Energy Statement

11 Blackburn Road, West Hampstead

Iceni Projects Limited on behalf of
Narrowpack Ltd

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CONTENTS

1. EXECUTIVE SUMMARY

1.1 This Energy Statement presents the energy strategy for the proposed development at 11 Blackburn Road, West Hampstead, London.

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

1.3 The following is therefore proposed:

- High performance building fabric and energy efficient heating, lighting, services and equipment;
- Passive design measures to reduce energy demand for heating and lighting; implementation of natural ventilation in residential spaces;
- Photovoltaics integrated in the glass louvres proposed for the new build terraced houses;
- Environmental enhancements of the Victorian warehouse with a focus on upgrading the fabric thermal elements.

1.4 For the new build terraced houses, the proposed energy strategy will yield ~20% carbon savings from renewables and overall carbon savings ~21% beyond the target emission rate (TER) of Part L1A 2013.

1.5 The level of environmental enhancements for the Victorian warehouse will comply with the mandatory requirements under BREEAM.

1.6 Overall, the proposed energy strategy for 11 Blackburn Road is considered consistent with the National Planning Policy Framework and policies of the London Borough of Camden and, when implemented, will provide an efficient and low carbon development.

2. INTRODUCTION

2.1 Iceni Projects Ltd was commissioned by Narrowpack Ltd to produce an Energy Statement for the proposed scheme at 11 Blackburn Road, West Hampstead.

Site & Surroundings

The Site

2.2 The site is located in West Hampstead, within the London Borough of Camden and has an area of 1,137sqm. The site has an east-west linear shape, with the footpath Billy Fury Way and railway to the north, and Blackburn Road to the south.

2.3 The site is predominantly laid to hardstanding and contains two dilapidated buildings; a Victorian warehouse and artist studio; a driveway and small forecourt area used for access and informal parking.

The Surroundings

2.4 The site is located near the West Hampstead Interchange on West End Lane, with its abundant local facilities, amenities and public transport connections.

2.5 The wider area is predominantly residential with commercial ground floor uses along West End Lane and a retail park to the east to Finchley Road.

2.6 Neighbouring buildings include an office building to the south-east and a recently completed student accommodation building further east. Terraced housing with ground floor commercial uses lie adjacent to the west.

The Proposed Development

2.7 The following is provided as the scheme description:

2.8 "Demolition of modern warehouse and replacement with seven 2bed houses, and refurbishment of Victorian warehouse to provide artist workshop / gallery space on ground floor and two x 2bed residential apartments above, together with car parking, landscaping and associated works."

Report Objective

2.9 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

2.10 Consideration has primarily been given to the planning policy context; this is detailed in Section 3. Passive design and energy efficiency are discussed in Section 4 prior to consideration of decentralised, low carbon and renewable technologies in Sections 5 and 6. The report concludes with the strategy.

3. PLANNING CONTEXT & OTHER CONSIDERATIONS

3.1 National, London and local planning policy relevant to energy and carbon dioxide is considered below:

National Planning Policy Framework

3.2 The NPPF states that the purpose of the planning system is to contribute to the achievement of sustainable development. The transition to a “low-carbon” future is referenced throughout this document; with a stated expectation that the planning system is to support this transition in conjuncture with the conservation of natural resources and the use of renewables.

London Planning Policy Framework

The London Plan – Spatial Development Strategy for Greater London

3.3 The London Plan is the overall strategic plan for London. Chapter five details *London’s Response to Climate Change* and policies 5.2, 5.3 and 5.5 -5.7 are most relevant to the energy strategy of new development in the London Boroughs; strategic and development-scale goals are established.

3.4 Policy 5.2 sets overall targets for the reduction of carbon dioxide emissions in new *major* development beyond Building Regulations requirements via the implementation of the Energy Hierarchy principles (“Be Lean”, “Be Clean”, “Be Green”) whereby demand through energy efficiency is prioritised for optimum and cost-effective carbon savings.

3.5 Policies 5.3 and 5.5 - 5.7 elaborate on the principles of the Energy Hierarchy in promoting energy efficiency and the efficient use of natural resources (5.3), the deployment of decentralised energy networks (5.5) and site-wide CHP energy networks (5.6), as well as the on-site renewable energy generation (5.7). Specific guidance is addressed to *major* development proposals.

3.6 According to the London Plan ‘major development’ is defined as that where 10 or more dwellings are to be constructed; for all other uses as that where the floor space will be 1,000 sqm or more (London Plan Further Alterations March 2015, Annex 6 *Glossary*). In line with this definition the proposal is not considered major development (<10No. of dwellings; <1,000 sqm non-residential floorspace).

Sustainable Design and Construction SPG

3.7 The Supplementary Planning Guidance aims to support developers, local planning authorities and neighbourhoods to achieve sustainable development and provides detail on the implementation of sustainable design and construction and the wider environmental sustainability policies of the London Plan.

Energy Planning – GLA Guidance on preparing energy assessments

3.8 The guidance note provides further detail on addressing the London Plan's energy hierarchy through the provision of an energy assessment to accompany strategic planning applications.

Local Planning Policy Framework

3.9 The local planning authority is Camden Council and policy is detailed within a number of statutory documents.

Camden Core Strategy: 2010-2025

3.10 The Core Strategy sets out the key elements of the vision for the borough and is a central part of the Local Development Framework (LDF). Policy CS13 is considered most pertinent to energy and is presented below:

Policy CS13 – Tackling climate change through promoting higher environmental standards [extract]

Reducing the effects of and adapting to climate change

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

[…]

(c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

1. ensuring developments use less energy;
2. making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
3. generating renewable energy on-site; and

(d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions.

Local Energy Generation

The Council will promote local energy generation and networks by:

(e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:

- housing estates with community heating or the potential for community heating and other uses with large heating loads;
- the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
- schools to be redeveloped as part of Building Schools for the Future programme;
- existing or approved combined heat and power/local energy networks (see Map 4);

and other locations where land ownership would facilitate their implementation.

(f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road).

3.11 Accompanying text to CS13 promotes a target of 20% on-site renewable energy generation subject to feasibility and viability.

Camden Development Policies: 2010-2025

3.12 The Development Policies LDF document sets out detailed planning criteria that are used to determine applications for planning permission in the borough.

3.13 Policies DP22 and DP32 of Section 3 "*Tackling climate change and improving and protecting Camden's environment and quality of life"* are considered most pertinent in the context of this report and key points are presented briefly below.

Policy DP22 – Promoting sustainable design and construction

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

(a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and

(b) incorporate green or brown roofs and green walls wherever suitable.

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

(c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;

(d) expecting developments (except new build) of 500sqm of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;

(e) expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

(f) summer shading and planting;

(g) limiting run-off;

(h) reducing water consumption;

(i) reducing air pollution; and

(j) not locating vulnerable uses in basements in flood-prone areas.

3.14 Whilst the focus of Policy DP32 principally concerns air quality, the accompanying text indicates that biomass boilers would be viewed as the least preferred option for the provision of renewable energy, due to impacts on air quality.

Camden Planning Guidance – CPG3 Sustainability

3.15 The guidance provides information on ways to achieve carbon reductions and more sustainable developments; it covers a range of issues including – energy, water efficiency, sustainable use of materials, sustainability assessment tools, climate change adaptation, and biodiversity.

3.16 Four sections are dedicated to the implementation of the Energy Hierarchy in new developments, namely Section 3 "*Energy efficiency: new buildings",* Section 4 "*Energy efficiency: existing buildings",* Section 5 "*Decentralised energy networks and combined heat and power",* and Section 6 "*Renewable energy".*

3.17 The document includes a series of "Key Messages", including:

Key Messages [extract]

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

- All new developments are to be designed to minimise carbon dioxide emissions; the most cost-effective ways to minimise energy demand are through good design and high levels of insulation and air tightness.
- Where feasible and viable your development will be required to connect to a decentralised energy network or include CHP.
- Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies.
- [for existing buildings] As a guide, at least 10% of the project cost should be spent on environmental improvements.

Emerging Local Policy – Draft Local Plan

3.18 Camden Council is reviewing its main planning policies and is currently consulting on a draft Local Plan. When finalised, the Local Plan will replace the Core Strategy and Camden Development Policies documents.

3.19 The draft policies have been reviewed in preparation of the energy strategy for the development; of most pertinence to this statement are draft policies CC1 (*Climate Change Mitigation*) and CC2 (*Adapting to Climate Change*).

Pre-Planning Consultation

3.20 Pre-application advice was sought from Camden Council and the following was stated in the Planning Officer's response with regards to the energy strategy:

"An energy statement should be submitted with an application of this nature which demonstrates how carbon dioxide emissions will be reduced in line with the energy hierarchy.

CPG3 - Sustainability provides guidance on what should be included in an energy statement. For a development of this size the Council would expect the applicant to explore the opportunity of providing a CHP. Further details can be found in CPG3- Sustainability."

Decentralised Energy Networks

3.21 Core Strategy Map 4 shows areas most likely to provide development-led decentralised energy networks; Figures 4 and 5 of CPG3 show the location of existing and proposed/emerging networks; the London Heat Map also provides equivalent information.

3.22 In line with CPG3 the Council expects that developments which fall within 1km of an existing energy network or one that could be operational within 3 years of occupation should assess the feasibility of connecting to the network; or that developments which fall within 500m of a potential network which has no timetable for delivery should ensure that the development is capable of connecting to a network in the future.

3.23 The proposed development lies outside the 1km and 500m boundaries of existing/emerging or potential district energy networks; the London Heat map also confirms that there are no existing or planned district energy networks within its vicinity; however the wider area is indicated as an "Opportunity Area" for the deployment of district energy networks.

Sustainability Standards

3.24 It is intended to assess the two flats that will result from the refurbishment of the Victorian warehouse as well as the employment floorspace of the warehouse under the BREEAM Refurbishment methodology for domestic and non-domestic uses respectively with a target of achieving 'Very Good'.

3.25 Further details on the BREEAM sustainability assessment tool can be found in the accompanying Sustainability Statement; BREEAM considers a number of issues relevant to energy including energy efficiency, carbon emissions, unregulated energy consumption, monitoring and management of energy systems.

3.26 The energy-related mandatory requirements for the development, as dictated by the targeted BREEAM performance are:

- The energy efficiency rating (EER) of the flats resulting from change of use and refurbishment of the Victorian warehouse would need to be 65 as per minimum;
- Major energy uses of non-residential spaces (artist's workshop/gallery) should be separately metered and monitored.

The Energy Hierarchy

3.27 The Energy Strategy is based upon the principles of the Energy Hierarchy and is consistent with the Council's recommended sequential approach.

3.28 The tiers of the Energy Hierarchy are:

(a) Be Lean Reduce Energy Demand

(b) Be Clean Use Low Carbon Source of Energy

(c) Be Green Use Renewable Energy

3.29 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.

3.30 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.

3.31 The second principle prioritises the use of low carbon sources of energy. This is on the basis that low carbon technologies can be cost-effective and provide significant carbon savings when compared to conventional technologies.

3.32 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.

3.33 In the following sections, passive design and energy efficiency, low-carbon and renewable technologies are considered.

4. PASSIVE DESIGN & ENERGY EFFICIENCY

4.1 This section considers features of the proposal relevant to passive design and energy efficiencies aiming to reduce the energy demand, in line with the first step of the Energy Hierarchy.

Bioclimatic Design Measures

4.2 The opportunities that arise to incorporate the principles of bioclimatic design differ between sites and can be limited in a dense urban context such as this. It is considered that the proposed design makes optimum use of the site; and whilst the orientation of the new build terraced houses is determined by the boundaries of the site, the internal layout and elevations' design is in agreement with bioclimatic design principles.

4.3 As the Victorian warehouse shall be refurbished, it is only via the internal layout of the spaces that the design can make better use of natural resources on site; this limited opportunity has been exploited as much as possible. The comments below primarily concern the new build terraced houses.

Sunlight/Daylight

4.4 The primary living spaces (dining room, living room) are oriented to the southern elevation and shall benefit from increased solar gains in the winter.

4.5 The glazing areas on the southern elevation are significantly higher compared to the northern, so that the design optimises the sunlight availability and yields higher energy savings for space heating and lighting.

4.6 The glazing areas throughout shall offer high levels of daylight availability in spaces, promoting energy savings and most importantly, the health and well-being of occupants. Smaller glazing areas are designed for the northern elevation, to achieve a balance between the daylighting requirements and heat losses from this exposed elevation.

4.7 The glass louvres (with PV modules integrated) on the southern elevation shall offer a level of shading, protecting the spaces from summer overheating.

4.8 The same principles of design have been incorporated in the internal layout design of the flats in the Victorian warehouse; the living rooms are oriented to the southern elevation and the extent of glazing is considered adequate to offer high daylight levels in all spaces.

4.9 Overall it is considered that the proposed design of glazed areas offers a good balance between sunlight/daylight harvesting, winter heat losses via the glazing and summer overheating.

Natural Ventilation

4.10 It is anticipated that the residential properties will be predominantly ventilated naturally via openable windows and / or trickle vents. Cross-ventilation is anticipated, given the positioning of openable windows on opposite sides (southern, northern elevations), the relatively small depth of the floors and the exposed northern elevation to wind.

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

Natural Cooling

4.12 The gardens at both the front and rear of the homes shall offer natural cooling through evaporative cooling.

Passive Design Measures

4.13 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

4.14 It is intended that the performance of the building fabric will be highly insulated, i.e. incorporate relatively low U-Values to reduce the rate at which the buildings lose heat, therefore reducing the heating energy demand.

4.15 The U-values of fabric elements of the new build houses shall be enhanced compared to minimum Building Regulations standards PartL1A (2013); indicative upper limits are given in Table 4.1 below.

4.16 The U-values for the fabric of the Victorian Warehouse shall aim to achieve the '*improved'* standards of Building Regulations Part L2A (2013) subject to technical, functional and economic viability. Loft, ground floor and solid wall insulation shall be implemented to this effect.

Table 4.1 Proposed upper limits for U-values of the new build block of flats

Element	Building Regulations Max. U-Values [W/m^{2}K]	Proposed U-Values [W/m^{2}K]
Walls	0.30	0.16
Roof	0.20	0.14
Ground Floor	0.25	0.14

Windows	2.00	1.40

Thermal Bridging

4.17 Thermal bridging is the penetration of the insulation layer by a highly conductive non-insulating material allowing rapid heat transfer from an interior to exterior environment (and vice versa). In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges.

4.18 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 and it is proposed that construction joint details are calculated by a person with suitable expertise and experience. For the purposes of the proposed scheme, it is expected that the scheme will work to accredited construction details.

Air Leakage

4.19 A high level of air tightness is proposed and a level below $4m^3/h/m^2$ is targeted for the new build terraced houses, meaning that air infiltration between the internal and the external environment will be largely controlled and space heating demand further reduced.

4.20 Draught proofing, solid wall insulation and replacement of windows in the Victorian warehouse shall be employed to limit air leakage as much as possible.

Thermal Mass

4.21 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.

4.22 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. However, to maximise the benefits, consideration will be given to daytime occupation; particularly during winter months where, without this, 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.

4.23 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 house interior. For this scheme – where feasible- it is proposed to incorporate high thermal mass (e.g. by use of concrete decks and screed) in floors and ceilings for the new build terraced houses.

Energy Efficiency Measures

Efficient Heating

4.24 Individual heating systems running on gas shall be used for the houses and flats. The gas fired boilers shall have a seasonal efficiency in the order of 93-95% and have a factory insulated storage vessel.

4.25 Heat losses from the heat distribution network shall be further 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 in the residential spaces.

4.26 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.

Mechanical Ventilation

4.27 Potentially, the artist's workshop may require mechanical ventilation to maintain indoor air quality. Should this be the case, a highly efficient system shall be specified incorporating heat recovery and natural cooling feasibility; a specific fan power of ≤1.0W/(litre.s^{-1}) and heat recovery efficiency ~70% will be targeted.

Lighting

4.28 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; advanced lighting controls (e.g. daylight dimming with constant illuminance control) shall be considered for the artist's workshop and gallery space; display lighting shall be highly efficient.

Energy Monitoring & Display

4.29 Energy display devices are proposed for the new build terraced houses, which will monitor and display live data of gas and electricity consumption to occupants, promoting a behavioural change and further energy savings.

Overheating Mitigation

4.30 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.

4.31 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).

4.32 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:

- Solar shading is incorporated to the southern elevation of the new build terraced houses, via louvres; louvres installed above the roof shall also offer protection of the floors below;
- Natural ventilation and cross-ventilation shall be feasible;
- Thermal mass shall be incorporated;
- Soft landscaping shall provide natural cooling;
- The heating and hot water distribution pipework shall be limited and highly insulated.

5. DECENTRALISED & LOW CARBON ENERGY APPRAISAL

Connection to a Decentralised Energy Network

5.1 Decentralised energy networks generate and supply electricity, heating or cooling close to where it is used. The energy can be generated in the same building or a relatively short distance from where it is used and transmitted through pipes (generally as hot or cold water) or along cables. Decentralised energy is more carbon dioxide efficient than traditional energy sources due to the shorter distances the energy has to travel to where it is used.

5.2 The term applies to the network rather than the origins of the energy, which is normally either:

- Waste heat from power generation plants or other industrial processes;
- Waste heat from CHP plants or renewable energy technologies;
- Conventional centralised systems (boilers).

5.3 The extent of any carbon savings will be largely determined by the energy source.

Existing/Planned Networks

5.4 As discussed above, the site is not within the vicinity of an existing or planned district energy network; the site lies outside the 1km and 500m boundaries of existing/emerging or potential district energy networks. The London Heat map also confirms that there are no existing or planned district energy networks within its vicinity.

Feasibility / Viability

5.5 Connecting to an existing or allowing for the connection to a planned energy network is therefore not feasible. The energy strategy shall however be compatible with a future connection to a network, should this become available and subject to feasibility/viability considerations at the time; this is in consideration of the future growth of the West Hampstead Interchange area which might allow for the deployment of such networks.

On-site Combined Heat and Power

5.6 Combined Heat & Power (CHP) systems generate thermal and electrical energy; the waste heat resulting from electricity generation is captured and used to heat water which can be distributed to cover part of the space heating and hot water demand in developments. The capture and use of the heat means this method of generating electricity produces less carbon dioxide emissions than traditional power stations. CHPs are typically gas-powered but can be run off alternative fuel sources (e.g. biofuel).

5.7 CHP is usually applied at scale on the basis that their ability to modulate output is limited and that a greater number of potential users helps regulate the heating demand. Thermal storage can also be used to maximise the usage of the CHP.

Feasibility / Viability

5.8 The small scale of the development and the limited mix of uses (the development is pre-dominantly residential) do not render the CHP a viable solution. The heating demand would be comparatively small and both electricity/heating demands will be irregular throughout the day and characterised by short periods of peak demand and longer periods of negligible demand.

5.9 The potential impacts on amenity; primarily on air quality and secondarily noise and vibration in the specific dense urban context are also considered prohibitive to putting forward this solution.

5.10 On the grounds of viability and air quality considerations, a CHP is not considered an appropriate technology for the proposed scheme.

6. RENEWABLE ENERGY TECHNOLOGIES APPRAISAL

6.1 Renewable technologies are those which take their energy from sources which are considered to be inexhaustible (e.g. sunlight, wind etc.). Emissions associated with renewables are generally considered to be negligible and the technologies are frequently referred to as “zero carbon”.

6.2 Consideration of renewables represents the third tier of the Energy Hierarchy and this section discusses their feasibility for the proposed scheme.

Biomass Systems

6.3 Biomass systems typically burn wood pellets, chips or logs to provide warmth for a single room or to power central heating systems. Biomass is considered sustainable as long as new plant material is grown to replace that used for the fuel.

6.4 Whilst emissions exist in relation to cultivation, manufacture and transport, these are not factored into assessments for Building Control or planning on the basis that these are source specific and vary substantially.

6.5 Whilst technically feasible, biomass is not deemed economically viable or operationally appropriate for the subject site on the basis that the site is located in an urban environment and away from a readily available source of biomass.

Heat Pumps

6.6 Heat pumps draw thermal energy from the air, water or ground for use as either space or water heating. Heat pumps are generally considered as renewable (despite an electrical input) because the source for the heat is the ambient temperature in the exterior environment, which is ultimately heated via the sun. Heat pumps run on electricity and any carbon savings need to be established against the carbon content of the electricity consumption.

6.7 Typical co-efficients of performance (CoP) are in the order of 3 to 4.5 (i.e. for each unit of electrical energy required to operate the system, between 3 and 4.5 units of thermal energy are moved and released into the internal environment).

6.8 Reversible systems can provide air conditioning comfort cooling; however, when in cooling mode, the system is not considered renewable as it is not taking advantage of a renewable source of energy.

6.9 For the site, water source heat pumps are not considered feasible due to the absence of a conveniently located water body.

6.10 Ground source heat pumps, whilst technically feasible, have been rejected on the basis that they represent a higher capital expenditure than alternatives.

6.11 Air source heat pumps are considered a technically feasible option for the site, however, are more carbon intensive than an alternative strategy and are therefore not proposed.

Hydro-electrical

6.12 Hydro-electrical systems capture the energy of flowing water to produce electricity. The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir; when this is released it runs through a turbine, activating the generator of electricity. Some hydroelectric power plants just use a small canal to channel the river water through a turbine; these are more appropriate for applications in buildings.

6.13 No resources are available on site for the implementation of this type of renewable energy generation technology.

Solar Energy

6.14 Both solar thermal and photovoltaic (PV) systems convert energy from the sun into a form which can be applied within the building. Solar thermal generates energy for heating (usually for hot water) and PV generates electricity.

6.15 Solar thermal technology would normally be applied to hot water heating; however, a back-up system (typically gas-fired boilers) would normally be employed to make up short-falls. Whilst a feasible technology, solar thermal is not proposed as the competitive alternative of photovoltaics yields significantly higher carbon savings.

6.16 Photovoltaics are deemed technically feasible and viable and are proposed to be incorporated as part of the glass louvres installed on the southern elevation and above the roof level of the new build terraced houses.

6.17 Photovoltaics are not considered an option for the Victorian warehouse, however, as the only appropriate placement would be the southern facing slope of the pitched roof, which would have an adverse impact on the appearance of the building.

Wind Turbines

6.18 The Department of Energy and Climate Change has produced a Windspeed Database for the UK, which can be used as a resource for a preliminary assessment of the viability of wind systems.

6.19 The database was originally developed by the Department of Trade and Industry prior to 2001, drawing on information from the 1970s and 1980s. Whilst the database is no longer updated, it does provide a guide of likely windspeeds across the country. It is therefore a useful data source to allow a preliminary assessment of the viability of systems.

6.20 According to the database, the windspeed at 10m above ground level (agl) in the vicinity of the site is 4.8m/s. This windspeed is within the range for economic viability (~4.5m/s to ~19m/s); however, is at the lower end and may be subject to local variation and turbulence in the specific dense urban context.

6.21 Whilst a wind turbine is technically feasible, it is not the preferred option for the site on the basis that wind speeds are relatively low and the technology is likely to underperform.

7. ENERGY STRATEGY

7.1 The proposed energy strategy for the scheme at 11 Blackburn Road is based upon the current planning policy regime as detailed within the London Borough of Camden Council local plan; consideration has also been given to the CPG3 *Sustainability* supplementary planning document.

7.2 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 than through the use of low or zero carbon technologies.

7.3 Section 4 highlights the key proposed energy efficiency measures; and the feasibility study detailed in Sections 5 and 6 has highlighted that decentralised energy (via connection to a decentralised energy network or on-site CHP) is not suitable for the proposed development; and has promoted the use of photovoltaics to achieve the desired carbon savings.

7.4 The photovoltaics shall be incorporated in the glass louvres applied vertically in front of the southern elevation and horizontally above the roof level of the new build terraced houses. Photovoltaics are not considered an option for the Victorian warehouse as the only appropriate placement would be the southern facing slope of the pitched roof, which would have an adverse impact on the appearance of the building. The proposed approach therefore makes best use of the potential of the site for renewable energy generation.

7.5 The energy strategy for the new build houses shall reduce carbon emissions by ~21.4% against the Building Regulations 2013 Target Emission Rate (Part L1A TER), with ~20% of savings attributed to the renewable energy generation by the photovoltaics. Approximately 9.6kWp of photovoltaics shall be installed and the carbon savings shall amount to 2,780.0 kg CO_2/annum in total.

7.6 This level of performance will be consistent with the Core Strategy Policy CS13 preferred level of carbon savings from renewables (see paragraph 3.11).

7.7 The energy strategy for the Victorian warehouse shall comprise the implementation of energy efficiency measures (subject to feasibility and viability) with a focus on the upgrade of the fabric (i.e. solid wall insulation, draught proofing, loft and ground floor insulation). A substantial improvement of the current thermal performance can be expected; resulting in a low carbon, energy efficient building.

Carbon Savings

7.8 Energy modelling has been undertaken using SAP (output reports given in Appendix 2), and the carbon savings delivered by the proposed energy strategy have been estimated using these models.

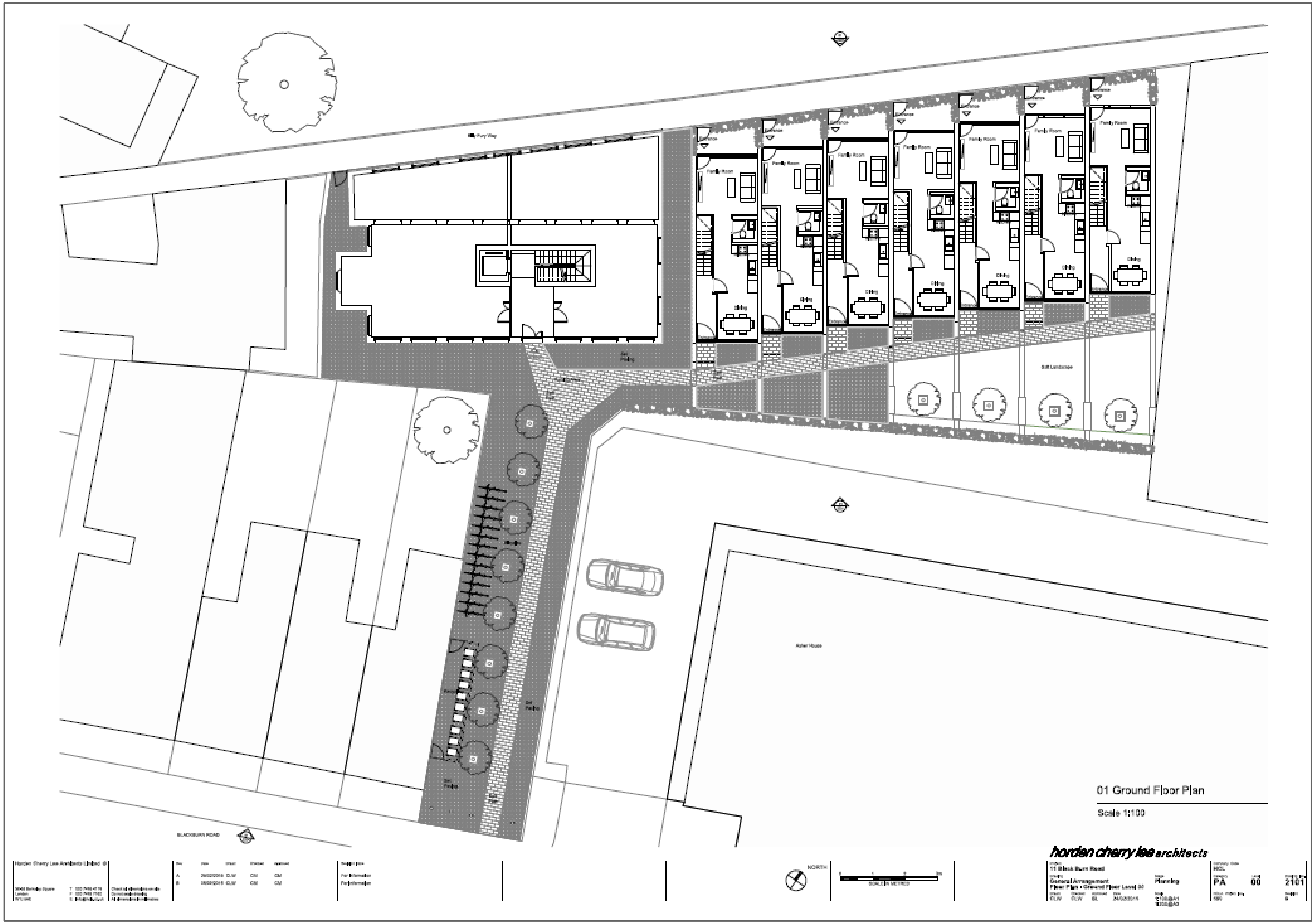
7.9 For the new build block of flats, the proposed energy strategy will yield ~20% carbon savings from renewables and overall carbon savings ~21% beyond the target emission rate (TER) of Part L1A 2013.

Table 7.1 The implementation of the energy hierarchy & estimated carbon savings for the new build terraced houses

The Energy Hierarchy Implementation for the new build terraced houses			
	Carbon Emissions [tonnes/annum]	Carbon Savings [tonnes/annum]	Carbon Savings [%]
Baseline (BR 2013 Part L Compliant)	12.99	n/a	n/a
Energy efficiency	12.78	0.21	1.62%
Efficient Supply/CHP	n/a	n/a	n/a
Renewable energy	10.21	2.570	20.11%
Total Carbon Savings	**2.78 tonnes/annum**		**21.40%**

7.10 Overall, the proposed energy strategy for 11 Blackburn Road is considered consistent with the National Planning Policy Framework and policies of the London Borough of Camden and, when implemented, will provide an efficient and low carbon development.

A1. SITE PLAN


01 Ground Floor Plan
Scale 1:100
hordencherrylee architects

A2. INDICATIVE ENERGY MODELLING RESULTS

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.16

Property Address: 11 Blackburn_Mid Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	36.4	(1a) x	2.95	(2a) =	107.38	(3a)
First floor	36.4	(1b) x	2.95	(2b) =	107.38	(3b)
Second floor	36.4	(1c) x	2.95	(2c) =	107.38	(3c)
Third floor	25.3	(1d) x	2.95	(2d) =	74.63	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	134.5	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		396.78	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.05	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.25	(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) =	0.19	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.25	0.24	0.24	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.22	0.23

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=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(24d)

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

(25)m=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(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			2.03	x	1.4	=	2.842			(26)
Doors Type 2			2.03	x	1.4	=	2.842			(26)
Windows Type 1			7.56	x1/[1/(1.4)+ 0.04]		=	10.02			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Windows Type 3			3.24	x1/[1/(1.4)+ 0.04]		=	4.3			(27)
Windows Type 4			5.04	x1/[1/(1.4)+ 0.04]		=	6.68			(27)
Floor			36.4	x	0.18	=	6.552001			(28)
Walls Type1	46.02	20.39	25.63	x	0.16	=	4.1			(29)
Walls Type2	46.02	33.89	12.13	x	0.16	=	1.94			(29)
Walls Type3	5.9	0	5.9	x	0.16	=	0.94			(29)
Roof	36.4	0	36.4	x	0.14	=	5.1			(30)
Total area of elements, m²			170.74							(31)
Party wall			168	x	0	=	0			(32)
Party wall			37.6	x	0	=	0			(32)

DER WorkSheet: New dwelling design stage

Internal floor	72.8			(32d)
Internal floor	25.3			(32d)
Internal ceiling	72.8			(32e)
Internal ceiling	25.3			(32e)

** 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) =	90.9	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13711.9	(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		12	(36)

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

Total fabric heat loss	(33) + (36) =	102.9	(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=	69.48	69.32	69.17	68.45	68.32	67.69	67.69	67.58	67.93	68.32	68.59	68.87	(38)

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

(39)m=	172.37	172.22	172.06	171.35	171.21	170.59	170.59	170.47	170.83	171.21	171.49	171.77	

Average = Sum(39)1…12 /12= 171.35 (39)

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

(40)m=	1.28	1.28	1.28	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.28	

Average = Sum(40)1…12 /12= 1.27 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.91 (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 — 103.21 (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=	113.53	109.41	105.28	101.15	97.02	92.89	92.89	97.02	101.15	105.28	109.41	113.53	

Total = Sum(44)1…12 = 1238.55 (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=	168.37	147.26	151.95	132.48	127.12	109.69	101.64	116.64	118.03	137.55	150.15	163.05	

Total = Sum(45)1…12 = 1623.93 (45)

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

(46)m=	25.26	22.09	22.79	19.87	19.07	16.45	15.25	17.5	17.7	20.63	22.52	24.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 195 (47)

Stroma FSAP 2012 Version: 1.0.1.16 (SAP 9.92) - http://www.stroma.com   Page 3 of 8

DER WorkSheet: New dwelling design stage

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)

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

(61)m=	50.96	46.03	50.96	49.32	49.44	45.81	47.34	49.44	49.32	50.96	49.32	50.96	(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=	219.33	193.28	202.91	181.79	176.56	155.5	148.98	166.08	167.35	188.51	199.47	214.01	(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=	219.33	193.28	202.91	181.79	176.56	155.5	148.98	166.08	167.35	188.51	199.47	214.01	

Output from water heater (annual)1…12 2213.77 (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=	68.72	60.47	63.26	56.38	54.63	47.92	45.63	51.14	51.57	58.48	62.25	66.96	(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=	145.29	145.29	145.29	145.29	145.29	145.29	145.29	145.29	145.29	145.29	145.29	145.29	(66)

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

(67)m=	27.02	24	19.52	14.78	11.04	9.32	10.08	13.1	17.58	22.32	26.05	27.77	(67)

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

(68)m=	303.07	306.21	298.29	281.41	260.12	240.1	226.73	223.58	231.51	248.38	269.68	289.69	(68)

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

Stroma FSAP 2012 Version: 1.0.1.16 (SAP 9.92) - http://www.stroma.com   Page 4 of 8

DER WorkSheet: New dwelling design stage

(69)m=	37.53	37.53	37.53	37.53	37.53	37.53	37.53	37.53	37.53	37.53	37.53	37.53	(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=	-116.23	-116.23	-116.23	-116.23	-116.23	-116.23	-116.23	-116.23	-116.23	-116.23	-116.23	-116.23	(71)

Water heating gains (Table 5)

(72)m=	92.37	89.98	85.03	78.3	73.42	66.56	61.33	68.74	71.63	78.6	86.46	89.99	(72)

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

(73)m=	492.04	489.78	472.42	444.08	414.17	385.57	367.72	375.01	390.3	418.88	451.78	477.04	(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)	
Southeast 0.9x	0.77	x	7.56	x	36.79	x	0.63	x	0.8	=	97.15	(77)
Southeast 0.9x	0.77	x	8.1	x	36.79	x	0.63	x	0.8	=	312.28	(77)
Southeast 0.9x	0.77	x	3.24	x	36.79	x	0.63	x	0.8	=	41.64	(77)
Southeast 0.9x	0.77	x	5.04	x	36.79	x	0.63	x	0.8	=	194.31	(77)
Southeast 0.9x	0.77	x	7.56	x	62.67	x	0.63	x	0.8	=	165.49	(77)
Southeast 0.9x	0.77	x	8.1	x	62.67	x	0.63	x	0.8	=	531.93	(77)
Southeast 0.9x	0.77	x	3.24	x	62.67	x	0.63	x	0.8	=	70.92	(77)
Southeast 0.9x	0.77	x	5.04	x	62.67	x	0.63	x	0.8	=	330.98	(77)
Southeast 0.9x	0.77	x	7.56	x	85.75	x	0.63	x	0.8	=	226.43	(77)
Southeast 0.9x	0.77	x	8.1	x	85.75	x	0.63	x	0.8	=	727.81	(77)
Southeast 0.9x	0.77	x	3.24	x	85.75	x	0.63	x	0.8	=	97.04	(77)
Southeast 0.9x	0.77	x	5.04	x	85.75	x	0.63	x	0.8	=	452.86	(77)
Southeast 0.9x	0.77	x	7.56	x	106.25	x	0.63	x	0.8	=	280.56	(77)
Southeast 0.9x	0.77	x	8.1	x	106.25	x	0.63	x	0.8	=	901.79	(77)
Southeast 0.9x	0.77	x	3.24	x	106.25	x	0.63	x	0.8	=	120.24	(77)
Southeast 0.9x	0.77	x	5.04	x	106.25	x	0.63	x	0.8	=	561.11	(77)
Southeast 0.9x	0.77	x	7.56	x	119.01	x	0.63	x	0.8	=	314.25	(77)
Southeast 0.9x	0.77	x	8.1	x	119.01	x	0.63	x	0.8	=	1010.08	(77)
Southeast 0.9x	0.77	x	3.24	x	119.01	x	0.63	x	0.8	=	134.68	(77)
Southeast 0.9x	0.77	x	5.04	x	119.01	x	0.63	x	0.8	=	628.49	(77)
Southeast 0.9x	0.77	x	7.56	x	118.15	x	0.63	x	0.8	=	311.97	(77)
Southeast 0.9x	0.77	x	8.1	x	118.15	x	0.63	x	0.8	=	1002.78	(77)
Southeast 0.9x	0.77	x	3.24	x	118.15	x	0.63	x	0.8	=	133.7	(77)
Southeast 0.9x	0.77	x	5.04	x	118.15	x	0.63	x	0.8	=	623.95	(77)
Southeast 0.9x	0.77	x	7.56	x	113.91	x	0.63	x	0.8	=	300.78	(77)
Southeast 0.9x	0.77	x	8.1	x	113.91	x	0.63	x	0.8	=	966.78	(77)
Southeast 0.9x	0.77	x	3.24	x	113.91	x	0.63	x	0.8	=	128.9	(77)
Southeast 0.9x	0.77	x	5.04	x	113.91	x	0.63	x	0.8	=	601.55	(77)

Stroma FSAP 2012 Version: 1.0.1.16 (SAP 9.92) - http://www.stroma.com Page 5 of 8

DER WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	x	7.56	x	104.39	x	0.63	x	0.8	=	275.64	(77)
Southeast 0.9x	0.77	x	8.1	x	104.39	x	0.63	x	0.8	=	885.99	(77)
Southeast 0.9x	0.77	x	3.24	x	104.39	x	0.63	x	0.8	=	118.13	(77)
Southeast 0.9x	0.77	x	5.04	x	104.39	x	0.63	x	0.8	=	551.29	(77)
Southeast 0.9x	0.77	x	7.56	x	92.85	x	0.63	x	0.8	=	245.18	(77)
Southeast 0.9x	0.77	x	8.1	x	92.85	x	0.63	x	0.8	=	788.06	(77)
Southeast 0.9x	0.77	x	3.24	x	92.85	x	0.63	x	0.8	=	105.08	(77)
Southeast 0.9x	0.77	x	5.04	x	92.85	x	0.63	x	0.8	=	490.35	(77)
Southeast 0.9x	0.77	x	7.56	x	69.27	x	0.63	x	0.8	=	182.9	(77)
Southeast 0.9x	0.77	x	8.1	x	69.27	x	0.63	x	0.8	=	587.9	(77)
Southeast 0.9x	0.77	x	3.24	x	69.27	x	0.63	x	0.8	=	78.39	(77)
Southeast 0.9x	0.77	x	5.04	x	69.27	x	0.63	x	0.8	=	365.8	(77)
Southeast 0.9x	0.77	x	7.56	x	44.07	x	0.63	x	0.8	=	116.37	(77)
Southeast 0.9x	0.77	x	8.1	x	44.07	x	0.63	x	0.8	=	374.04	(77)
Southeast 0.9x	0.77	x	3.24	x	44.07	x	0.63	x	0.8	=	49.87	(77)
Southeast 0.9x	0.77	x	5.04	x	44.07	x	0.63	x	0.8	=	232.74	(77)
Southeast 0.9x	0.77	x	7.56	x	31.49	x	0.63	x	0.8	=	83.14	(77)
Southeast 0.9x	0.77	x	8.1	x	31.49	x	0.63	x	0.8	=	267.25	(77)
Southeast 0.9x	0.77	x	3.24	x	31.49	x	0.63	x	0.8	=	35.63	(77)
Southeast 0.9x	0.77	x	5.04	x	31.49	x	0.63	x	0.8	=	166.29	(77)

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

(83)m=	645.38	1099.32	1504.14	1863.7	2087.5	2072.4	1998.02	1831.05	1628.66	1214.98	773.02	552.31	(83)

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

(84)m=	1137.42	1589.1	1976.56	2307.78	2501.67	2457.98	2365.74	2206.06	2018.97	1633.87	1224.79	1029.36	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.9	0.78	0.61	0.44	0.32	0.35	0.56	0.86	0.98	0.99	(86)

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

(87)m=	19.81	20.16	20.52	20.81	20.95	20.99	21	21	20.97	20.74	20.19	19.73	(87)

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

(88)m=	19.86	19.86	19.86	19.86	19.86	19.87	19.87	19.87	19.86	19.86	19.86	19.86	(88)

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

(89)m=	0.99	0.96	0.88	0.73	0.54	0.36	0.24	0.27	0.48	0.81	0.97	0.99	(89)

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

(90)m=	18.3	18.8	19.29	19.67	19.82	19.86	19.87	19.87	19.85	19.6	18.86	18.19	(90)

fLA = Living area ÷ (4) = 0.21 (91)

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

(92)m=	18.62	19.09	19.56	19.91	20.06	20.1	20.11	20.11	20.09	19.84	19.14	18.52	(92)

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

Stroma FSAP 2012 Version: 1.0.1.16 (SAP 9.92) - http://www.stroma.com Page 6 of 8

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.62	19.09	19.56	19.91	20.06	20.1	20.11	20.11	20.09	19.84	19.14	18.52		(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=	0.98	0.95	0.87	0.73	0.55	0.38	0.25	0.29	0.5	0.81	0.96	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	1120	1505.39	1720.16	1687.04	1383.26	931.89	597.51	630.6	1000.72	1322.15	1177.98	1018.63		(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=	2468.71	2443.71	2246.32	1886.34	1431.31	938.51	598.26	631.94	1022.61	1582.52	2065.19	2459.7		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	1003.44	630.55	391.47	143.5	35.75	0	0	0	0	193.71	638.79	1072.16		
Total per year (kWh/year) = Sum(98)1...5,10...12 =													4109.37	(98)
Space heating requirement in kWh/m²/year													30.55	(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) x [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		95.8	(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)														
	1003.44	630.55	391.47	143.5	35.75	0	0	0	0	193.71	638.79	1072.16		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	1047.43	658.2	408.63	149.79	37.31	0	0	0	0	202.21	666.79	1119.16		
Total (kWh/year) =Sum(211)1...5,10...12=													4289.53	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)
Water heating														
Output from water heater (calculated above)														
	219.33	193.28	202.91	181.79	176.56	155.5	148.98	166.08	167.35	188.51	199.47	214.01		
Efficiency of water heater													86.5	(216)
(217)m=	93.99	93.44	92.41	90.37	87.94	86.5	86.5	86.5	86.5	90.98	93.41	94.12		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	233.36	206.85	219.58	201.16	200.77	179.77	172.23	192	193.46	207.21	213.54	227.39		
Total = Sum(219a)1...12 =													2447.33	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4289.53

DER WorkSheet: New dwelling design stage

Water heating fuel used			2447.33	
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			477.16	(232)
Electricity generated by PVs			-667.74	(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	0.216	=	926.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	528.62	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1455.16	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	247.64	(268)
Energy saving/generation technologies Item 1		0.519	=	-346.56	(269)
Total CO2, kg/year	sum of (265)…(271) =			1395.17	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			10.37	(273)
EI rating (section 14)					(274)

A3. GENERAL NOTES

A3.1 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 Iceni Projects Ltd for inaccuracies in the data supplied by any other party.

A3.2 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.

A3.3 No site visits have been carried out, unless otherwise specified.

A3.4 This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in guidance may necessitate a re-interpretation of the report in whole or in part after its original submission.

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