	Score of 25-34 with a score of 5 in each section	Score of 35-39 with a score of 7 in each section
Alternative Compliant Scheme	Compliance	Beyond Compliance
Checklist A-3	50% of the optional items	80% of the optional items

Exemplary Credit

Considerate Constructors Scheme	Score of 40 or more with a score of 7 in each section	Indicative Innovation Credits Achieved Please Select
Alternative Compliant Scheme	Exemplary Level Compliance	
Checklist A-3*	All Items (Optional & Mandatory)	

* Small Scale Project Only

Comments

Man 03 Construction Site Impacts				
No. of BREEAM credits available	1	Available contribution to overall score	1.09%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	

Assessment Criteria	Indicative Credits
Where evidence demonstrate that site impacts will be monitored, as detailed below:	1

	One Credit
Large Scale	Where there is evidence to demonstrate that 2 or more of the sections in Checklist A-4 are completed
Small Scale	Where there is evidence to demonstrate that 2 or more of the sections in Checklist A-5 are completed

Sections of Checklist	
Large Scale - Checklist A-4	Small Scale - Checklist A-5
Monitor, report and set targets for CO2 production of energy use arising from site activities	Set objectives for reducing CO2 production from energy use arising from site activities
Monitor, report and set targets for water consumption arising from site activities	Set objectives for reducing water use arising from site activities
A main contractor with an environmental materials policy	Main contractor environmental materials statement
A main contractor that operates an Environmental Management System	
80% of site timber is reclaimed, re-used or responsibly sourced	80% of site timber is reclaimed, re-used or responsibly sourced

Same definition of small and large scale as in Man 02

Comments

Man 04 Security			
No. of BREEAM credits available	2	Available contribution to overall score:	2.18%
No. of BREEAM innovation credits	0	Minimum Standards applicable:	No
Assessment Criteria			Indicative Credits
Where the following requirements will be met:			1
One Credit Secure windows and doors	External doors and accessible windows meet minimum standards and appropriately certified		
Two Credits Secured by design	Principles and guidance of Secured by Design Section 2 are complied with		
	A suitably qualified security consultant is consulted at the design stage and their recommendations are incorporated into the refurbishment		
Comments			
Man 05 Protection and Enhancement of Ecological Features			
No. of BREEAM credits available	1	Available contribution to overall score:	1.09%
No. of BREEAM innovation credits	1	Minimum Standards applicable:	No
Assessment Criteria			Indicative Credits
Where the following requirements will be met:			1
One Credit Protecting Ecological Features	Site survey carried out to determine presence of ecological features		
	Statutory Nature Conservation Organisation notified of protected species		
	Features of ecological value protected during refurbishment works		
Exemplary Credit Ecological enhancement	A suitably qualified ecologist recommends features to enhance ecology of the site		Indicative Innovation Credits Achieved
	adopts all general ecological recommendations		
	adopts 30% of additional recommendations		
Comments			
Man 06 Project Management			
No. of BREEAM credits available	2	Available contribution to overall score:	2.18%
No. of BREEAM innovation credits	2	Minimum Standards applicable:	No
Assessment Criteria			Indicative Credits
Where the following requirements will be met:			1
One Credit Project Roles and Responsibilities	Where all of the project team are involved in the project decision making		
	Small Scale - the project manager assigns individual and shared responsibilities amongst the project team including all trades on site		
	Large Scale - the project manager assigns individual and shared responsibilities across the following key design and refurbishment stages: i. Planning and Building control notification ii. Design iii. Refurbishment iv. Commissioning and handover v. Occupation		
Small Scale projects: five units or fewer and less than £100k		Large Scale projects: more than five units and more than £100k	
One Credit Handover and Aftercare	Handover meeting arranged		
	2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation		
Exemplary Credits			Indicative Innovation Credits Achieved
One Exemplary Credit Early Design Input			0
One Exemplary Credit Thermographic Surveying and Airtightness Testing	Where Thermographic surveying and Airtightness testing have been carried out at both pre and post refurbishment stages		
	Where an improved air tightness target has been set at design stage and testing demonstrates that this has been achieved post refurbishment		
Comments			

HEALTH & WELLBEING		Section Weighting: 17%		Indicative Section Score 8.50%	
Hea 01 Daylighting					
No. of BREEAM credits available	2	Available contribution to overall score		2.83%	
No. of BREEAM innovation credits	0	Minimum Standards applicable		No	
Assessment Criteria					Indicative Credits
Where the refurbishment results in a neutral impact on daylighting or where minimum daylighting standards are met, up to two credits may be awarded as follows:					0
For Existing Dwellings and Change of Use Projects					
First Credit Maintaining Good Daylighting		The refurbishment results in a neutral impact on the dwellings daylighting levels in the kitchen, living room, dining room and study			
Where the property is being extended					
First Credit Maintaining Good Daylighting		New spaces achieve minimum daylighting levels The extension does not significantly reduce daylighting levels in the kitchen, living room, dining room or study of neighbouring properties			
For All Properties					
Second Credit Minimum Daylighting		The dwelling achieves minimum daylighting levels in the kitchen, living room, dining room and study			
Comments					
Hea 02 Sound Insulation					
No. of BREEAM credits available	4	Available contribution to overall score		5.67%	
No. of BREEAM innovation credits	0	Minimum Standards applicable		No	
Assessment Criteria					Indicative Credits
To ensure the provision of acceptable sound insulation standards and so minimise the likelihood of noise complaints.					1
Properties where sound testing has been carried out:					
Up to Four Credits		Four credits awarded according to the improvement over building regulations. See table in additional information in Technical Manual			
Properties where sound testing is not feasible and not required by the appointed Building Control body					
Two Credits		Where existing separating walls and floors are designed to meet the requirements of Building Regulations with compliant construction details			
Up to Four Credits		Where a Suitably Qualified Acoustician (SQA) provides recommendations for the specification of all existing separating walls and floors			
		SQA confirms in their professional opinion that they have the potential to meet or exceed the sound insulation credit requirements			
		Where these recommendations are implemented			
		See table in additional information in Technical Manual			
Historic Buildings					
Up to Four Credits		Where the dwelling is a Historic Building and sound testing results demonstrate existing separating walls and floor meet the Historic Building credit requirements			
		See table in additional information in Technical Manual			
		Where sound testing is not feasible and not required by the appointed Building Control body meeting criteria 2 and 3 using Table 12			
		Properties where sound testing has been carried out, credits awarded according to the improvement over building regulations. See table in additional information in Technical Manual			
		Where the dwelling is a detached property			
		Where the dwelling is a property with separating walls or floors only between non habitable rooms OR Testing not required by building control body			
Detached Properties					
Four Credits		By Default			
Properties with separating walls or floors only between non habitable rooms OR Testing not required by building control body					
Four Credits		By Default			
Comments					
Hea 03 Volatile Organic Compounds					
No. of BREEAM credits available	1	Available contribution to overall score		1.42%	
No. of BREEAM innovation credits	0	Minimum Standards applicable		No	
Assessment Criteria					Indicative Credits
Where the refurbishment avoids the use of VOCs with new products meeting the following requirements:					1
One Credit Avoiding the use of VOCs		Where all decorative paints and varnishes used in the refurbishment have met the requirement listed in table 5.4 in the Technical Manual			
		Where at least five of the eight remaining product categories listed in table 5.4 have met the testing requirements and emission levels for Volatile Organic Compound (VOC) emissions against the relevant standards identified within table 5.4 in the Technical Manual			
		Where five or less products are specified within the refurbishment, all must meet the requirements in order to achieve this credit.			
Comments					

Hea 04 Inclusive Design															
No. of BREEAM credits available	2	Available contribution to overall score	2.83%												
No. of BREEAM innovation credits	1	Minimum Standards applicable	No												
Assessment Criteria			Indicative Credits												
Where an access statement has been carried out using Checklist A-8 of the Technical Manual to optimise the accessibility of the home as follows:			1												
<table border="1"> <thead> <tr> <th colspan="3">Checklist A-8 of the Technical Manual</th> </tr> <tr> <th></th> <th>Section 1</th> <th>Section 2</th> </tr> </thead> <tbody> <tr> <td>One Credit Minimum Accessibility</td> <td>Completed with Evidence</td> <td></td> </tr> <tr> <td>Two Credits Advanced Accessibility</td> <td>Completed with Evidence</td> <td>Completed with Evidence</td> </tr> </tbody> </table>				Checklist A-8 of the Technical Manual				Section 1	Section 2	One Credit Minimum Accessibility	Completed with Evidence		Two Credits Advanced Accessibility	Completed with Evidence	Completed with Evidence
Checklist A-8 of the Technical Manual															
	Section 1	Section 2													
One Credit Minimum Accessibility	Completed with Evidence														
Two Credits Advanced Accessibility	Completed with Evidence	Completed with Evidence													
Exemplary Performance			Indicative Innovation Credits Achieved												
One Credit	Where an access expert suitably qualified member of the design team has completed sections 1, 2 and 3 of Checklist A-8, access statement template with evidence provided of the measures implemented in the refurbishment		0												
Comments															
Hea 05 Ventilation															
No. of BREEAM credits available	2	Available contribution to overall score	2.83%												
No. of BREEAM innovation credits	0	Minimum Standards applicable	Yes												
Assessment Criteria			Indicative Credits												
Where the dwelling meets the following ventilation requirements:			2												
One Credit Minimum Ventilation Requirements	A minimum level of background ventilation is provided (with trickle ventilators or other means of ventilation) for all habitable rooms, kitchens, utility rooms and bathrooms compliant with section 7, Building Regulations Approved Document Part F, 2010														
	A minimum level of extract ventilation is provided in all wet rooms (e.g. kitchen, utility and bath-rooms), compliant with section 5, Building Regulations Approved Document Part F 2010.														
	A minimum level of purge ventilation is provided in all habitable rooms and wet rooms, compliant with section 7, Building Regulations Approved Document Part F, 2010.														
	It is an historic building and meets historic building requirements in CN4 of the technical manual														
Two Credits Advanced Requirements	Ventilation is provided for the dwelling that meets the requirements of Section 5 of Building Regulations Part F in full														
	Where the building is a historic building and meets the requirements for Historic Buildings in compliance note 4 of the technical manual														
Comments															
Hea 06 Safety															
No. of BREEAM credits available	1	Available contribution to overall score	1.42%												
No. of BREEAM innovation credits	0	Minimum Standards applicable	Yes												
Assessment Criteria			Indicative Credits												
Where a fire and carbon monoxide (CO) detection and alarm system is specified as follows:			1												
One Credit Fire and Carbon Monoxide (CO) Detection and Alarm Systems	Where a compliant fire detection and fire alarm system is provided														
	Carbon Monoxide detector installed if dwelling is supplied with mains gas or other fossil fuel														
	Mains supplied fire detection and alarm system if project involves re-wiring*														
	Battery operated fire detection and alarm system if no re-wiring* is to take place														
* see CN9 in Hea 06 for the definition of re-wiring															
Comments															
ENERGY Section Weighting: 43% Indicative Section Score 35.59%															
Ene 01 Improvement in Energy Efficiency Rating															
No. of BREEAM credits available	6	Available contribution to overall score	8.90%												
No. of BREEAM innovation credits	0	Minimum Standards applicable	No												
Assessment Criteria			Indicative Credits												
Where the following targets are met for the improvement in Energy Efficiency Rating achieved as a result of refurbishment:			3.5												
	Improvement in EER	Credits													
	≥ 5	0.5													
	≥ 9	1													
	≥ 13	1.5													
	≥ 17	2													
	≥ 21	2.5													
	≥ 26	3													
	≥ 31	3.5													
	≥ 36	4													
	≥ 42	4.5													
	≥ 48	5													
	≥ 54	5.5													
	≥ 60	6													
Comments															

Ene 02 Energy Efficiency Rating Post Refurbishment				
No. of BREEAM credits available	4	Available contribution to overall score	5.93%	
No. of BREEAM innovation credits	2	Minimum Standards applicable	Yes	
Assessment Criteria				Indicative Credits
Where the following Energy Efficiency Rating benchmarks will be met as a result of refurbishment:				3.5
	EER post refurbishment	Credits	Minimum requirements	
	≥50	0.5	'Pass' level EER of 50	
	≥55	1	'Good' level EER of 58	
	≥60	1.5		
	≥65	2	'Very Good level' EER of 65	
	≥70	2.5	'Excellent' level EER of 70	
	≥75	3		
	≥80	3.5	'Outstanding' level EER of 81	
	≥85	4		
	Exemplary	Credits		Indicative Innovation Credits Achieved
	≥90	1		0
	≥100	2		
Comments				
Ene 03 Primary energy demand				
No. of BREEAM credits available	7	Available contribution to overall score	10.38%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where the following Primary Energy Demand benchmarks will be met as a result of refurbishment:				7
	Primary Energy Demand Post Refurbishment	Credits		
	≤ 400	0.5		
	≤ 370	1		
	≤ 340	1.5		
	≤ 320	2		
	≤ 300	2.5		
	≤ 280	3		
	≤ 260	3.5		
	≤ 240	4		
	≤ 220	4.5		
	≤ 200	5		
	≤ 180	5.5		
	≤ 160	6		
	≤ 140	6.5		
	≤ 120	7		
Comments				
Ene 04 Renewable Technologies				
No. of BREEAM credits available	2	Available contribution to overall score	2.97%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where the dwelling will meet the following % contribution from renewables and primary energy demand targets as a result of refurbishment				0
	Dwelling Type	Primary Energy Demand	Percentage from Renewables	
			1 Credit	2 Credits
	Detached	≤ 250 kWh/m ² /year	≥10%	≥20%
	Semi-Detached		≥10%	≥20%
	Bungalow		≥10%	≥20%
	End of Terrace		≥10%	≥20%
	Mid Terrace	≤ 220 kWh/m ² /year	≥10%	≥20%
	Low Rise Flat		≥10%	≥20%
	Mid Rise Flat		≥10%	≥15%
	High Rise Flat		≥10%	≥15%
Comments				
Ene 05 Energy Labelled White Goods				
No. of BREEAM credits available	2	Available contribution to overall score	2.97%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where Energy Efficiency White goods are to be provided as follows:				2
First Credit	Appliance	Appliance provided	Appliance not to be provided	
	Fridges, Freezers and Fridge-Freezers	A+ Rating under EU Energy Efficiency Labelling Scheme	EU Energy Efficiency Labelling Scheme Information Leaflet provided to all dwellings	
Second Credit	Appliance	Appliance provided	Appliance not to be provided	
	Washing Machines and Dishwashers	Washing Machine A++ under EU Energy Efficiency Labelling Scheme AND Dishwasher A+ under EU Energy Efficiency Labelling Scheme	Second credit not achieved	
	Washer-Dryers and Tumble Dryers	Appliances specified with A Rating under EU Energy Efficiency Labelling Scheme	EU Energy Efficiency Labelling Scheme Information Leaflet provided to all dwellings	
Comments				

Ene 06 Drying Space				
No. of BREEAM credits available	1	Available contribution to overall score	1.48%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where adequate, secure internal or external space with posts and footings or fixings is provided with the following:				⇒ 1
1 Credit				
Number of bedrooms	Drying line required			
1-2	4m+			
3+	6m+			
Comments				
Ene 07 Lighting				
No. of BREEAM credits available	2	Available contribution to overall score	2.97%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where energy efficient internal and external lighting is provided as follows:				⇒ 2
External Lighting - 1				
Energy Efficient Space Lighting of more than 45 lumens per circuit watt and Energy Efficient Security Lighting OR				
Where Energy Efficient Space Lighting is provided ONLY				
Internal Lighting - 1				
Maximum average wattage across the total floor area of the dwelling of 9 watts/m2				
Comments				
Ene 08 Display Energy Devices				
No. of BREEAM credits available	2	Available contribution to overall score	2.97%	
No. of BREEAM innovation credits	1	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where consumption data is displayed to occupants by a compliant energy display device				⇒ 2
Electricity usage data displayed		Primary Heating Fuel		
		Electricity	Other	
Electricity usage data displayed		2 credits awarded	1 credit awarded	
Primary Heating Fuel usage data displayed		N/A	1 credit awarded	
Electricity & Primary Heating Fuel usage displayed		N/A	2 credits awarded	
Exemplary Credits				
One credit		Where the first two credits are achieved		
Recording consumption data		Where any compliant Energy Display Device is capable of recording consumption data		
				Indicative Innovation Credits Achieved
				⇒ 0
Comments				
Ene 09 Cycle Storage				
No. of BREEAM credits available	2	Available contribution to overall score	2.97%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where individual or communal compliant cycle storage is provided as follows:				⇒ 2
Dwelling Size	One Credit	Two Credits		
Studios/ 1 bedroom	1 per two dwellings	1 per dwelling		
2-3 bedrooms	1 per dwelling	2 per dwelling		
4 bedrooms	2 per dwelling	4 per dwelling		
Comments				
Ene 10 Home Office				
No. of BREEAM credits available	1	Available contribution to overall score	1.48%	
No. of BREEAM innovation credits	0	Minimum Standards applicable	No	
Assessment Criteria				Indicative Credits
Where sufficient space and services will be provided to allow occupants to set up a home office in a suitable room with adequate ventilation				⇒ 1
Comments				

WATER		Section Weighting: 11%		Indicative Section Score 8.80%	
Wat 01 Internal Water Use					
No. of BREEAM credits available	3	Available contribution to overall score		6.60%	
No. of BREEAM innovation credits	1	Minimum Standards applicable		Yes	
Assessment Criteria					Indicative Credits
Where the dwellings water consumption meets the following consumption benchmarks, or where terminal fittings meet the following water consumption standards:					2
Calculated Water Consumption (litres/person/day)	Equivalent terminal fitting standards	Minimum Standard	Credits		
>150	Typical baseline performance	N/A	0		
from 140 to ≤ 150	All showers specified to 'Good' OR All taps and WC's to 'Good' OR Kitchen fittings specified to 'Excellent'	N/A	0.5		
from 129 to < 140	All showers specified to 'Excellent' OR All showers and bathroom taps to 'Good'	BREEAM Very Good	1		
from 118 to < 129	All bathroom and WC room fittings specified to 'Good' OR All bathroom fittings specified to 'Excellent'	N/A	1.5		
from 107 to < 118	All Bathroom and WC room fittings specified to 'Excellent' OR All Bathroom fittings Specified to 'Excellent' and WC room fitting specified to 'Good' OR All Bathroom fittings, kitchen and utility sittings specified to 'Good'	BREEAM Excellent	2		
from 96 to < 107	All kitchen, bathroom, utility room and WC room fittings specified to 'Good' OR All bathrooms, kitchens and utility rooms specified to 'Excellent'	N/A	2.5		
< 96	All bathroom fittings specified to 'Excellent' and WC room, kitchen and utility room fittings specified to 'Good'	BREEAM Outstanding	3		
NOTE: 'Good' fittings are equivalent to good practice fittings with 'Excellent' fittings equivalent to best practice fittings (see the technical manual for full details).					
Exemplary Credit		If the water consumption is less than 80l/person/day			Indicative Innovation Credits Achieved Please Select
Comments					
Wat 02 External Water Use					
No. of BREEAM credits available	1	Available contribution to overall score		2.20%	
No. of BREEAM innovation credits	0	Minimum Standards applicable		No	
Assessment Criteria					Indicative Credits
Where the following requirements will be met:					1
Requirements:					
One Credit	Where a compliant rainwater collection system for external/internal irrigation use has been provided to dwellings. OR Where dwellings have no individual or communal garden space.				
Comments					
Wat 03 Water Meter					
No. of BREEAM credits available	1	Available contribution to overall score		2.20%	
No. of BREEAM innovation credits	0	Minimum Standards applicable		No	
Assessment Criteria					Indicative Credits
Where an appropriate water meter for measuring usage of mains potable water meter has been provided to dwelling(s), one credit may be awarded					1
Comments					
MATERIALS		Section Weighting: 8%		Indicative Section Score 3.67%	
Mat 01 Environmental Impact of Materials					
No. of BREEAM credits available	25	Available contribution to overall score		4.16%	
No. of BREEAM innovation credits	0	Minimum Standards applicable		No	
Assessment Criteria					Indicative Credits
Up to 25 credits can be awarded, with credits calculated using the Mat 01 calculator tool. The table below shows the maximum number of credits available for each element:					10
Elements	Green Guide Rating credits available	Thermal performance credits available*			
Roof	5	3			
External walls	5	3.8			
Internal walls (including separating walls)	5	-			
Upper and Ground Floor	5	1.2			
Windows	5	2			
The full 25 credits represents all of the elements containing refurbished or existing materials that meet the Green Guide Rating of A+(6)					
GG Rating	Points for existing / refurbished elements	Points for new elements			
A+ (6)	5				
A+ (5)	4.6				
A+ (4)	4.2				
A+ (3)	3.8				
A+ (2)	3.4				
A+	3				
A	2	3			
B	1	2			
C	0.5	1			
D	0.25	0.5			
E	0	0.25			
		0			
Where the full 25 credits cannot be achieved the score can be 'topped up' with thermal performance credits. The full number of thermal performance credits for each element can be achieved when achieving the minimum U-values shown below.					
Elements		Minimum U-Value			
Roof		0.11			
External walls		0.15			
Internal walls (including separating walls)		-			
Upper and Ground Floor		0.15			

Comments	Windows	1.4

Mat 02 Responsible Sourcing of Materials				Available contribution to overall score		2.50%	
No. of BREEAM credits available		15		Minimum Standards applicable		Yes	
No. of BREEAM innovation credits		0					
Assessment Criteria				Indicative Credits			
Where new materials are responsibly sourced, up to 12 credits may be awarded where 80% of new materials for an element are responsibly sourced. The credits achieved are dependent on % of point achieved which is based upon the responsible sourcing tier level of each material sourced as detailed below:				8			
Sustainable Procurement Plan (3 BREEAM credits)				Will all new timber used in the project be sourced in accordance with the UK Government's Timber Procurement Policy?			
The principal contractor sources materials for the project in accordance with a documented sustainable procurement plan				Yes			
OR Where the principal contractor is a Small Company (up to 3 BREEAM credits)							
Checklist A-9 is filled in with supporting evidence							
Table 1							
BREEAM credits		% of available points achieved					
12		≥54%					
10		≥45%					
8		≥36%					
6		≥ 27%					
4		≥ 18%					
2		≥ 9%					
Comments							
Mat 03 Insulation				Available contribution to overall score			
No. of BREEAM credits available		8		Minimum Standards applicable		1.33%	
No. of BREEAM innovation credits		0				No	
Assessment Criteria				Indicative Credits			
Where any new insulation specified for use within external walls, ground floor, roof and buildings services meet the following requirements:				4			
Requirements							
4 Credits		Where the Insulation Index for new insulation used in the buildings is ≥2					
		Where Green Guide ratings are determined using the Green Guide to specification tool					
Requirements							
4 Credits		Where ≥ 80% of the new thermal insulation used in the building elements is responsibly sourced.					
Comments							
WASTE				Section Weighting: 3%		Indicative Section Score 1.80%	
Was 01 Household Waste				Available contribution to overall score			
No. of BREEAM credits available		2		Minimum Standards applicable		1.20%	
No. of BREEAM innovation credits		0				No	
Assessment Criteria				Indicative Credits			
Where compliant recycling and composting facilities are provided, up to two credits may be awarded as follows				2			
Scenario		First Credit - Recycling Facilities					
		Internal recycling storage requirements					
Compliant collection scheme in place		3 internal recycling containers provided where recycling is not sorted post collection					
		1 internal recycling container provided where recycling is sorted post collection					
		Minimum 30 litre total capacity, no single container less than 7 litre capacity					
No compliant collection scheme in place No adequate external storage		Dedicated position in accordance with compliance note 1					
		3 internal recycling containers provided					
		Minimum 60 litre total capacity					
No compliant collection scheme in place Adequate external storage provided		Dedicated position in accordance with compliance note 1					
		3 internal recycling containers provided					
		Minimum 30 litre total capacity, no single container smaller than 7 litre capacity					
		Dedicated position in accordance with compliance note 1					
Second credit - Composting facilities							
With external space		Without external space					
Where a composting service or facility is provided for green/garden waste		Where a composting service or facility is provided for kitchen waste					
Where a composting service or facility is provided for kitchen waste		Where an interior container is provided for kitchen composting waste of at least 7 litres					
Where an interior container is provided for kitchen composting waste of at least 7 litres							
Comments							
Was 02 Refurbishment Site Waste Management				Available contribution to overall score			
No. of BREEAM credits available		3		Minimum Standards applicable		1.80%	
No. of BREEAM innovation credits		1				No	
Assessment Criteria				Indicative Credits			
Up to three credits are available depending on the site waste management plan to be implemented as follows				1			
Projects up to £100k							
Three Credits		Where waste generated through the refurbishment process is managed in accordance with Checklist A-9		Indicative Innovation Credits Achieved			
Exemplary Credit		Where a compliant Level 1; Site Waste Management Plan (SWMP) is in place		Please Select			
Projects up to £300k							
Three Credits		Where a compliant Level 1; Site Waste Management Plan (SWMP) is in place					
Exemplary Credit		Where a compliant Level 2; Site Waste Management Plan (SWMP) is in place					
		Non-hazardous construction waste generated by the dwellings refurbishment meets or exceeds the resource efficiency benchmark					
		The percentage of non-hazardous construction waste and demolition waste generated by the					

	project has been diverted from landfill and meets or exceeds the refurbishment & demolition waste diversion benchmarks
Projects over £300k	
First Credit Management Plan	Where a compliant Level 2; Site Waste Management Plan (SWMP) is in place
Second Credit Good Practice Waste Benchmarks	First credit achieved
	Non-hazardous construction waste generated by the dwellings refurbishment meets or exceeds the resource efficiency benchmark
	Amount of waste generated against £100,000 of project value is recorded in the SWMP
	Pre-refurbishment audit of the existing building is completed
Third Credit Best Practice Waste Benchmarks	If demolition is included as part of the refurbishment programme, then the audit should also cover demolition materials
	Where the first two credits have been achieved achieved
Exemplary Credit	Where Non-hazardous demolition waste generated by the dwellings refurbishment meets or exceeds the refurbishment & demolition waste diversion benchmarks
	Where non-hazardous construction waste generated by the dwellings refurbishment meets or exceeds the <i>exemplary level resource efficiency benchmark</i>
	Where Non-hazardous demolition waste generated by the dwellings refurbishment meets or exceeds the exemplary level diversion benchmarks
Comments	

POLLUTION		Section Weighting: 6%		Indicative Section Score 3.75%																																	
Pol 01 NOx Emissions																																					
No. of BREEAM credits available	3	Available contribution to overall score	2.25%																																		
No. of BREEAM innovation credits	0	Minimum Standards applicable	No																																		
Assessment Criteria				Indicative Credits																																	
Credits are awarded on the basis of NOx emissions arising from the operation of space heating and hot water systems for each refurbished dwelling as follows:				2																																	
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Pol 02 Surface Water Runoff																																					
No. of BREEAM credits available	3	Available contribution to overall score	2.25%																																		
No. of BREEAM innovation credits	1	Minimum Standards applicable	No																																		
Assessment Criteria				Indicative Credits																																	
Where impacts of the refurbishment on surface water runoff are neutralised or where runoff is reduced as a result of refurbishment, up to three credits can be awarded as follows:				1																																	
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Comments																																					
Pol 03 Flooding																																					
No. of BREEAM credits available	2	Available contribution to overall score	1.50%																																		
No. of BREEAM innovation credits	0	Minimum Standards applicable	Yes																																		
Assessment Criteria				Indicative Credits																																	
Where the dwelling is located in a low flood risk zone, or where in a medium to high flood risk zone and a flood resilience/resistance strategy has been implemented, up to two credits can be awarded as follows:				2																																	
Minimum Standards		A minimum of two credits must be achieved for this issue at the Excellent and Outstanding levels																																			
Option 1 - Low Flood Risk																																					
Two Credits		Where a Flood Risk Assessment (FRA) has been carried out and the assessed dwellings are defined as having a low annual probability of flooding.																																			
Option 2 - Medium / High Flood Risk																																					
Two Credits		Where a Flood Risk Assessment (FRA) has been carried out and the assessed dwellings are defined as having a medium or high annual probability of flooding.																																			
		Two credits are awarded where as a result of the dwellings floor level or measures to keep water away the dwelling is defined as achieving avoidance from flooding by following Checklist A-10; Decision Strategy Flow Chart.																																			
		Where avoidance is not possible, two credits are achieved where a full flood resilience/resistance strategy is implemented for the dwellings in accordance with recommendations made by a Suitably Qualified Building Professional																																			
Comments																																					