Grays Inn Road, Camden

Energy Statement

Ensphere Group Ltd on behalf of Create REIT

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Gray’s Inn Road

Energy Statement

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Final	V2	Angie Bara	Pete Jeavons	March 2018

Contents

1. Executive Summary

1.1 This Energy Statement presents the energy strategy for a proposed scheme at 288 Gray's Inn Road, London.

1.2 The proposed scheme includes the redevelopment of existing offices to provide 2no residential units.

1.3 Consideration has primarily been given to the planning policy context and other requirements prior to establishing a strategy based upon the Energy Hierarchy; with a priority given to energy reduction and efficiency. Low carbon and renewable technologies have also been considered in the context of their technical feasibility and financial viability.

1.4 The proposed scheme includes the redevelopment of the site to office accommodation.

1.5 The following is therefore proposed:

- High performance building fabric and energy efficient lighting, services and equipment;
- Passive design measures to reduce energy demand for heating, cooling, ventilation and lighting;
- Highly efficient condensing gas boiler to provide space heating and hot water
- Installation of renewables (Monocrystalline PV) on the building's roof, to support the required 19% reduction in energy.

1.6 Part L compliance will be achieved through highly efficient design alone. The proposed energy strategy for the proposals is therefore considered consistent with the National Planning Policy Framework and policies of the GLA and local authority and, when implemented, will provide a highly-efficient and low carbon development.

2. Introduction

2.1 Ensphere Group Ltd was commissioned by Create REIT to produce an Energy Statement for a proposed development at 288 Gray's Inn Road, Camden.

Site & Surroundings

2.2 The site is located in the London Borough of Camden, along Gray's Inn Road; a wide two-way route whose northern end leads to Kings Cross square.

2.3 The site is well served by local transport links, shops and schools. King's Cross/St Pancras National Rail stations are located less than 1km away. From there, underground and national/international railway and bus services run regularly.

Proposed Development

2.4 Development proposals include the conversion of existing offices to residential units along with associated roof terraces to the rear of the 2nd and 3rd floors.

Report Objective

2.5 The objective of the Energy Statement is to outline how energy efficiency, low carbon and renewable technologies have been considered as part of the energy strategy.

Methodology

2.6 Consideration has primarily been given to the planning policy context and the subsequent sections aim to formulate the most efficient energy strategy so that the required performance standard is either met or exceeded.

2.7 The formulation of the energy strategy follows the principles of the "Energy Hierarchy" and prioritises energy efficiency over low-carbon and renewable energy generation. Consideration is therefore given to potential technology options before summarising the proposed approach in the final section.

3. Planning Policy Context

3.1 National and local planning policy relevant to sustainable development is considered in detail below:

National Planning Policy Framework

3.2 The Department for Communities and Local Government determines national policies on different aspects of planning and the rules that govern the operation of the system.

3.3 The transition to a low carbon economy is promoted in paragraphs 17, 93 through to 97 of the NPPF.

London Planning Policy Framework

3.1 The London Plan is the overall strategic plan for London. Chapter five of the Plan details London's Response to Climate Change and Policy 5.2 Minimising Carbon Dioxide Emissions is pertinent to this Energy Statement.

Local Planning Policy Framework

3.2 The local planning authority is the London Borough of Camden and policy is detailed within several statutory documents.

Local Plan (June 2017)

3.3 The Local Plan was adopted by Council on 3 July 2017 and has replaced the Core Strategy and Camden Development Policies documents as the basis for planning decisions and future development in the borough. Policies relevant to this report are presented below.

Policy CC1 Climate Change Mitigation [extract]

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 have been met;

c. Ensure that the location of the development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. Support and encourage sensitive energy efficiency improvements to existing buildings;

e. Require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. Expect all developments to optimise resource efficiency.

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

g. Working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. Protecting existing decentralised energy networks (e.g. at Gower Street Bloomsbury, Kings Cross, Gospel Oak, and Somers Town) and safeguarding potential network routes; and

i. Requiring all major developments to assess the feasibility of connecting to an existing decentralised 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.

4. Other Policy & Regulatory Considerations

4.1 This section comprises an overview of other considerations relevant to the Energy Statement.

Building Regulations

Update 2013 (Part L Conservation of Fuel & Power)

4.2 The Department for Communities and Local Government announced on 30 July 2013 that the update to Part L would include a further 6% carbon reduction for residential from 6 April 2014 and a further 9% reduction for non-residential.

National Planning Practice Guidance

Climate Change

4.3 Advises how planning can identify suitable mitigation and adaption measures in plan-making and the application process to address the potential for climate change.

Renewable and Low Carbon Energy

4.4 The guidance is intended to assist local councils in developing policies for renewable energy in local plans, and identifies the planning considerations for a range of renewable sources.

London Planning Practice Guidance

Energy Planning Guidance (April 2014)

4.5 Policy 5.2 of the London Plan requires each major development proposal to submit a detailed energy assessment. The GLA provides guidance to developers and their advisors on preparing energy assessments to accompany strategic planning applications. With regards to the carbon reduction targets detailed in policy 5.2 of the London Plan, the mayor will apply a 35 per cent target beyond Part L 2013 of the Building Regulations. This is deemed to be broadly equivalent to the 40 per cent target beyond Part L 2010.

Local Planning Policy Guidance

Camden Planning Guidance – Sustainability (CPG3) (2015)

4.6 The guidance provides information on ways to achieve carbon reductions and more sustainable developments. It highlights the Council's requirements and guidelines in support of policies CS13, DP22 and DP23.

4.7 Requires developments involving 5 or more dwellings and/or 500sq m (gross internal) floorspace or more to submit an energy statement which demonstrates how carbon dioxide emissions will be reduced in line with the energy hierarchy.

5. Formulation of the Strategy

5.1 The Energy Strategy is based upon the principles of the Energy Hierarchy and is consistent with the London Plan's recommended hierarchical approach.

5.2 The tiers of the Energy Hierarchy are:

1. Be Lean — Reduce Energy Demand
2. Be Clean — Use Energy More Efficiently
3. Be Green — Use Renewable Energy

5.3 The residual energy demand that needs to be supplied via burning fossil fuels is therefore minimised, and significant carbon savings are achieved during the operation phase of the development's lifecycle.

5.4 The first principle therefore relies on energy efficient design and the site characteristics such as the local climate, surroundings, scale and size of the development all influence the energy savings that can be achieved. Furthermore, the design of the building fabric can reduce energy wastage and associated energy demand.

5.5 The second principle prioritises using energy more efficiently. This is on the basis that low carbon technologies can be cost-effective and provide significant carbon savings when compared to conventional technologies, and are therefore prioritised.

5.6 The third principle of the hierarchy promotes the use of renewable technologies. Whilst these technologies can be relatively expensive to install, they do offer the potential to significantly reduce carbon emissions.

6. Passive Design & Energy Efficiency

6.1 This section considers features of the proposed design relevant to passive energy savings and energy efficiencies.

Passive Design

6.2 Within an urban context the potential for optimising a buildings' access to solar gains and daylight is limited and highly influenced by the site dimensions, shape and orientation as well as by the impact of surrounding buildings. For the proposed scheme and given the scale, massing of the building, as well as site constraints, the available potential of the site has been exploited as much as possible.

Solar Gains & Daylight

6.3 The building design takes advantage of the site's potential and incorporates passive design measures to further optimise solar radiation and daylight availability in the business unit.

6.4 The glazing areas throughout shall offer high levels of daylight availability in spaces and as appropriate for the intended use, promoting energy savings and most importantly, the health and well-being of occupants.

Natural Ventilation

6.5 It is anticipated that the building will be predominantly ventilated naturally via openable windows and / or trickle vents.

6.6 This has the advantage of lower energy consumption; decreased costs associated with capital expenditure, operation and maintenance; and reduced noise impacts associated with mechanical plant.

Fabric Efficiency

6.7 Much of the fabric design will be undertaken at the detailed design stage; however, the following provides an indication as to the anticipated approach.

Heat Transfer Coefficients

6.8 Heat Transfer Coefficients, otherwise referred to as U-Values, are a measure of the rate of heat transfer through a building element over a given area, under standardised conditions (i.e. the rate at which heat is lost or gained through a fabric).

6.9 It is intended that the performance of the building fabric will incorporate relatively low U-Values to reduce the rate at which the building loses heat, preserving the heat within the space and reducing the requirement for mechanical heating.

6.10 The U-values for the basic building elements shall be enhanced compared to minimum Building Regulations standards (2013); indicative upper limits are given in the table below:

Table 6.1 Proposed U-Values for Building Elements

Element	Proposed Upper Limits (U-Values) [W/m²K]
External Walls	0.13
Roof	0.13
Exposed Floor	0.20
Windows	1.40

Air Leakage

6.11 A high level of air tightness is proposed and a level below $5m^3/h/m^2$ is targeted, meaning that air infiltration between the internal and the external environment will be largely controlled and space heating demand further reduced.

Thermal Mass

6.12 Thermal mass is the ability of the fabric of a building to absorb heat, store it, and at a later time release it. Similar to the Heat Transfer Coefficients, this is a detail that will be considered more fully as the design progresses.

6.13 Nevertheless, it is recognised that thermal mass has the potential to capture and release energy and help regulate requirements throughout the day. Typically, a higher thermal mass helps reduce the cooling requirements for buildings in the UK during summer months.

6.14 To maximise the benefits, consideration will be given to the specific climate and daytime occupation; particularly during winter months where the addition of thermal mass can increase winter heating. Furthermore, the removal of heat during summer months (e.g. night-time ventilation) is key to gains by having mass and the approach is not necessarily suited to buildings with 24 hour occupancy.

6.15 As a rule of thumb, the best place for thermal mass is inside the insulated building envelope and a better insulated envelope will mean more effective thermal mass. Furthermore, thermal mass should be left exposed internally to allow it to interact with the building interior.

Thermal Bridging

6.16 The building fabric shall be constructed so that there are no reasonably avoidable thermal bridges in the insulation layers caused by gaps within the various elements.

Service Energy Efficiency

Efficient Heating

6.17 Boiler components shall have a seasonal efficiency in the order of 90%; and the thermal store shall be factory insulated to a high standard to minimise heat wastage.

6.18 Heat losses from the heat distribution network shall be restricted by installing pre-insulated pipework and exceeding current insulation guidelines. For advanced energy savings and improved thermal comfort, an underfloor heating system can be considered for the distribution of heat.

6.19 Advanced space heating controls shall be employed as appropriate (e.g. room thermostats, time programmers) and the charging system will be linked to use; providing incentives to the occupants to efficiently manage consumption.

Lighting

6.20 At this stage, detailed lighting design calculations have not yet been undertaken, but lighting design is intended to be highly efficient and in excess of Building Regulations requirements. Lighting will be zoned and controlled as appropriate throughout the development; and lighting controls (e.g. photoelectric sensors) shall be considered for the communal areas. Daylight sensors shall automatically control the operation of external lighting fittings.

Overheating Mitigation

6.21 The issue of overheating will need detailed and considered assessment at a later stage of design on the basis that, as buildings become progressively better sealed and insulated, the potential for overheating increases.

6.22 Causes of overheating can be external heat gains (e.g. solar gains), internal heat gains (e.g. heat dissipated from building services equipment, pipework, lighting, appliances, occupants activity) and other factors relating to the site and the surroundings which can further enhance the overheating risks (e.g. urban heat island effect).

6.23 For the specific development the following measures are considered that will contribute in managing overheating risks; and subject to further analysis at later design stages:

- Reduced glazing facing east and west, i.e. the elevations experiencing increased summer solar irradiation;
- Natural ventilation shall be feasible;
- Thermal mass shall be incorporated;

- The heating and hot water distribution pipework shall be highly insulated and designed to minimise pipework length.

7. Low Carbon & Renewable Technologies

7.1 Low carbon and renewable technologies have been considered as follows:

- Combined Heat & Power (CHP) – Because of the size and nature of the proposed scheme, the anticipated demand profile is not considered suitable for CHP;
- Air Source Heat Pump (ASHP) – Whilst the technology could feasibly be employed to satisfy the space heating demand, in consideration of the surrounding residential uses, it is rejected on the grounds of cost, noise and aesthetics;
- Biomass – This technology is rejected on the basis that the site is located in an urban environment, away from a readily available source of material. Furthermore, the use of biomass would require regular deliveries and combustion of the material would likely impact local air quality;
- Ground Source Heat Pump (GSHP) – The technology is presently rejected on the basis that there is no adequate space to install such technology and there are uncertainties concerning the thermal properties of the ground and testing and installation costs are likely to be excessive for a project of this scale;
- Photovoltaics (PV) – The installation of monocrystalline photovoltaic panels is the preferred technology on the basis that the desired levels of carbon saving can be best achieved through this approach. Furthermore, the use of the roof provides adequate area for the number of panels required.
- Solar Thermal –Whist technically feasible in a limited capacity, the technology is not preferred on the basis that the desired levels of carbon saving can be achieved through an alternative approach.
- Wind Turbines – This technology is rejected on the basis of the urban location and relatively low wind speeds.

7.2 Space heating and hot water will therefore be provided via low NOx conventional gas-fired boilers.

8. Summary

8.1 This Energy Statement provides an overview of the energy strategy in consideration of the site context, anticipated energy requirements and local priorities and initiatives.

8.2 A review of Camden Council's planning policies has identified a number of requirements relating to energy. Of these, Local Plan policy CC1 (*Climate Change Mitigation*) is considered most pertinent along with Camden Planning Guidance – *Sustainability* (CPG3). Consideration has also been given to the NPPF and GLA's London Plan and the targets contained therein.

8.3 The approach follows the Energy Hierarchy, with priority given to efficient design on the basis that it is preferable to reduce carbon emissions by reducing energy demand first with low or zero carbon technologies to compliment any shortfall. It is therefore proposed that PV panels are installed in order to meet the required reduction in energy.

8.4 Indicative sample energy modelling has been undertaken using the SAP Methodology, in support of the energy strategy proposals (indicative outputs are included in Appendix A2).

8.5 Part L compliance will be achieved through highly efficient design alongside the installation of renewable technology. Overall carbon savings, including those gained through the incorporation of photovoltaics, will be >19% below Part L 2013 compliance.

8.6 The proposed energy strategy for the proposals is therefore considered consistent with the National Planning Policy Framework and policies of the GLA and Camden Council and, when implemented, will provide a highly-efficient and low carbon development.

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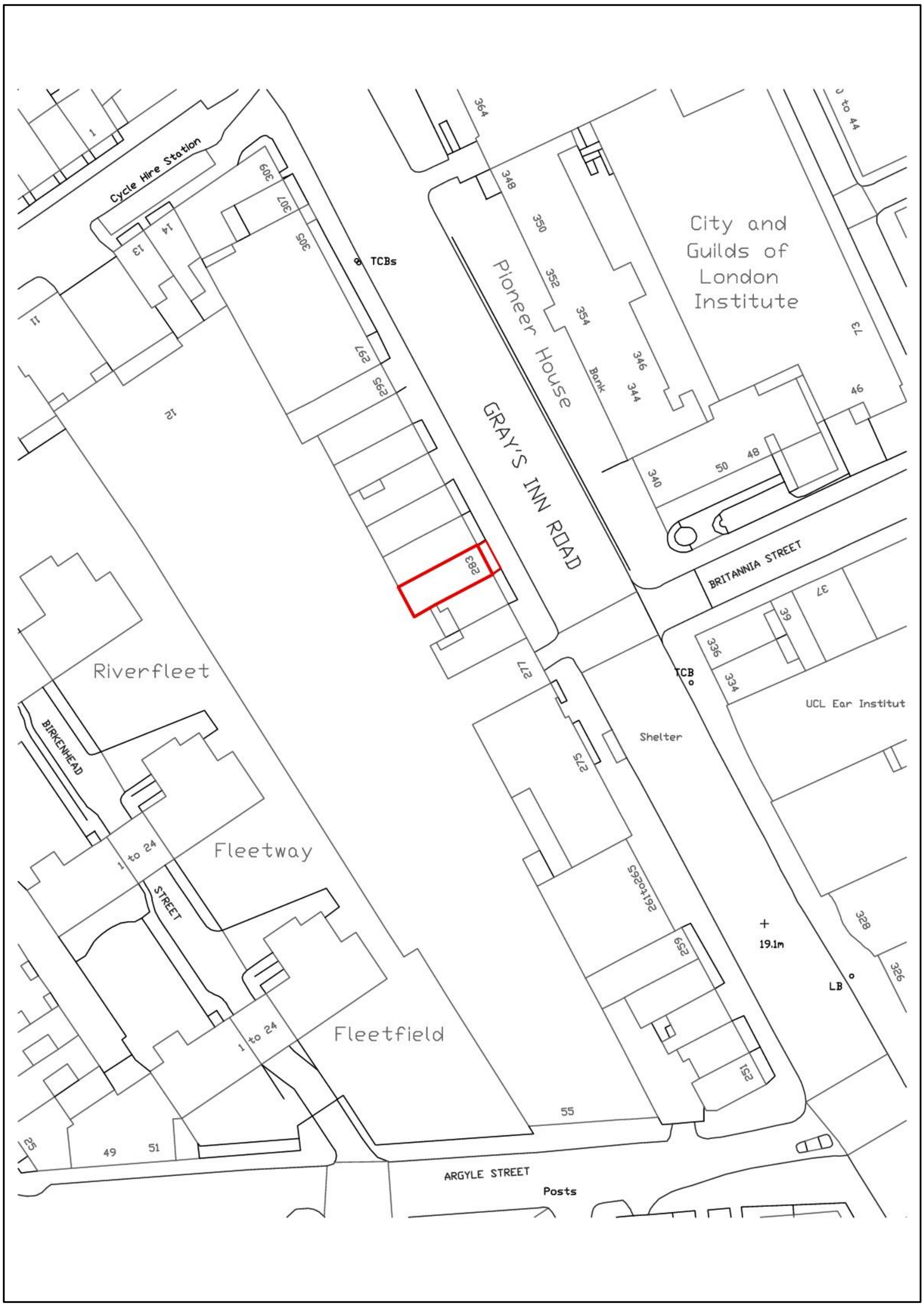
Appendix A Site Plans



Cycle Hire Station
GRAY'S INN ROAD
Pioneer House
City and Guilds of London Institute
BRITANNIA STREET
Riverfleet
Fleetway
Fleetfield
BIRKENHEAD STREET
ARGYLE STREET
Posts
UCL Ear Institut
Shelter
TCBs
TCB
LB
19.1m
Bank
283

Appendix B Energy Modelling Outputs

Block Compliance WorkSheet: Block

User Details

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP
Software Version: Version: 1.0.4.10

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat 1	13.56	17.27	36.2	40	57.76
Flat 2	13.17	16.32	39.2	43.9	85.15

Calculation Summary

Total Floor Area	142.91
Average TER	16.70
Average DER	13.33
Average DFEE	37.99
Average TFEE	42.32
Compliance	Pass
% Improvement DER|TER	20.18
% Improvement DFEE|TFEE	10.23

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.76	(1a) x	3.12	(2a) =	180.21	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.76	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	180.21	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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							1	x 10 =	10	(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) =	10	÷ (5) =	0.06	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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		5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.31	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.24	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7 (22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4 (22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28

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]

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

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)

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]

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.52	0.53	0.53	0.54	0.54	(24d)
(25)m=	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.52	0.53	0.53	0.54	0.54	(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	
Windows Type 1			5.81	x1/[1/(1.4)+ 0.04]		=	7.7			(27)
Windows Type 2			6.19	x1/[1/(1.4)+ 0.04]		=	8.21			(27)
Windows Type 3			2.27	x1/[1/(1.4)+ 0.04]		=	3.01			(27)
Walls Type1	36.5	16.54	19.96	x	0.13	=	2.59			(29)
Walls Type2	28	0	28	x	0.13	=	3.64			(29)
Roof	5.71	0	5.71	x	0.13	=	0.74			(30)
Total area of elements, m²			70.21							(31)
Party wall			10.55	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) =	28.91	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	3732.39	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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		3	(36)

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

Total fabric heat loss	(33) + (36) =	31.91	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	32.44	32.34	32.24	31.75	31.66	31.24	31.24	31.16	31.4	31.66	31.84	32.04	(38)

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

(39)m=	64.35	64.24	64.14	63.66	63.57	63.14	63.14	63.07	63.31	63.57	63.75	63.94	

Average = Sum(39)1…12 /12= 63.66 (39)

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DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.11	1.11	1.1	1.1	1.09	1.09	1.09	1.1	1.1	1.1	1.11

Average = Sum(40)1…12 /12= 1.1 (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 1.92 (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 79.74 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	87.72	84.53	81.34	78.15	74.96	71.77	71.77	74.96	78.15	81.34	84.53	87.72

Total = Sum(44)1…12 = 956.93 (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=	130.08	113.77	117.4	102.35	98.21	84.75	78.53	90.12	91.19	106.28	116.01	125.98

Total = Sum(45)1…12 = 1254.68 (45)

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

(46)m=	19.51	17.07	17.61	15.35	14.73	12.71	11.78	13.52	13.68	15.94	17.4	18.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

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

(61)m=	25.73	23.22	25.68	24.81	25.61	24.76	25.56	25.6	24.79	25.65	24.87	25.72	(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=	155.82	137	143.08	127.17	123.82	109.5	104.09	115.71	115.98	131.93	140.88	151.7	(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=	155.82	137	143.08	127.17	123.82	109.5	104.09	115.71	115.98	131.93	140.88	151.7

Output from water heater (annual)1…12 1556.69 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	49.69	43.64	45.46	40.24	39.06	34.37	32.5	36.36	36.52	41.75	44.79	48.32	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.88	95.88	95.88	95.88	95.88	95.88	95.88	95.88	95.88	95.88	95.88	95.88	(66)

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

(67)m=	14.91	13.24	10.77	8.15	6.1	5.15	5.56	7.23	9.7	12.32	14.38	15.33	(67)

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

(68)m=	167.26	169	164.63	155.31	143.56	132.51	125.13	123.4	127.77	137.08	148.84	159.88	(68)

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

(69)m=	32.59	32.59	32.59	32.59	32.59	32.59	32.59	32.59	32.59	32.59	32.59	32.59	(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=	-76.71	-76.71	-76.71	-76.71	-76.71	-76.71	-76.71	-76.71	-76.71	-76.71	-76.71	-76.71	(71)

Water heating gains (Table 5)

(72)m=	66.78	64.93	61.1	55.88	52.5	47.73	43.69	48.87	50.72	56.12	62.21	64.95	(72)

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

(73)m=	303.72	301.94	291.26	274.12	256.92	240.16	229.14	234.27	242.96	260.28	280.19	294.92	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	2.27	x	11.28	x	0.63	x	0.7	=	15.65	(75)
Northeast	0.9x	0.77	x	2.27	x	22.97	x	0.63	x	0.7	=	31.87	(75)
Northeast	0.9x	0.77	x	2.27	x	41.38	x	0.63	x	0.7	=	57.41	(75)
Northeast	0.9x	0.77	x	2.27	x	67.96	x	0.63	x	0.7	=	94.29	(75)
Northeast	0.9x	0.77	x	2.27	x	91.35	x	0.63	x	0.7	=	126.74	(75)

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Northeast 0.9x	0.77	x	2.27	x	97.38	x	0.63	x	0.7	=	135.12	(75)
Northeast 0.9x	0.77	x	2.27	x	91.1	x	0.63	x	0.7	=	126.4	(75)
Northeast 0.9x	0.77	x	2.27	x	72.63	x	0.63	x	0.7	=	100.77	(75)
Northeast 0.9x	0.77	x	2.27	x	50.42	x	0.63	x	0.7	=	69.96	(75)
Northeast 0.9x	0.77	x	2.27	x	28.07	x	0.63	x	0.7	=	38.94	(75)
Northeast 0.9x	0.77	x	2.27	x	14.2	x	0.63	x	0.7	=	19.7	(75)
Northeast 0.9x	0.77	x	2.27	x	9.21	x	0.63	x	0.7	=	12.78	(75)
Southeast 0.9x	0.77	x	6.19	x	36.79	x	0.63	x	0.7	=	69.6	(77)
Southeast 0.9x	0.77	x	6.19	x	62.67	x	0.63	x	0.7	=	118.56	(77)
Southeast 0.9x	0.77	x	6.19	x	85.75	x	0.63	x	0.7	=	162.22	(77)
Southeast 0.9x	0.77	x	6.19	x	106.25	x	0.63	x	0.7	=	201	(77)
Southeast 0.9x	0.77	x	6.19	x	119.01	x	0.63	x	0.7	=	225.14	(77)
Southeast 0.9x	0.77	x	6.19	x	118.15	x	0.63	x	0.7	=	223.51	(77)
Southeast 0.9x	0.77	x	6.19	x	113.91	x	0.63	x	0.7	=	215.49	(77)
Southeast 0.9x	0.77	x	6.19	x	104.39	x	0.63	x	0.7	=	197.48	(77)
Southeast 0.9x	0.77	x	6.19	x	92.85	x	0.63	x	0.7	=	175.65	(77)
Southeast 0.9x	0.77	x	6.19	x	69.27	x	0.63	x	0.7	=	131.04	(77)
Southeast 0.9x	0.77	x	6.19	x	44.07	x	0.63	x	0.7	=	83.37	(77)
Southeast 0.9x	0.77	x	6.19	x	31.49	x	0.63	x	0.7	=	59.57	(77)
Southwest 0.9x	0.77	x	5.81	x	36.79		0.63	x	0.7	=	65.33	(79)
Southwest 0.9x	0.77	x	5.81	x	62.67		0.63	x	0.7	=	111.28	(79)
Southwest 0.9x	0.77	x	5.81	x	85.75		0.63	x	0.7	=	152.26	(79)
Southwest 0.9x	0.77	x	5.81	x	106.25		0.63	x	0.7	=	188.66	(79)
Southwest 0.9x	0.77	x	5.81	x	119.01		0.63	x	0.7	=	211.32	(79)
Southwest 0.9x	0.77	x	5.81	x	118.15		0.63	x	0.7	=	209.79	(79)
Southwest 0.9x	0.77	x	5.81	x	113.91		0.63	x	0.7	=	202.26	(79)
Southwest 0.9x	0.77	x	5.81	x	104.39		0.63	x	0.7	=	185.36	(79)
Southwest 0.9x	0.77	x	5.81	x	92.85		0.63	x	0.7	=	164.87	(79)
Southwest 0.9x	0.77	x	5.81	x	69.27		0.63	x	0.7	=	122.99	(79)
Southwest 0.9x	0.77	x	5.81	x	44.07		0.63	x	0.7	=	78.25	(79)
Southwest 0.9x	0.77	x	5.81	x	31.49		0.63	x	0.7	=	55.91	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	150.59	261.71	371.9	483.95	563.2	568.42	544.15	483.61	410.48	292.97	181.32	128.26	(83)

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

(84)m=	454.31	563.65	663.16	758.07	820.11	808.58	773.29	717.87	653.44	553.25	461.51	423.18	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.94	0.85	0.68	0.49	0.36	0.4	0.64	0.9	0.98	1	(86)

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

(87)m=	20.18	20.36	20.57	20.79	20.91	20.94	20.95	20.95	20.92	20.75	20.42	20.14	(87)

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

(88)m=	19.99	19.99	19.99	20	20	20.01	20.01	20.01	20	20	20	20	(88)

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

(89)m=	0.99	0.97	0.93	0.81	0.62	0.42	0.28	0.32	0.56	0.87	0.98	0.99	(89)

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

(90)m=	18.91	19.16	19.46	19.75	19.89	19.93	19.93	19.93	19.91	19.71	19.25	18.86	(90)

fLA = Living area ÷ (4) = | 0.38 | (91)

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

(92)m=	19.39	19.61	19.89	20.15	20.28	20.31	20.32	20.32	20.3	20.11	19.7	19.35	(92)

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

(93)m=	19.24	19.46	19.74	20	20.13	20.16	20.17	20.17	20.15	19.96	19.55	19.2	(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=	0.99	0.97	0.92	0.81	0.63	0.43	0.29	0.33	0.57	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	449.24	546.52	611.41	612.34	513.82	348.75	225.03	237.15	372.79	480.07	449.52	419.75	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	961.56	935.65	849.03	706.45	535.58	351.3	225.28	237.63	382.87	594.9	793.45	958.99	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	381.16	261.49	176.79	67.76	16.19	0	0	0	0	85.43	247.62	401.2	

Total per year (kWh/year) = Sum(98)1...5,9...12 = | 1637.65 | (98)

Space heating requirement in kWh/m²/year | 28.35 | (99)

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		90	(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)														
	381.16	261.49	176.79	67.76	16.19	0	0	0	0	85.43	247.62	401.2		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	423.52	290.55	196.44	75.29	17.98	0	0	0	0	94.93	275.14	445.77		
Total (kWh/year) =Sum(211)1...5,10...12=													1819.61	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

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Water heating

Output from water heater (calculated above)

	155.82	137	143.08	127.17	123.82	109.5	104.09	115.71	115.98	131.93	140.88	151.7		
Efficiency of water heater													87	(216)
(217)m=	89.11	88.95	88.63	88.02	87.34	87	87	87	87	88.15	88.89	89.16		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	174.86	154.02	161.43	144.48	141.78	125.87	119.65	133	133.31	149.66	158.49	170.15		
Total = Sum(219a)$_{1...12}$ =													1766.7	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1819.61	
Water heating fuel used			1766.7	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			263.35	(232)
Electricity generated by PVs			-321.28	(233)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	393.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	381.61	(264)
Space and water heating	(261) + (262) + (263) + (264) =			774.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	136.68	(268)
Energy saving/generation technologies Item 1		0.519	=	-166.74	(269)
Total CO2, kg/year	sum of (265)…(271) =			783.5	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			13.56	(273)
EI rating (section 14)				90	(274)

Appendix C General Notes

The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by Ensphere Group Ltd for inaccuracies in the data supplied by any other party.

The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

No site visits have been carried out, unless otherwise specified.

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