DEMOLITION OF EXISTING SCHOOL BUILDINGS AND CONSTRUCTION OF THREE NEW DWELLINGS, FIVE CONVERSION DWELLINGS AND ONE CONVERSION OFFICE TOGETHER WITH CAR PARKING AT THE OLD SCHOOL, PARK LANE, RICHMOND, TW9 2RA

SUSTAINABILITY AND ENERGY STRATEGY STATEMENT

MONITOR energy consultancy

August 2014

THE HALEBOURNE GROUP LIMITED

Architect: The Halebourne Group Limited

Property:

Demolition of Existing School and Construction of Five Conversion Dwellings, One Conversion Office and Three New Dwellings together with Car Parking

The Old School, Park Lane, Richmond, TW9 2RA

Issue: 2

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1.0 BRIEF

Monitor Energy Consultancy were instructed by Maze Planning on behalf of The Halebourne Group Limited, the Clients, to undertake a Sustainability and Renewable Energy assessment, to appraise how the proposed development at The Old School, Park Lane, Richmond, TW9 2RA will respond to the London Borough of Richmond Upon Thames Sustainable Development Checklist. The purpose of the report is as follows:

To demonstrate how the development will reduce the carbon emissions through the provision of on-site renewable energy and how the development will meet conservation measures, sustainable drainage and water conservation requirements and the re-use of the existing materials of the demolished areas of the development to comply with the requirements of the London Borough of Richmond Upon Thames Supplementary Planning Document "Sustainable Construction Checklist Guidance Document" adopted August 2011 and the Mayor's London Plan 2011. These requirements are that a reduction of 20% carbon emissions is achievable from both regulated and unregulated emissions. This will also relate to the requirement to achieve Code for Sustainable Homes Level 4 for the Energy Ene1 category and Code for Sustainable Homes Level 3 for the remaining categories.

1.1 Approach

The clients approach, via the architects, to sustainable development is to first improve the energy efficiency of the building to the requirements of 25% better than the current Building Regulations. This follows the most recognised method of achieving sustainability through the energy hierarchy:

Use less energy (be lean).

Use renewable energy (be green).

Supply energy efficiently (be clean).

This appraisal demonstrates that by adopting the above approach, a 19% reduction in carbon emissions to the current Building Regulations will be achieved, including both regulated and unregulated emissions. This is also to the standards set by the Code for Sustainable Homes Level 4.

A detailed appraisal of all practical renewable technologies has been undertaken and the use of photovoltaic thermal panels has been adopted for the development. The primary advantages of these systems are as follows:

- Proven and well recognised technologies with limited requirements for future maintenance.
- A visible indication of the sustainability credentials of the development.
- Can be easily upgraded in the future to provide more hot water or electricity; particularly relevant with the implementation of Feed-in Tariffs and Renewable Heat Incentives.

This appraisal demonstrates that by the adoption of the strategy of incorporating energy efficient measures, the overall reduction in carbon emissions through the use of onsite renewable technology in the form of photovoltaic thermal panels is **7612.24 kgCO2/yr**

The extent of photovoltaic thermal panels will be drawn on to the elevations and when in use will provide a visible indication of the development's sustainable credentials.

Water efficient fittings to sanitary and kitchen fittings and water butts within the rear garden are proposed to achieve at least the minimum standards of compliance as required by the Code for Sustainable Homes Level 3/4 rating which clearly demonstrates a commitment to water conservation.

2.0 EXECUTIVE SUMMARY

2.1 Site Description

The demolition, careful removal of existing features for replacement and the erection of eight dwellings, one office, car parking facilities, landscaping and access drive on the site of The Old School, Park Lane, Richmond, TW9 2RA. The site is classified as a brownfield site as it is new dwellings built on the site of an existing school in a residential area which makes optimum use of the land available, in terms of site coverage and height and does not prevent other land coming forward for development in the future and helps to achieve a comprehensively planned development framework. The site is not in an open land area; is in an air quality management area (AQMA); is not in a District Heating Opportunity Area (DHOA); has no hazardous substances present; is not contaminated and is not in an area designated as on an archaeological site or monument.

This report basically demonstrates that the calculated minimum 20% carbon dioxide emissions (including both regulated and unregulated emissions,) to be off-set by on-site renewables for this development is **7612.24 kg CO2 /yr.**

2.2 Proposed Development

The proposed development comprises three new build houses, built as a terrace, and five dwellings and one office formed as a conversion of the existing school building, constructed with traditional brick cavity walls and slate tile roof areas. The proposed new driveway and paved areas will be constructed with permeable materials to reduce the surface water run-off potential. The waste materials from the demolition of the existing school will be re-used where possible and the remainder sent for recycling and not to landfill.

The energy performance of the proposed three new dwellings has been assessed for the base line requirement of compliance with Part L1A of the 2013 Building Regulations and the five conversion dwellings and one conversion office assessed with the minimum compliance standards set out in Part L1B of the 2010 Building Regulations. With the appropriate measures incorporated this report demonstrates that it will achieve minimum Building Regulations and therefore Code for Sustainable Homes Level 3 for energy.

To assess the 20% site wide carbon emissions to be off-set by on site renewable energy, the unregulated loads for each dwelling were calculated using the Code for Sustainable Homes Ene7 calculator and tabulated to the regulated HVAC loads calculated using SAP 2012.

The potential benefits of additional energy efficiency measures have been proportionally assessed across each group of dwellings together with the further improvements that can be achieved using low and zero carbon technologies in order to achieve the 20% carbon off-set required by the London Borough of Richmond Upon Thames and the 19% improvement over minimum Building Regulations 2013 standards to achieve a Code for Sustainable Homes Level 4 for the Energy Category.

The energy strategy comprises passive and low energy design measures including:

- Enhanced thermal performance to the floor, external walls and roof types.
- High performance double glazed windows and doors.
- High efficiency gas fired boiler with sophisticated controls.
- Low air permeability rate.
- Use of 100% low energy lighting.

In addition, the new dwellings (Units 7-9) will be provided with individual extract ventilation fans whilst the conversion dwellings (Units 2–6) and the conversion office (Unit 1) will be provided with individual extract fans. Photovoltaic thermal panels will be provided to the South facing roof slopes and concealed flat roof area.

Sufficient roof space is available on the development to accommodate photovoltaic panels and it is therefore proposed that sloping and horizontal PV arrays comprising of 109 photovoltaic panels be installed to generate **18.31** kWp of renewable energy. This would off-set **7612.24 kg CO2 per year** (7.61 tonnes CO2 per year) across the development, refer to Section 5.

The summary of carbon emission and energy results is provided in section 6 which includes the overall area weighted average CO2 savings expected as a result of incorporating all energy reduction measures.

All other matters are covered by comparison with the appropriate category as defined by the current version of the Code for Sustainable Homes which provides the latest Government advice to help deliver sustainable development with low carbon emissions in the housing sector. (Source – London Borough of Richmond upon Thames Council SPD Sustainable Construction Checklist Guidance Document adopted August 2011).

2.3 Relevant Policies, Strategies and Guidance

2.3.1 UK Government Strategy Documents

A series of Planning Policy Statements (PPS) and Planning Policy Guidance notes (PPG) are relevant to the sustainability and energy appraisal. These include the following:

- National Planning Policy Framework
- The Housing Green Paper
- PPS1 - Delivering Sustainable Development
- Planning and Climate Change supplement to PPS1
- PPS7 - Sustainable Development in Rural Areas
- PPS10 - Planning for Sustainable Waste Management
- PPS22 - Renewable Energy

Key aspects of these documents are shown in **Appendix A**

2.3.2 London Borough of Richmond upon Thames Planning Policies

The following documents set out the planning policies relevant for the Sustainable Construction Checklist SPD:

- Richmond Core Strategy (April 2009)
- Richmond Development Management Plan (DMP) (emerging, 2011)
- London Plan, Consolidated with Alterations since 2004 (February 2008)
- London Plan (emerging replacement plan, October 2009)

Minimum Policy Compliance

Environmental rating:

- Richmond Core Strategy CP1 Sustainable Development
- Richmond DMP Policy DM SD 1 Sustainable Construction
- Richmond DMP Policy DM SD 2 Renewable Energy and Decentralised Energy networks
- London Plan (LP) Policy 4A.3 Sustainable Design and Construction

Energy Assessment:

- London Plan Policy 4A.4 Energy assessment

Carbon Dioxide emissions reduction:

- Richmond Core Strategy CP2 Reducing Carbon Emissions
- Richmond DMP Policy DM SD 1 Sustainable Construction
- Richmond DMP Policy DM SD 2 Renewable Energy and Decentralised Energy Networks
- LP Policy 4A.3 Sustainable design and construction
- LP Policy 4A.5 Provision of heating and cooling networks
- LP Policy 4A.6 Decentralised Energy: Heating, Cooling and Power
- LP Policy 4A.7 Renewable Energy
- LP Policy 4A.8 Hydrogen Economy

Energy Use and Pollution/ Need for Cooling:

- Richmond Core Strategy CP1 Sustainable Development
- Richmond Core Strategy CP2 Reducing Carbon Emissions
- Richmond DMP Policy DM SD 4 Adapting to Higher Temperatures and Need for Cooling
- Richmond DMP Policy DM SD 5 Living Roofs
- LP Policy 4A.3 Sustainable design and construction

3.0 PLANNING REQUIREMENTS

3.1 Introduction

This section of the report identifies the design measures that will be implemented by the clients in order to meet the requirements of the London Borough of Richmond upon Thames' Sustainable Construction Checklist SPD adopted on 13 August 2011. This can best be demonstrated by referring to the relevant sections of the Code for Sustainable Homes (CSH) which provides the latest Government advice to delivering sustainable development with low carbon emissions in the housing sector. It sets standards for achieving energy and water efficient buildings focusing on a high quality, highly insulated building shell with low air permeability taking advantage of passive solutions before the addition of active or renewable features:

- high levels of insulation
- low levels of air-permeability
- passive solar design strategies
- low energy lighting
- the use of environmentally benign materials
- low water use sanitary ware
- rainwater harvesting

3.2 Design Philosophy

The design intention for the new dwellings (units 7-9) is to maximise the potential of the South facing facade to harness useful solar gains in order to reduce the heating requirement. The thermal performance of the building fabric is to be enhanced by increasing insulation beyond the requirements of current Building Regulations, accredited details are to be adopted to reduce cold bridging and to achieve low design air permeability rates. For all units, energy efficient heating, ventilation and lighting systems are to be incorporated.

General design philosophy for Code Level 3 homes is to keep the same basic specification throughout the dwellings for simplicity. In this case, the new dwellings will all have the same basic specification throughout for each dwelling. Similarly, the conversion dwellings (Units 2-6) and the conversion office (Unit 1) will share the same specification. The intention is that every floor, wall, roof and window detail will be consistent for each part of the development. This specification employs U values as per the schedule described in Section 6.1 of the report which enables Building Regulations to be achieved under Part L1A or Part L1B as appropriate.

Water efficient fittings to sanitary and kitchen fittings and water butts within garden areas are proposed to achieve at least the minimum standards of compliance as required by the Code for Sustainable Homes Level 3 and 4 (105 litres/per person/day) rating which clearly demonstrates a commitment to water conservation.

3.3 Code Requirements

The main commentary on these design measures applicable to the requirements for planning are included below and are discussed in relation to each relevant section of the CSH.

3.3.1 Energy

The clients have adopted the most recognised sustainable strategy for achieving Code ratings which adopts the following principles as based on the current version of the Code:

- Improve building fabric and insulation levels.
- Carefully detail all building junctions to reduce heat loss and air leakage.

- Introduce energy efficient technologies.

ENE1 Dwelling Emission Rate

This element is mandatory and now mirrors Part L1A which changed in October 2013. The requirement of 19% improvement of the DER over the TER for Code Level 4 will be attained without a single credit in the new scoring system. This is because the latest version of Part L1A seeks to reduce CO2 emissions from new homes compared with pre October 2013 standards. Methods of reaching these standards are detailed within the energy efficiency section.

ENE2 Fabric Energy Efficiency

This element is mandatory, in the latest version of the Code the heat loss parameter has been dropped in favour of the term "FEES" measured in kWh/m2/yr. The methods of reaching this standard have been covered within the energy efficiency section.

ENE3 Energy Display Devices

This is not a mandatory element but is considered to be an important aspect of improving householders understanding of energy use.

ENE4 Drying Space

A secure drying space will be provided either within the rear garden areas or by the use of proprietary and appropriately sized indoor drying lines.

ENE5 Provision of A+ white goods

All white goods provided will be A+ rated wherever possible as part of the sustainability strategy.

ENE6 External Lighting

This is not a mandatory element but all external lighting will be energy efficient.

Where security light fittings are designed for energy efficiency, these will be adequately controlled, all burglar security lights will have a maximum wattage of 150W, movement detecting control devices (PIR) and daylight cut-off sensors. All other security lighting will have dedicated energy efficient fittings and will be fitted with daylight cut-off sensors or timers.

ENE7 Renewable Technologies

This is achieved where the site wide renewable strategy, in combination with the requirements to reduce energy demand for the dwelling, ensures that there is a 20% reduction in CO2 through renewable technology.

This technology must be covered by the Microgeneration Certification Scheme (MCS) and that it is installed by MCS accredited installers. Only systems approved by this scheme have been incorporated within the development.

ENE8 Cycle Storage

The clients are committed to providing an appropriate level of cycle storage. The architect is to ensure that all the cycle storage is provided and is Code compliant and is all accessible without having to take bikes through the property. Minimum storage space required for the Code is provided and is at least as per below:

1 cycle: 2m long x 0.75m wide.
2 cycles: 2m long x 1.5m wide.
4 cycles: 2m long x 2.5m wide.

ENE9 Home Office

This is not a mandatory element but the architect has incorporated a designated study as an appropriate space for a home office within the floor plans where the following criteria are met:

A minimum 1.8m wall length to allow a desk, chair and filing cabinet or bookshelf to be installed, with space to move around the front and side of the desk, use the chair appropriately and operate the filing cabinet safely.
Two double power sockets.
Two telephone points (or double telephone point) or one telephone point where the dwelling is connected to cable or broadband is available at the address.
Adequate daylighting from nearby windows. The detailed calculations will be undertaken at a later stage but typically the location of the home office space has been located close to available windows.

3.3.2 Water

WAT1 Internal Water Use

This element is mandatory and Part G of the Building Regulations, which came into force in April 2010, will generally allow compliance with Code Level 3 of the CSH. This limits the potable internal water use to less than 105 litres per person per day.

As the scheme progresses towards construction, the detailed specifications of sanitary fittings will be developed with the clients to ensure compliance with this element and will be calculated using the Water Efficiency Calculator for new dwellings. This is the Government's National calculation method for the assessment of water efficiency in new dwellings in support of Building Regulations Part G 2009 and the Code for Sustainable Homes April 2009 and subsequent versions. The calculator assesses the contribution that each internal water fitting (micro component) has on whole house water consumption, measured in litres per person per day based on research into typical water use.

WAT2 External Water Use

This is not a mandatory element but the clients are committed to providing water butts in the private garden areas. Minimum storage volume requirements for homes with individual gardens, patios and terraces are as below:

- Terraces and patios – 100 litres minimum
- 1 – 2 bedroom home with private garden – 150 litres minimum
- 3+ bedroom home with private garden – 200 litres minimum

The specification of the rainwater collector provided by the clients will ensure compliance with the following criteria:

- No open access at the top of the collector (a childproof lid is allowed).
- Provision of a tap or other arrangement for drawing off water.
- Connection to the rainwater downpipes with an automatic overflow into the conventional rainwater drainage system.
- A means of detaching the rainwater downpipe and access provision to enable cleaning of the interior.
- Where the collection system is to be sited outside and not buried, it must be stable and adequately supported; the material used for the container shall be durable and opaque to sunlight.

3.3.3 Materials

MAT1 Environmental Impact of Materials

This is a mandatory element and the clients are committed to reducing the environmental impact of their building materials. The clients will achieve this through the sourcing of materials to achieve a Green Guide rating of between A+ and D, for the following five elements of the building envelope:

Roof
External Walls
Internal Walls
Upper and Ground Floors
Windows

As the scheme progresses to construction, a detailed specification list will be provided by the Client's technical team in conjunction with their buying team and drawings clearly marking the location and area of the elements and the details of the materials used within the elements will be prepared. This will allow the Code Mat 1 Calculator Tool to be utilised to demonstrate compliance.

MAT2 Responsible Sourcing of Basic Building Materials

This is not a mandatory element although the clients are committed to responsibly resourcing all building materials.

MAT3 Responsible Sourcing of Finishing Materials

This is not a mandatory element although the clients are committed to responsibly resourcing all building materials.

3.3.4 Surface Water Run-Off

SUR1 Surface Water Run-off

The client is committed to design the surface water drainage for this project which avoid, reduce and delay the discharge of rainfall run-off to watercourses and public sewers using SuDS techniques. This will protect receiving waters from pollution and minimise the risk of flooding and other environmental damage in watercourses. The criteria for this category will be followed.

The driveway, paths and paved areas will utilise permeable materials which will also minimise the site surface water run-off.

SUR2 Flood Risk

This element is achievable as the site is not in an area of flood risk.

3.3.5 Waste

A waste strategy for construction and in use will be prepared for this development and will demonstrate compliance with the following criteria:

WAS1 Storage of Household Waste

This element is mandatory and as the scheme progresses, the layouts will demonstrate how there is adequate space allocated for waste storage complying with the criteria. Internally, recyclable household waste is sorted before collection and at least three separate bins are provided with 30 litres total capacity. Every bin provided should have at least 7 litres capacity and be located in an adequate internal space which is not a free standing bin in the kitchen.

WAS2 Site Waste Management Plans

This element is not now mandatory and the client will prepare a detailed SWMP as the scheme progresses towards construction. This SWMP will take account of the materials arising from the demolition works etc. and also for disposal of site waste as it occurs and generally diverting from landfill.

WAS3 Composting

This element is not mandatory but will be achieved through the three bin collection system, which means that green/kitchen waste is collected by the Council. This means that this credit can be awarded by default as we are providing suitable internal storage.

3.3.6 Pollution

POL1 Global Warming Potential

This element is not mandatory but the clients will ensure that the insulation materials do not have a negative environmental impact during manufacture. All insulation products that arrive on site can be confirmed as having a GWP less than 5.

POL2 NOx Emissions

The clients will install gas boilers with low NOX emissions and Class 5.

3.3.7 Health and Wellbeing

HEA1 Daylighting

The daylighting calculations will be undertaken and it is likely that the dwellings will attain the requirements by ensuring adequate daylight factor in the kitchen, living room, dining room and study/home office.

HEA2 Sound Insulation

The dwellings will be designed and tested to achieve the sound insulation standards required by the current Building Regulations.

HEA3 Private Space

All of the dwellings incorporate a private space with the following criteria:

- A minimum size that allows all occupants to sit outside.
- Allows easy access to all occupants, including wheelchair users.
- Accessible only to occupants of the dwelling.

HEA4 Lifetime Homes –Lifetime Homes credits will not be sought.

3.3.8 Management

MAN1 Home User Guide
This element is not mandatory but the clients are committed to providing a Home User Guide, compiled using *Checklist Man 1 Part.* The Home User Guide will be provided in an appropriate format for users. This might include translation into foreign languages, braille, large print or audio CD. In summary the Home User Guide will contain information pertaining to:

Part 1
a) Environmental strategy/ design and features.
b) Energy Efficiency Information.
c) Water Use.
d) Waste and Recycling.
e) Sustainable DIY
f) Emergency Information.
g) References/ Further information.
h) Alternative formats.

Part 2
a) Recycling.
b) SUDs.
c) Public Transport.
d) Local Amenities.
e) Responsible Purchasing.
f) Emergency Information.

g) References/ Further Information.

MAN2 Considerate Constructors Scheme

The clients or their contractor will sign up to the Considerate Constructors Scheme and the site will be appropriately audited to achieve the Checklist Man 2 items and score.

MAN3 Construction Site Impacts

The clients or their contractor will maintain a record of on on-site water usage and diesel consumption for this section. Additionally monitoring CO2 emissions of all delivery staff and sub-contractors vehicles will be considered as the scheme progresses towards construction.

MAN4 Security

This credit is attained through the requirement of the LPA and the Design Guide to ensure that the requirements of Secured by Design are considered in the development of the scheme.

3.3.9 Ecology

ECO1 Ecological Value of Site – A report must be provided by a qualified ecologist

ECO2 Ecological Enhancement – A report must be provided by a qualified ecologist and recommendations followed.

ECO 3 Protection of Ecological Features

All existing features of ecological value on the development site potentially affected by the works will be maintained and adequately protected during site clearance, preparation and construction works.

ECO4 Change in Ecological Value of Site – A report must be provided by a qualified ecologist and recommendations followed.

ECO5 Building Footprint – Not applicable

Code Pre-Assessment

To demonstrate compliance with the CSH we have undertaken the pre-assessment sheets for the dwellings and these are included within **Appendix D**. As the scheme progresses to detailed design, the formal assessments will be undertaken using the appropriate version of CSH and SAP. To summarise the approach we have included the CSH assessments for these 8 number two and three bed terraced houses in **Appendix D** which all achieve a credit score of >**57**% which represent a PASS for Level 3. It will be noted that the Energy Category of the CSH must achieve Level 4.

4.0 WATER EFFICIENCY

To help reduce the burden on the local water resources, a series of water efficiency measures are being proposed on the development. A water use of 105 litres/person/day is targeted which is the equivalent required for Code for Sustainable Homes Level 3/4 housing.

The water efficiency measures being considered are as follows and as the scheme progresses to detailed design the clients will review the strategy in detail:

Low use aerated taps;
Baths with a limited volume of 150 litres;
Showers limited to 6 l/min;
Dual flush low volume toilets with a 6/4 litre capacity;
Water butts within rear gardens.

Through the use of the Water Efficiency Calculator for new dwellings, the above strategy will achieve at least Code for Sustainable Homes Level 3/4 with regards to water. With the implementation of the above strategy, the development will be seen to be actively promoting water efficiency.

5.0 ENERGY EFFICIENCY STATEMENT

5.1 Introduction

5.1.1 Purpose

The purpose of this section of the document is to explain the energy strategy proposed for the proposed development at The Old School, Park Lane, Richmond, TW9 2RA. The report provides details of the energy assessment for the eight residential dwellings and one office explaining the energy efficiency measures together with assessment of potential low and zero carbon technologies.

5.1.2 Proposed Development

The Client proposes to construct eight 2 storey residential dwellings of 2 and 3 bedroom types and one office together with car parking facilities.

5.1.3 Background Policy Documents

Refer to Sections 2.3.1 and 2.3.2.

5.1.4 Disclaimer

This report has been prepared solely for the use of the Client, and Monitor energy consultancy accept no responsibility for its use by any third parties.

5.2 Approach

The basic approach for the energy strategy is as follows:

1. Establish the baseline energy demand in line with statutory requirements in terms of Building Regulations compliance.
2. Adopt passive and low energy design techniques in order to reduce the energy demand for the development beyond the baseline energy demand requirements.
3. Assess the potential viability of low and zero carbon technologies to suit the development and establish potential energy and carbon dioxide reduction for viable solutions.

This approach is in line with the principles detailed within the London Borough of Richmond upon Thames Sustainable Construction Checklist.

5.3 Energy Demand Assessment

The energy strategy for the development is based on the energy performance of the residential units and office and their associated carbon emission rates. The dwellings have been modelled using SAP 2012 to ensure that the Standard Case dwelling carbon emission rates meet Building Regulations 2013 compliance, with the calculated DER/BER (Dwelling/Building Emission Rate) equalling or bettering the calculated TER (Target Emission Rate) individually and as a weighted aggregate.

To assess the 20% site wide carbon emissions to be off-set by on site renewable energy the unregulated loads for each dwelling were calculated using the Code for Sustainable Homes Ene7 calculator and tabulated to the regulated HVAC loads calculated using SAP 2012. To achieve Code for Sustainable Homes Level 4 the DER must better the TER by a minimum of 19% for the new dwellings (Units 7-9) and Building Regulation L1B pass criteria required for the conversion dwellings (Units 2-6) and the office (Unit 1).

The short fall in the attained DER values has been established and the additional renewable energy off-set requirements have been calculated and tabled in this report.

In accordance with Mayor of London's Energy Hierarchy (*summarised as 'be Lean, be Clean, be Green'*) this report outlines the predicted energy usage and carbon dioxide (CO2) emissions for the proposed development and considers the impact of energy efficiency measures in achieving significant reductions.

Following the 'Lean' principle, passive design and efficiency measures were considered first to optimise the reduction of energy use within the development. These are described in Section 6.1.

Localised and decentralised energy networks were considered to meet the 'Clean' requirement and this is described in Section 6.2.

Finally, six potential renewable energy technologies were considered for integration within the proposed development as part of the '*Be Green'* stage and the feasibility assessments are described in Section 7.

The energy demand assessment has been undertaken using the Standard Assessment Procedure (SAP) 2009 Version 9.9 and the results in the tables represent all nine dwellings in the development.

5.4 Adopted Technology

Photovoltaic (PV) Technology

Photovoltaic cells and photovoltaic sheet have been considered as a viable option for this scheme with appropriate roof space being available as:-

Photovoltaic cells generate electricity for use in the development.
Excess electricity generated could be exported to the National Grid.

PV panels are included within the current Feed in Tariff scheme and therefore can provide income to the site which should reduce pay back periods for the equipment along with reducing the energy used from the National grid.

The proposed development has a reasonable roof area and this has been evaluated to assess what percentage reduction from onsite renewable energy may be realistically achieved.

The assessment is based upon the annual solar radiation kWh/m2 as identified within SAP 2012 Table H2 this is shown in the extracts below.

Table H2: Annual solar radiation, kWh/m²

Tilt of Collector	Orientation of Collector				
	South	SE/SW	E/W	NE/NW	North
Horizontal	961				
30°	1073	1027	913	785	730
45°	1054	997	854	686	640
60°	989	927	776	597	500
Vertical	746	705	582	440	371

Table H3: Overshading Factor

Overshading	% of Sky blocked by obstacles	Overshading Factor
Heavy	>80%	0.50
Significant	>60% - 80%	0.67
Modest	20% - 60%	0.83
None or very little	<20%	1.00
Note: Overshading must be assessed separately for solar panels, taking account of the tilt of the collector. Usually there is less overshading of a solar collector compared to overshading of windows for solar gain (Table 6d) Notes 1. The overshading category of "very little" is not appropriate for new dwellings.		

Tilt of Collector	Average kWh/m2	Over shading factor	kWp	Over shading factor (Table 6d)	Yield kWh/yr	Area of PV panels	Number of PV panels or sheet/ 1kWp	CO_2 offset/ panel kg/yr
Horizontal	961.00	1.00	1	0.83	797.63	7.98	7.35	65.81
45°	1054.00	1.00	1	0.83	874.82	8.75	6	72.85

Table 5.4.1 - Horizontal and Sloping Panel Solar Yield

CO_2 Offset by one PV Panel kg/yr		CO_2 kg per annum		Number PV Panels	Number of PV Panels/ kWp	kWp
		Houses	20% Target			
Horizontal – Houses 7-9	65.81	12078.90	2415.78	37	7.35	6.31
Pitched 45° - Houses 2-6	72.85	17364.35	3472.87	48	6.00	8.00
Pitched 45° - Office 1	72.85	8617.97	1723.59	24	6.00	4.00
Totals		**38061.22**	**7612.24**			**18.31**

To comply with Planning policy the 20% minimum carbon emissions (including regulated HVAC loads and unregulated appliances and cooking loads) that is required to be off-set by on-site renewable energy is **7612.24** kg CO2 per annum.

To comply with Planning policy the dwelling DER must better the TER by 19% to achieve Code for Sustainable Homes Level 4. To achieve this target reduction in carbon dioxide emissions a polycrystalline array of photovoltaic (PV) solar modules is proposed to be installed to match the slope of the roof angle on each roof. The PV panels will have a Peak panel power output of 240 Wp. Sufficient roof space has been identified upon each block to off-set the relevant associated carbon emission off-set as identified in the table below:-

						PV Panels		
	Carbon Off-set Total Kg CO2	Area m2	Cpv kgCO2 /m2/yr	Epv KWh/ m2/yr	PV Area m2	Number of PV Panels	Electrical Yield generated kWh/yr	KWp
Houses 7 - 9	2415.78	399.59	6.05		60	37	5033.05	6.31
Houses 2 - 6	3472.87	388.99	8.93		77	48	6998.56	8.00
Office Unit 1	1723.59	145.50	11.85		39	24	3499.89	4.00
20% Renewable Target	7612.24	934.08	8.15	90.18	176	109	15531.5	18.31

Table 5.4.1 : Details the Photo Voltaic array requirement to meet Planning policy.

An indicative PV array layout has been included for each block to illustrate how this would look from an aerial viewpoint, refer to the Appendices.

The 109No. Photo Voltaic panels are each 1650 mm long x 992 mm wide and have a total area of 176m2. Each panel provides 615Kwh per kWp approximately 90.18kWh/m2 of panel.

It is anticipated that the PV array will provide an **18.31** kWp and save **7612.24** kg CO2 per year (7.61 tonnes CO2 per year) across the development.

6.0 ESTABLISHING CO2 EMISSIONS

This section of the energy statement seeks to identify the carbon footprint of the development. The Base Case DER and Actual DER Carbon Emissions as calculated by SAP 2012 in accordance with Building Regulations ADL1A 2013 and ADL1B 2010 without renewables are detailed below for all dwellings.

Dwelling Ref	Area GIA	2010 CO2 kg/m2/yr		% improvement over Standard Case	Code Level
		Standard Case/TER	Actual Case DER/BER		
Office 1	145.50	*18.90	18.90	0	**L3**
House 2	79.20	*24.59	24.59	0	**L3**
House 3	60.01	*32.68	32.68	0	**L3**
House 4	83.76	*27.13	27.13	0	**L3**
House 5	89.29	*24.77	24.77	0	**L3**
House 6	76.73	*27.80	27.80	0	**L3**
House 7	131.29	16.03	15.88	0.94	**L3**
House 8	137.01	14.44	14.63	-1.17	**L2**
House 9	131.29	16.03	15.88	0.94	**L3**

* Assessed using criteria from Building Regulations Part L1B 2010/2014. Assumed DER/BER=TER

Table 6.0.1: Base case SAP results 2012 for all dwellings

Table 6.0.1 illustrates compliance with Building regulations ADL1A for all the new dwellings. Under Section 4.0 of the approved Building Regulations document ADL1A, the Dwelling Emission Rate (DER) must be lower or equal to the Target Emission Rate (TER). For the conversion units, the passive measures introduced must be in accordance with the standards set for ADL1B.

Table 6.0.2 illustrates the carbon dioxide loads for the regulated HVAC and unregulated loads associated with each dwelling type across the development. The unregulated loads are associated with electrical appliances and cooking, and calculated from the Code for Sustainable Homes Energy Ene7 calculator. These figures have been used to assess the total energy usage and CO2 emissions across the site and to set the 20% carbon off-set required to satisfy the LBRUT planning requirement.

Dwelling Ref	Area GIA	HVAC Regulated	CO2 Unregulated kg/m2/yr		Total CO2 kg/m2/yr	Total CO2 kg/yr	20% Renewable Target kg CO2/yr	CO2 off-set kg/m2/yr
Conversion Dwellings		DER/BER CO2 kg/m2/yr	Electrical Appliances	Cooking				
Office 1	145.50	18.90	38.20	2.13	59.23	8617.97	1723.59	11.85
House 2	79.20	24.59	16.23	2.24	42.53	3368.38	673.68	8.51
House 3	60.01	32.68	17.01	2.78	50.61	3037.11	607.42	10.12
House 4	83.76	27.13	16.01	2.15	44.38	3717.27	743.45	8.88
House 5	89.29	24.77	15.72	2.04	41.16	3675.18	735.04	8.23
House 6	76.73	27.80	16.37	2.31	46.48	3566.41	713.28	9.29
Total Area	534.49		CO2 Emissions (Reg + Unreg)			25982.32	5196.46	9.72

New Dwellings		DER CO2 kg/m2/yr	Electrical Appliances	Cooking				
House 7	131.29	15.88	13.46	1.44	30.77	4039.79	807.96	6.15
House 8	137.01	14.63	13.18	1.38	29.19	3999.32	799.86	5.84
House 9	131.29	15.88	13.46	1.44	30.77	4039.79	807.96	6.15
Total Area	399.59		CO2 Emissions (Reg + Unreg)			12078.90	2415.78	6.05

Summary - Houses 2-9 and Office 1					
Total Area	**934.08**	**CO2 Emissions (Reg + Unreg)**	**38061.22**		
		Minimum 20% Renewable Target		**7612.24**	**8.15**

Table 6.0.2: Site Wide Regulated and Unregulated Co2 Emissions Used To Derive The 20% Carbon Off-Set.

The total site wide carbon dioxide emissions for the development are **38061.22** kg CO2 per year. The calculated minimum 20% carbon dioxide emissions to be off-set by on-site renewables for this development are therefore **7612.24** kg CO2 per year.

To satisfy the planning requirement the DER for each dwelling would basically need to be 19% lower than the associated TER value.

The impact of the 20% carbon dioxide emission off-set upon each dwelling DER was therefore assessed on an area basis to establish what level of improvement has been achieved by the revised DER over their respective TER's. The shortfall in the DER/BER was then assessed to establish the additional carbon dioxide emissions to be off-set by renewable technologies to meet the Code for Sustainable Homes Level 4 (19% improvement to Building Regulations Part L1A 2013 or L1B requirements) and to satisfy the LBRUT planning policy.

The results are tabled below in Table 6.0.3. In this case there was no shortfall.

Dwelling Ref	GIA Area	2013 CO2 Kg/m2/yr		DER including 20% renewables	Improvement over TER (%)	CSH Level 4 DER> TER min	Additional CO2 Off-set Kg/yr
		TER	DER/BER				
Conversion Dwellings							
Office 1	145.50	18.90	18.90	6.30	66.67	66.67	0
House 2	79.20	24.59	24.59	9.42	61.69	61.69	0
House 3	60.01	32.68	32.68	18.47	43.48	43.48	0
House 4	83.76	27.13	27.13	11.02	59.38	59.38	0
House 5	89.29	24.77	24.77	8.72	64.80	64.80	0
House 6	76.73	27.80	27.80	10.52	62.16	62.16	0

* Assessed using criteria from Building Regulations Part L1B 2010/2014. Assumed DER/BER=TER

New Dwellings							
House 7	131.29	16.03	15.88	7.71	40.74	40.74	0
House 8	137.01	14.44	14.63	6.46	39.75	39.75	0
House 9	131.29	16.03	15.88	7.71	40.74	40.74	0

Table 6.0.3: Net Improvement To The Dwellings DER/BER Values From The 20% Renewable Off-Set, And Any Additional CO2 Off-Set Required To Satisfy CSH Level 4.

It can be seen that the adjusted DER values all meet CSH Level 4.

These figures have been added to the 20% carbon emission off-set and taken into account within the PV calculations refer to section 5.

The anticipated energy use for the site is illustrated in the following tables for natural gas and grid electricity.

Dwelling Reference	GIA Area	2012 CO2 Kg/m2/yr		Natural Gas kWh/yr		Electricity kWh/yr		Natural Gas	Electricity
		TER	DER/BER	Heating	Hot Water	Pumps controls	Lights	Total kWh/yr	Total kWh/yr
Conversion Dwellings									
Office 1	145.50	18.90	18.90	9154.84	2592.19	175.00	538.11	11747.03	713.11
House 2	79.20	24.59	24.59	5146.17	2440.06	75.00	520.01	7586.23	595.01
House 3	60.01	32.68	32.68	5685.58	2226.39	75.00	410.61	7911.97	485.61
House 4	83.76	27.13	27.13	6749.73	2469.29	75.00	467.31	9219.02	542.31
House 5	89.29	24.77	24.77	6345.79	2510.32	75.00	501.40	8856.11	576.40
House 6	76.73	27.80	27.80	6273.83	2414.95	75.00	418.15	8688.78	493.15
Total Area	**534.49**							54009.14	3405.59

New Dwellings									
House 7	131.29	16.03	15.88	5649.37	2631.82	75.00	495.67	8281.19	570.67
House 8	137.01	14.44	14.63	5226.35	2642.70	75.00	511.34	7869.05	586.34
House 9	131.29	16.03	15.88	5649.37	2631.82	75.00	495.67	8281.19	570.67
Total Area	**399.59**							24431.43	1727.68
Site Total	**934.08**							78440.57	5133.27

Table 6.0.4: Energy Use For All Dwellings

6.1 Energy Efficiency Measures

The passive and low energy design measures that will be incorporated into the development are as follows:

- Enhanced thermal performance to the building fabric by increasing insulation where possible.
- An assumed thermal bridging y value of 0.07W/m2K for the conversion dwellings (Units 2-6) and office (Unit 1) and a calculated value of between 0.068 and 0.069W/m2K for each of the new build dwellings (Units 7-9).
- High performing doors, windows and roof lights.
- Lower air permeability rate of 3m3/hr/m3 at 50 Pa pressure for the new dwellings (Units 7-9), N/A to the conversion dwellings (Units 2-6) and conversion office (Unit 1).
- High efficiency gas combination boilers with programmer, room thermostat and TRV controls (Units 7-9) and FGHRS (Flue gas heat recovery system) (Units 2-6).
- High efficiency WWHRS (Waste water heat recovery system (Units 2-6)
- Energy efficient individual mechanical fans for the new build dwellings (Units 7-9). Individual extract fans and passive vents for the conversion dwellings (Units 2-6) and the conversion office (Unit 1).

U-Values

	Baseline scheme U Values, W/m2K	Energy efficient scheme U values, W/m2K
Ground floor	0.10	0.10
External cavity walls	0.20	0.20
Timber walls	0.20	0.20
Party walls	0.00	0.00
Pitched roof, flat ceilings	0.10	0.10
Pitched roof, sloping ceilings	0.12	0.12
Flat roof	0.15	0.15
Doors	1.20	1.20
Windows and Rooflights	1.40	1.40

Heating and Ventilation

Air permeability rate	3 for new build dwellings (Units 7-9) and N/A for conversion dwellings (Units 2-6) and conversion office (Unit 1)
Ventilation	Individual extract fans and passive vents for the conversion dwellings (Units 2-6) and conversion office (Unit 1) and individual fans for the new build dwellings (units 7- 9)
Gas combination boiler	89.5% 2009 SEDBUK seasonal efficiency with time and temperature zone control
Low energy lighting	100%

6.2 Energy Efficient Supply

There are no combined heat and power (CHP) or community/district heating schemes known to be within economically viable distance of this proposed scheme of nine dwellings.

6.3 Renewable Energy Target

The London Borough of Richmond upon Thames has set a target of complying with the Code for Sustainable Homes Level 4 in CO2 emission reduction from a development through the use of onsite energy systems. The estimated annual CO2 emissions for this development based on the SAP calculation after implementation of the passive and low energy measures are **7612.24** kg CO2/yr.

Within Section 7 the various potential renewable energy technologies have been reviewed and for this development the conclusion is that photovoltaic panels would be the most viable option.

7 RENEWABLE ENERGY TECHNOLOGIES ASSESSMENT

7.1 Photovoltaic cells

There is an opportunity to install photovoltaic cells due to the available area of South facing inclined roof and concealed flat roof. The total PV panels required to satisfy the constraints of the Code for Sustainable Homes Level 4 and the 20% carbon off-set required to comply with the Planning policy of the London Borough of Richmond Upon Thames is 18.31kWp. The installation of the roof panels would be inclined at the angle of the roof for optimum efficiency. The SAP calculation has been repeated again to include 18.31kWp of photovoltaic panels, which would in total off-set **7612.24** kgCO2/yr, therefore exceeding the target to achieve Code for Sustainable Homes Level 4.

7.2 Solar Water Heating

The development has the potential to use solar water heating with panels located on the sloping and flat roof areas. For maximum, efficiency these should ideally be South facing and would therefore be competing for the same space as the PV panels.

Solar water heating panels would not be able to achieve the required 20% carbon reduction as there is a finite requirement for hot water, therefore increasing the area of panels will not reduce the CO2 emissions proportionately.

The preferred heating and hot water strategy is for the use of high efficiency combination boilers which maximise living space and avoids the need for stored hot water within the dwelling, which can result in inefficient standing heat losses. Solar water heating would require storage for the heated water, so for these three reasons this option has discarded.

7.3 Ground Source Heat pump

Approximately 10m of trench for slinky pipes would be required to obtain 1kW output of heating. For a small to average heat pump of 6kW this would require 60m for each unit, therefore there would not be adequate space on the site for this option. The alternative method involving drilling a borehole would be extremely expensive and is not generally considered a feasible option for small scale domestic applications.

7.4 Combined Heat and Power (CHP)

CHP is on-site generation of electricity using waste heat from to provide useful heat for the development or adjacent schemes. No existing CHP system has been identified within viable vicinity of the site. For maximum efficiency, a CHP system needs to operate for at least 5000 hours/year and requires a heat sink, a consistent base heating load requirement throughout the year where the waste heat from the electrical generation may be used constantly and efficiently while simultaneously providing electricity for the site. It is therefore more appropriate for hospitals, hotels etc where demand is consistent. Domestic dwellings have variable occupation patterns with heating and electrical demand focussing on early mornings and evenings during the week, changing to a more even pattern at weekends. For a development of this size and scale, it would not be appropriate to provide a new CHP plant.

7.5 Wind

The London Renewable Toolkit recommends that wind turbines are only appropriate where the average wind velocity is in excess of 6m/s. The DECC wind speed database estimates the average wind speed is less than 3.27m/s at an average height of 20m above ground level in this location which would not create a viable supply of energy. In addition, a wind turbine would be both visually and audibly intrusive and not suitable for this small urban site where there is insufficient space to accommodate it. For these reasons, wind power has been discounted for this development

7.6 Biomass

Biomass boilers are less efficient than the high efficiency combination boilers proposed, they would require increased management, maintenance and space for both a central energy plant room and biomass store. In addition, there would be a requirement for biomass deliveries via heavy vehicles therefore it is considered that this site and its location are not suitable for fuel delivery, storage or local supply.

8.0 CONCLUSION

This report identifies how a minimum of 20% of the carbon emissions for which the development is responsible, including both regulated and unregulated emissions, are off-set by on-site renewable energy production methods.

The calculated minimum 20% carbon dioxide emissions to be off-set by on-site renewables for this development is **7612.24 kg CO2** per year. The introduction of the 20% renewable contribution when apportioned across the respective dwelling blocks generally satisfies the Planning policy. To satisfy these criteria it would appear that sufficient roof space exists to accommodate a horizontal PV array comprising of 109 No Photo Voltaic panels in total to provide **18.31 kWp** and save **7612.24 kg CO2 per year** (**7.61 tonnes** CO2 per year) across the development.

The scheme therefore demonstrates compliance with London Borough of Richmond upon Thames Planning Policies.

The energy strategy for the proposed development has adopted a hierarchical approach of using passive and low energy design to reduce the baseline energy demand and hence CO2 emissions followed by the application of low and zero carbon technologies as appropriate.

The analysis has shown that by incorporating passive and low energy design measures there is a reduction in the development CO2 emissions based on the SAP calculation method.

The potential on-site low and zero carbon technologies have been assessed taking into account the scale of this particular development and constraints such as location, visual impact, preventing additional vehicle movements and local pollution concerns.

The strategy is to utilise photovoltaic panels on the roofs of the dwellings. It is estimated that this will achieve a **7612.24 kg CO2** reduction in annual CO2 emissions when the passive and low energy measures are combined with the low and zero carbon technologies. This development achieves a better than 19% reduction in CO2 emissions compared to a Building Regulations Part L1A 2013 and L1B 2010 compliant scheme.

The SAP 2009 DER Worksheets are included in **APPENDIX B**

APPENDIX A

UK Government Strategy Documents

Planning for a Sustainable Future: White Paper:

This document sets out the Government's detailed proposals for reform of the Planning System. Many of the matters have been taken forward by the Planning Act 2008 or other amending legislation. However, the White Paper provides an overall context for the planning law and policy that has been produced since 2007.
The White Paper considered the long-term challenges for planning including:

Tackling climate change;
Supporting sustainable economic development;
Increasing housing supply;
Protecting and enhancing the environment and natural resources;
Improving local and national infrastructure;
Maintaining security of energy supply.

Homes for the future: Housing Green Paper

The Housing Green Paper was published in July 2007 and sets out the Government's proposals to improve housing provision in terms of quality and quantity. Targets were set for carbon emissions, requiring all new homes to be zero carbon from 2016 as well as standards for water use, seeking to cut usage by 20% in new homes. Many of the matters discussed in the Green Paper are reflected in PPS3.

PPS1 – Delivering Sustainable Development

Published in 2005, PPS1 establishes the overall framework of planning policies on the delivery of sustainable development through the planning system. The statement reiterates the following four aims for sustainable development:

1. Social progress which recognises the needs of everyone
2. Effective protection of the environment
3. The prudent use of natural resources
4. The maintenance of high and stable levels of economic growth and employment.

PPS1 sets out six key principles which should be applied to ensure that development plans and decisions taken on planning applications contribute to the delivery of sustainable development:

1. Sustainable development should be pursued in an integrated manner
2. Global sustainability should be contributed toward by addressing the causes and potential impacts of climate change
3. A spatial planning approach should be at the heart of planning for sustainable development
4. High quality inclusive design should be promoted in the layout of new development and individual buildings, in terms of function and impact, over the life of the scheme
5. Polices should be set out to provide comprehensive and inclusive access, both in terms of location and external physical access

6. Community involvement is an essential element in delivering sustainable development and creating sustainable and safe communities.

The Planning and Climate Change supplement to PPS1, published in December 2007, sets out how planning should contribute to reducing emissions and stabilising climate change.

With regard to determining planning applications, paragraph 40 comments that an applicant should expect expeditious and sympathetic handling where a proposal would deliver the above key objectives. Planning Authorities should expect new development to:

- Comply with adopted DPD policies on local requirements for decentralised energy supply and for sustainable buildings, unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable.
- Take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption, including maximising cooling and avoiding solar gain in the summer and overall be planned so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form, together with the proposed density and mix of development, support opportunities for decentralised and renewable or low-carbon energy supply
- Deliver a high quality local environment
- Provide public and private open space as appropriate so that it offers accessible choice of shade and shelter, recognising the opportunities for flood storage, wildlife and people provided by multifunctional green spaces
- Give priority to the use of sustainable drainage systems, paying attention to the potential contribution to be gained to water harvesting from impermeable surfaces and encourage layouts that accommodate waste water recycling
- Provide for sustainable waste management.

PPS22 – Renewable Energy

PPS22 promotes the use of renewable energy to meet the Government's sustainable development objectives and also to accord with the various international agreements to which it is party. Paragraph 18 states: "Local planning authorities and developers should consider the opportunity for incorporating renewable energy projects in all new developments. Small scale renewable energy schemes utilising technologies such as solar panels, biomass heating, small scale wind turbines, photovoltaic cells and combined heat and power schemes can be incorporated both into new developments and some existing buildings. Local Planning Authorities should specifically encourage such schemes through positive expressed polices in local development documents."

2.3.2 Local Government

Policy NE/3 - This policy follows the same intent as above and is positive towards promoting and encouraging developments with renewable energy sources.

2.3.4 Code for Sustainable Homes

The Code for Sustainable Homes (CSH) replaced the Government's Ecohomes strategy to improve the sustainable credentials of residential developments. The CSH introduces minimum environmental standards in the following areas:

Energy; Water; Materials; Surface Water Run-off; Waste; Pollution; Health and Wellbeing; Management; Ecology.

The CSH requirement for the proposed development at The Old School, Park Lane, Richmond, TW9 2RA are:

> All dwellings are to achieve Code Level 4 in the Energy Ene1 category which corresponds to achieving 19% less CO2 emissions than a Building Regulations Part L1A 2010 compliant scheme.
>
> All dwellings to achieve Code Level 3 in all other categories

2.3.5 Feed in Tariffs (FiTs)

Feed in Tariffs are payments to ordinary energy users for renewable electricity that they generate. The Government introduced these payments in April 2010, to enable the UK to increase the level of renewable energy used towards the target of 15% of the total energy used by 2020. It is hoped that the implementation of Feed in Tariffs, will in the long term increase the market value of properties with renewable technologies. At this stage, the use of Feed in Tariffs has not been assumed but the strategy allows for the simple addition of renewables should the resident wish to sign up. Prospective purchasers will be made aware of the benefits and the required commitments to Feed in Tariffs to encourage maximum usage of renewables.

2.3.6 Renewable Heat Incentives

The implementation of RHI has been delayed due to a European Commission challenge to the incentives proposed to large scale biomass production. Renewable Heat Incentives are the equivalent scheme to the Feed in Tariffs, but in relation to the production of heat from renewable technologies. This includes systems such as solar thermal panels and biomass boilers. As the use of heat incentives becomes more widespread, it is likely that over time the market value of properties will reflect the use of renewable technologies. At this stage, Renewable Heat Incentives will not have an impact on the strategy, but prospective purchasers will be made aware of the benefits and the required commitments to Feed in Tariffs to encourage maximum usage of renewable

APPENDIX B

SAP 2012 DER Worksheets

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	2 The Old School Park Lane, Richmond, London, TW9		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		39.00	(1a)	x	2.31	(2a)	=	90.09	(3a)
+1		40.20	(1b)	x	3.05	(2b)	=	122.61	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.20	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			212.70	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		4	x 10 =	40	(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, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.19	(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		2		(9)
Additional infiltration			0.10	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.00	(12)
If no draught lobby, enter 0.05, else enter 0			0.00	(13)
Percentage of windows and doors draught proofed		100.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0.05	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0.69	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.69	(18)
Number of sides on which the dwelling is sheltered			4	(19)
Shelter factor	1 - [0.075 x (19)] =		0.70	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.48	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)

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

0.61	0.60	0.59	0.53	0.52	0.46	0.46	0.45	0.48	0.52	0.54	0.57	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

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

0.69	0.68	0.67	0.64	0.63	0.60	0.60	0.60	0.62	0.63	0.65	0.66	(24d)

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

0.69	0.68	0.67	0.64	0.63	0.60	0.60	0.60	0.62	0.63	0.65	0.66	(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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.08	x	1.80	=	3.74			(26)
Window			6.16	x	1.50	=	9.26			(27)
Ground floor			39.00	x	0.22	=	8.58			(28a)
Exposed floor			1.20	x	0.22	=	0.26			(28b
External wall			23.62	x	0.30	=	7.09			(29a)
External wall			2.84	x	0.28	=	0.80			(29a)
Party wall			94.97	x	0.00	=	0.00			(32)
Roof			21.31	x	0.16	=	3.41			(30)
Roof			35.70	x	0.18	=	6.43			(30)
Total area of external elements ∑A, m²			131.91							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	39.57	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		450.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		19.79	(36)
Total fabric heat loss	(33) + (36) =	59.35	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
48.33	47.82	47.31	44.95	44.50	42.44	42.44	42.06	43.24	44.50	45.40	46.34	(38)
Heat transfer coefficient, W/K (37)m + (38)m												
107.69	107.17	106.67	104.30	103.86	101.80	101.80	101.42	102.59	103.86	104.75	105.69	
										Average = ∑(39)1...12/12 =	104.30	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.36	1.35	1.35	1.32	1.31	1.29	1.29	1.28	1.30	1.31	1.32	1.33	
										Average = ∑(40)1...12/12 =	1.32	(40)
Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.45	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.33	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
101.56	97.87	94.17	90.48	86.79	83.10	83.10	86.79	90.48	94.17	97.87	101.56	
										∑(44)1...12 =	1107.94	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
150.61	131.73	135.93	118.51	113.71	98.12	90.93	104.34	105.58	123.05	134.32	145.86	
										∑(45)1...12 =	1452.68	(45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.59	19.76	20.39	17.78	17.06	14.72	13.64	15.65	15.84	18.46	20.15	21.88	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	201.57	177.75	186.89	167.82	164.67	147.44	141.88	155.30	154.90	174.01	183.63	196.82	(62)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	201.57	177.75	186.89	167.82	164.67	147.44	141.88	155.30	154.90	174.01	183.63	196.82	

∑(64)1...12 = 2052.68 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	62.82	55.31	57.94	51.73	50.55	44.95	42.97	47.43	47.44	53.65	56.99	61.24	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.38	122.38	122.38	122.38	122.38	122.38	122.38	122.38	122.38	122.38	122.38	122.38	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	29.45	26.15	21.27	16.10	12.04	10.16	10.98	14.27	19.16	24.32	28.39	30.26	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.76	220.02	214.33	202.20	186.90	172.52	162.91	160.65	166.35	178.47	193.77	208.15	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.24	35.24	35.24	35.24	35.24	35.24	35.24	35.24	35.24	35.24	35.24	35.24	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	(71)
Water heating gains (Table 5)	84.43	82.30	77.87	71.85	67.94	62.44	57.76	63.75	65.88	72.11	79.15	82.31	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	394.35	391.19	376.18	352.87	329.59	307.83	294.36	301.39	314.10	337.62	364.02	383.44	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.16	x	46.75	x 0.9 x	0.72	x	0.70	=	100.59	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	100.59	164.74	209.85	237.17	247.15	237.85	232.39	225.68	219.21	177.68	119.23	86.92	(83)
Total gains - internal and solar (73)m + (83)m	494.94	555.92	586.02	590.04	576.74	545.68	526.75	527.07	533.31	515.30	483.25	470.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) | 21.00 | (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	1.00	1.00	0.99	0.94	0.80	0.82	0.97	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.07	20.17	20.32	20.52	20.72	20.90	20.98	20.98	20.86	20.60	20.31	20.07	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.79	19.80	19.80	19.83	19.83	19.85	19.85	19.86	19.84	19.83	19.82	19.81	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	1.00	0.98	0.87	0.62	0.65	0.92	1.00	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.96	19.06	19.21	19.43	19.63	19.81	19.85	19.85	19.77	19.51	19.22	18.97	(90)

Living area fraction — Living area ÷ (4) = 0.44 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.46	19.55	19.70	19.92	20.12	20.30	20.35	20.35	20.26	20.00	19.70	19.46	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.46	19.55	19.70	19.92	20.12	20.30	20.35	20.35	20.26	20.00	19.70	19.46	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	1.00	0.98	0.91	0.71	0.73	0.94	1.00	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	494.87	555.71	585.40	587.86	567.22	495.00	371.88	387.20	502.29	513.07	483.05	470.31	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1632.15	1570.42	1408.37	1149.09	874.04	579.88	382.03	400.81	631.79	975.77	1320.11	1613.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	846.13	681.88	612.29	404.09	228.27	0.00	0.00	0.00	0.00	344.25	602.68	850.20	

∑(98)1...5, 10...12 = 4569.80 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 57.70 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		88.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	952.85	767.89	689.52	455.05	257.06	0.00	0.00	0.00	0.00	387.67	678.70	957.43

∑(211)1...5, 10...12 = 5146.17 (211)

Water heating

Efficiency of water heater

86.85	86.70	86.44	85.85	84.65	79.50	79.50	79.50	79.50	85.44	86.44	86.89	(217)

Water heating fuel, kWh/month

232.10	205.02	216.22	195.48	194.53	185.46	178.47	195.34	194.84	203.65	212.44	226.52	
									∑(219a)1...12 =		2440.06	(219)

Annual totals

Space heating fuel - main system 1			5146.17	
Water heating fuel			2440.06	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			520.01	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	8181.24	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5146.17	x	3.48	x 0.01 =	179.09	(240)
Water heating	2440.06	x	3.48	x 0.01 =	84.91	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	520.01	x	13.19	x 0.01 =	68.59	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	462.48	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.56	(257)
SAP value	78.18	
SAP rating (section 13)	78	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	5146.17	x	0.22	=	1111.57	(261)
Water heating	2440.06	x	0.22	=	527.05	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1638.63	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	520.01	x	0.52	=	269.88	(268)
Total CO_2, kg/year				(265)...(271) =	1947.44	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	24.59	(273)
EI value					78.99	
EI rating (section 14)					79	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5146.17	x	1.22	=	6278.33	(261)
Water heating	2440.06	x	1.22	=	2976.88	(264)

Space and water heating			(261) + (262) + (263) + (264) =		9255.21	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	520.01	x	3.07	=	1596.43	(268)
Primary energy kWh/year					11081.88	(272)
Dwelling primary energy rate kWh/m2/year					139.92	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	3 The Old School Park Lane, Richmond, London, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		29.81	(1a)	x	3.45	(2a)	=	102.84	(3a)
+1		30.20	(1b)	x	2.22	(2b)	=	67.04	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.01	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			169.89	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(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, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.24	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.49	(18)
Number of sides on which the dwelling is sheltered		4	(19)
Shelter factor	1 - [0.075 x (19)] =	0.70	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.34	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.42	0.37	0.37	0.32	0.32	0.31	0.34	0.37	0.38	0.40	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

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

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.71	x	1.80	=	4.88			(26)
Window			4.82	x	1.50	=	7.25			(27)
Ground floor			29.81	x	0.22	=	6.56			(28a)
External wall			55.32	x	0.30	=	16.60			(29a)
Party wall			46.96	x	0.00	=	0.00			(32)
External wall			19.32	x	0.28	=	5.41			(29a)
Roof			14.25	x	0.16	=	2.28			(30)
Roof			21.86	x	0.18	=	3.93			(30)
Total area of external elements ∑A, m²			148.09							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	46.90	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		450.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		22.21	(36)
Total fabric heat loss	(33) + (36) =	69.12	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	33.29	33.09	32.89	31.95	31.77	30.95	30.95	30.80	31.27	31.77	32.13	32.50	(38)
Heat transfer coefficient, W/K (37)m + (38)m	102.41	102.21	102.01	101.07	100.89	100.07	100.07	99.92	100.39	100.89	101.25	101.62	

Average = ∑(39)1...12/12 = 101.06 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.71	1.70	1.70	1.68	1.68	1.67	1.67	1.67	1.67	1.68	1.69	1.69	

Average = ∑(40)1...12/12 = 1.68 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.98	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.27	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	89.40	86.15	82.90	79.65	76.39	73.14	73.14	76.39	79.65	82.90	86.15	89.40	

∑(44)1...12 = 975.25 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	132.57	115.95	119.65	104.31	100.09	86.37	80.04	91.84	92.94	108.31	118.23	128.39	

∑(45)1...12 = 1278.70 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	19.89	17.39	17.95	15.65	15.01	12.96	12.01	13.78	13.94	16.25	17.73	19.26	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)

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

183.53	161.98	170.61	153.63	151.05	135.69	130.99	142.80	142.25	159.27	167.55	179.35	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

183.53	161.98	170.61	153.63	151.05	135.69	130.99	142.80	142.25	159.27	167.55	179.35

∑(64)1...12 = 1878.70 (64)

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

56.82	50.06	52.52	47.01	46.02	41.05	39.35	43.28	43.23	48.75	51.64	55.43	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	99.10	99.10	99.10	99.10	99.10	99.10	99.10	99.10	99.10	99.10	99.10	99.10	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.25	20.65	16.79	12.71	9.50	8.02	8.67	11.27	15.13	19.21	22.42	23.90	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.97	174.77	170.24	160.61	148.46	137.04	129.40	127.61	132.13	141.76	153.92	165.34	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.91	32.91	32.91	32.91	32.91	32.91	32.91	32.91	32.91	32.91	32.91	32.91	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-79.28	-79.28	-79.28	-79.28	-79.28	-79.28	-79.28	-79.28	-79.28	-79.28	-79.28	-79.28	(71)
Water heating gains (Table 5)	76.37	74.49	70.60	65.30	61.86	57.01	52.89	58.17	60.04	65.53	71.72	74.50	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	328.32	325.64	313.36	294.35	275.55	257.80	246.69	252.78	263.03	282.22	303.78	319.47	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	4.82	x	10.63	x 0.9 x	0.72	x	0.70	=	17.90	(74)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	17.90	34.21	58.13	93.37	125.78	134.65	125.72	99.74	69.89	40.72	22.08	14.92	(83)
Total gains - internal and solar (73)m + (83)m	346.22	359.85	371.49	387.73	401.33	392.45	372.41	352.52	332.92	322.95	325.87	334.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	1.00	1.00	1.00	0.98	0.92	0.94	0.99	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.77	19.84	20.00	20.24	20.51	20.77	20.91	20.88	20.67	20.34	20.02	19.76	(87)

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

19.54	19.54	19.54	19.55	19.55	19.56	19.56	19.57	19.56	19.55	19.55	19.55	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	1.00	1.00	1.00	0.99	0.94	0.74	0.81	0.98	1.00	1.00	1.00	(89)

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

18.44	18.51	18.67	18.93	19.20	19.45	19.55	19.54	19.36	19.03	18.70	18.44	(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.02	19.09	19.25	19.50	19.77	20.02	20.14	20.12	19.93	19.60	19.28	19.01	(92)

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

19.02	19.09	19.25	19.50	19.77	20.02	20.14	20.12	19.93	19.60	19.28	19.01	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	1.00	0.99	0.96	0.83	0.88	0.98	1.00	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	346.18	359.78	371.33	387.14	398.29	375.06	310.79	309.88	327.90	322.51	325.78	334.36	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1507.07	1450.04	1300.47	1071.16	813.91	542.33	354.04	371.83	585.08	907.81	1232.71	1505.03	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	863.71	732.66	691.28	492.49	309.22	0.00	0.00	0.00	0.00	435.46	652.99	870.99	

∑(98)1...5, 10...12 = 5048.80 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 84.13 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		88.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	972.64	825.07	778.47	554.61	348.22	0.00	0.00	0.00	0.00	490.39	735.35	980.84

∑(211)1...5, 10...12 = 5685.58 (211)

Water heating

Efficiency of water heater	87.02	86.96	86.79	86.40	85.52	79.50	79.50	79.50	79.50	86.10	86.73	87.06	(217)
Water heating fuel, kWh/month	210.92	186.27	196.58	177.82	176.63	170.67	164.77	179.62	178.94	184.98	193.18	206.00	

∑(219a)1...12 = 2226.39 (219)

Annual totals

Space heating fuel - main system 1	5685.58
Water heating fuel	2226.39

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			410.61	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	8397.58	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5685.58	x	3.48	x 0.01 =	197.86	(240)
Water heating	2226.39	x	3.48	x 0.01 =	77.48	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	410.61	x	13.19	x 0.01 =	54.16	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		459.39	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.84	(257)
SAP value	74.37	
SAP rating (section 13)	74	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	5685.58	x	0.22	=	1228.09	(261)
Water heating	2226.39	x	0.22	=	480.90	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1708.99	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	410.61	x	0.52	=	213.11	(268)
Total CO_2, kg/year				(265)...(271) =	1961.02	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	32.68	(273)
EI value					74.98	
EI rating (section 14)					75	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5685.58	x	1.22	=	6936.41	(261)
Water heating	2226.39	x	1.22	=	2716.20	(264)
Space and water heating			(261) + (262) + (263) + (264) =		9652.61	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	410.61	x	3.07	=	1260.57	(268)
Primary energy kWh/year					11143.43	(272)
Dwelling primary energy rate kWh/m2/year					185.69	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	4 The Old School Park Lane, Richmond, London, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		41.45	(1a)	x	2.31	(2a)	=	95.75	(3a)
+1		42.31	(1b)	x	3.05	(2b)	=	129.05	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	83.76	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			224.80	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		4	x 10 =	40	(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, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.18	(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		2		(9)
Additional infiltration			0.10	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.00	(12)
If no draught lobby, enter 0.05, else enter 0			0.00	(13)
Percentage of windows and doors draught proofed		100.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0.05	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0.68	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.68	(18)
Number of sides on which the dwelling is sheltered			4	(19)
Shelter factor	1 - [0.075 x (19)] =		0.70	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.47	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)

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

0.61	0.59	0.58	0.52	0.51	0.45	0.45	0.44	0.47	0.51	0.53	0.56	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system | N/A | (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h | N/A | (23c)

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

0.68	0.68	0.67	0.64	0.63	0.60	0.60	0.60	0.61	0.63	0.64	0.66	(24d)

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

0.68	0.68	0.67	0.64	0.63	0.60	0.60	0.60	0.61	0.63	0.64	0.66	(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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.08	x	1.80	=	3.74			(26)
Window			13.26	x	1.50	=	19.94			(27)
Ground floor			41.45	x	0.22	=	9.12			(28a)
Exposed floor			1.12	x	0.22	=	0.25			(28b
External wall			61.52	x	0.30	=	18.46			(29a)
External wall			2.89	x	0.28	=	0.81			(29a)
Party wall			55.58	x	0.00	=	0.00			(32)
Roof			22.27	x	0.16	=	3.56			(30)
Roof			37.87	x	0.18	=	6.82			(30)
Total area of external elements ∑A, m²			182.46							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	62.70	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		450.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		27.37	(36)
Total fabric heat loss	(33) + (36) =	90.06	(37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
50.67	50.14	49.63	47.20	46.74	44.63	44.63	44.24	45.44	46.74	47.66	48.62	(38)

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

140.73	140.21	139.69	137.26	136.81	134.69	134.69	134.30	135.51	136.81	137.73	138.69	

Average = ∑(39)1...12/12 = | 137.26 | (39)

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

1.68	1.67	1.67	1.64	1.63	1.61	1.61	1.60	1.62	1.63	1.64	1.66	

Average = ∑(40)1...12/12 = | 1.64 | (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.53	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	94.30	(43)

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
103.73	99.95	96.18	92.41	88.64	84.87	84.87	88.64	92.41	96.18	99.95	103.73

∑(44)1...12 = | 1131.55 | (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

153.82	134.53	138.83	121.03	116.13	100.21	92.86	106.56	107.83	125.67	137.18	148.97

∑(45)1...12 = | 1483.64 | (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	23.07	20.18	20.82	18.15	17.42	15.03	13.93	15.98	16.18	18.85	20.58	22.35	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	204.78	180.56	189.79	170.35	167.09	149.53	143.82	157.52	157.15	176.63	186.49	199.93	(62)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	204.78	180.56	189.79	170.35	167.09	149.53	143.82	157.52	157.15	176.63	186.49	199.93	

∑(64)1...12 = 2083.64 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	63.89	56.24	58.90	52.57	51.35	45.65	43.62	48.17	48.18	54.53	57.94	62.27	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	126.52	126.52	126.52	126.52	126.52	126.52	126.52	126.52	126.52	126.52	126.52	126.52	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.46	23.50	19.11	14.47	10.82	9.13	9.87	12.83	17.21	21.86	25.51	27.20	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	227.12	229.48	223.54	210.89	194.93	179.93	169.91	167.56	173.49	186.14	202.10	217.10	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-101.21	-101.21	-101.21	-101.21	-101.21	-101.21	-101.21	-101.21	-101.21	-101.21	-101.21	-101.21	(71)
Water heating gains (Table 5)	85.87	83.69	79.17	73.02	69.02	63.40	58.62	64.75	66.92	73.29	80.47	83.70	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	403.40	400.62	385.77	362.34	338.73	316.42	302.36	309.08	321.59	345.24	372.04	391.95	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.16	x	46.75	x 0.9 x	0.72	x	0.70	=	100.59	(78)
West	0.77	x	7.10	x	19.64	x 0.9 x	0.72	x	0.70	=	48.70	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	149.29	260.01	366.75	466.01	527.60	524.94	505.71	460.46	401.70	290.74	179.96	126.97	(83)
Total gains - internal and solar (73)m + (83)m	552.70	660.64	752.52	828.35	866.33	841.36	808.07	769.55	723.28	635.98	552.00	518.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) — 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	1.00	0.99	0.97	0.87	0.70	0.75	0.94	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.83	19.96	20.17	20.45	20.72	20.92	20.98	20.97	20.84	20.49	20.11	19.82	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.56	19.56	19.56	19.59	19.59	19.61	19.61	19.61	19.60	19.59	19.58	19.57	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	0.99	0.93	0.75	0.50	0.55	0.87	0.99	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.52	18.65	18.87	19.16	19.41	19.58	19.61	19.61	19.53	19.20	18.82	18.52	(90)

Living area fraction — Living area ÷ (4) = 0.45 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.11	19.24	19.46	19.74	20.00	20.18	20.23	20.22	20.12	19.78	19.40	19.11	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.11	19.24	19.46	19.74	20.00	20.18	20.23	20.22	20.12	19.78	19.40	19.11	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	0.99	0.95	0.81	0.59	0.65	0.91	0.99	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	552.55	660.06	750.24	817.80	820.19	679.82	479.61	498.77	655.33	630.99	551.59	518.82	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2084.69	2011.18	1809.69	1488.50	1135.63	751.81	488.45	513.50	815.24	1255.70	1694.51	2067.72	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1139.92	907.95	788.23	482.90	234.69	0.00	0.00	0.00	0.00	464.78	822.91	1152.38	

∑(98)1...5, 10...12 = 5993.76 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 71.56 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		88.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1283.69	1022.47	887.65	543.81	264.29	0.00	0.00	0.00	0.00	523.40	926.70	1297.73

∑(211)1...5, 10...12 = 6749.73 (211)

Water heating

Efficiency of water heater

87.25	87.11	86.83	86.17	84.68	79.50	79.50	79.50	79.50	86.03	86.92	87.29	(217)

Water heating fuel, kWh/month

234.72	207.28	218.57	197.68	197.32	188.09	180.91	198.14	197.67	205.31	214.56	229.04	

∑(219a)1...12 = 2469.29 (219)

Annual totals

Space heating fuel - main system 1		6749.73	
Water heating fuel		2469.29	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		467.31	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	9761.33	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6749.73	x	3.48	x 0.01 =	234.89	(240)
Water heating	2469.29	x	3.48	x 0.01 =	85.93	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	467.31	x	13.19	x 0.01 =	61.64	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		512.35	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.67	(257)
SAP value	76.69	
SAP rating (section 13)	77	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6749.73	x	0.22	=	1457.94	(261)
Water heating	2469.29	x	0.22	=	533.37	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1991.31	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	467.31	x	0.52	=	242.53	(268)
Total CO_2, kg/year				(265)...(271) =	2272.77	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	27.13	(273)
EI value					76.35	
EI rating (section 14)					76	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6749.73	x	1.22	=	8234.67	(261)
Water heating	2469.29	x	1.22	=	3012.53	(264)

Space and water heating			(261) + (262) + (263) + (264) =		11247.20	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	467.31	x	3.07	=	1434.64	(268)
Primary energy kWh/year					12912.09	(272)
Dwelling primary energy rate kWh/m2/year					154.16	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	5 The Old School Park Lane, Richmond, London, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		52.75	(1a)	x	2.31	(2a)	=	121.85	(3a)
+1		36.54	(1b)	x	2.11	(2b)	=	77.10	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	89.29	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			198.95	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		4	x 10 =	40	(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, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.20	(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		2		(9)
Additional infiltration			0.10	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.00	(12)
If no draught lobby, enter 0.05, else enter 0			0.05	(13)
Percentage of windows and doors draught proofed		100.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0.05	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.75	(18)
Number of sides on which the dwelling is sheltered			4	(19)
Shelter factor	1 - [0.075 x (19)] =		0.70	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.53	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)

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

0.67	0.66	0.64	0.58	0.57	0.50	0.50	0.49	0.53	0.57	0.59	0.62	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

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

0.72	0.72	0.71	0.67	0.66	0.62	0.62	0.62	0.64	0.66	0.67	0.69	(24d)

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

0.72	0.72	0.71	0.67	0.66	0.62	0.62	0.62	0.64	0.66	0.67	0.69	(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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.96	x	1.80	=	7.13			(26)
Window			12.57	x	1.50	=	18.90			(27)
Ground floor			52.75	x	0.22	=	11.61			(28a)
External wall			45.81	x	0.30	=	13.74			(29a)
Party wall			109.48	x	0.00	=	0.00			(32)
Roof			23.61	x	0.16	=	3.78			(30)
Roof			18.49	x	0.18	=	3.33			(30)
Total area of external elements ∑A, m²			157.19							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	58.48	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		450.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		23.58	(36)
Total fabric heat loss	(33) + (36) =	82.06	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	47.58	47.00	46.44	43.81	43.31	41.02	41.02	40.59	41.90	43.31	44.31	45.35	(38)
Heat transfer coefficient, W/K (37)m + (38)m	129.64	129.07	128.50	125.87	125.37	123.08	123.08	122.65	123.96	125.37	126.37	127.42	
Average = ∑(39)1...12/12 =												125.86	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.45	1.45	1.44	1.41	1.40	1.38	1.38	1.37	1.39	1.40	1.42	1.43	
Average = ∑(40)1...12/12 =												1.41	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.62	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	96.33	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	105.96	102.11	98.25	94.40	90.55	86.69	86.69	90.55	94.40	98.25	102.11	105.96	
∑(44)1...12 =												1155.92	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	157.14	137.43	141.82	123.64	118.64	102.37	94.86	108.86	110.16	128.38	140.13	152.18	
∑(45)1...12 =												1515.60	(45)
Distribution loss 0.15 x (45)m	23.57	20.61	21.27	18.55	17.80	15.36	14.23	16.33	16.52	19.26	21.02	22.83	(46)

Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	208.09	183.46	192.78	172.95	169.59	151.69	145.82	159.82	159.47	179.34	189.45	203.14	(62)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	208.09	183.46	192.78	172.95	169.59	151.69	145.82	159.82	159.47	179.34	189.45	203.14	

∑(64)1...12 = 2115.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	64.99	57.20	59.89	53.44	52.19	46.37	44.28	48.93	48.96	55.43	58.92	63.34	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	130.79	130.79	130.79	130.79	130.79	130.79	130.79	130.79	130.79	130.79	130.79	130.79	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.39	25.22	20.51	15.53	11.61	9.80	10.59	13.76	18.47	23.45	27.37	29.18	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	237.77	240.23	234.02	220.78	204.07	188.37	177.88	175.41	181.63	194.86	211.57	227.27	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-104.64	-104.64	-104.64	-104.64	-104.64	-104.64	-104.64	-104.64	-104.64	-104.64	-104.64	-104.64	(71)
Water heating gains (Table 5)	87.35	85.12	80.50	74.22	70.14	64.40	59.52	65.77	67.99	74.50	81.84	85.13	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	418.74	415.81	400.26	375.76	351.06	327.80	313.22	320.18	333.33	358.05	386.02	406.83	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	12.03	x	19.64	x 0.9 x	0.72	x	0.70	=	82.52	(80)
East	0.77	x	0.54	x	19.64	x 0.9 x	0.72	x	0.70	=	3.70	(76)

Solar gains in watts ∑(74)m...(82)m	86.23	168.68	277.79	405.14	496.52	508.27	483.90	415.66	323.08	200.15	107.52	70.91	(83)
Total gains - internal and solar (73)m + (83)m	504.97	584.49	678.05	780.91	847.57	836.08	797.12	735.84	656.41	558.20	493.54	477.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) | 21.00 | (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	1.00	1.00	0.97	0.85	0.66	0.74	0.96	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.97	20.07	20.26	20.53	20.78	20.95	20.99	20.99	20.86	20.53	20.21	19.96	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.72	19.73	19.73	19.76	19.76	19.78	19.78	19.78	19.77	19.76	19.75	19.74	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	0.99	0.94	0.73	0.49	0.56	0.90	1.00	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.79	18.90	19.09	19.38	19.62	19.76	19.78	19.78	19.70	19.39	19.06	18.80	(90)

Living area fraction | Living area ÷ (4) = | 0.45 | (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.32	19.43	19.62	19.91	20.15	20.30	20.33	20.33	20.23	19.91	19.58	19.33	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.32	19.43	19.62	19.91	20.15	20.30	20.33	20.33	20.23	19.91	19.58	19.33	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	0.99	0.95	0.79	0.57	0.64	0.93	1.00	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	504.93	584.34	677.22	774.35	804.10	658.38	455.01	473.15	609.85	556.45	493.42	477.71	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1947.76	1875.31	1686.42	1385.28	1059.45	701.85	459.05	481.78	759.54	1166.97	1577.33	1927.63	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1073.46	867.53	750.85	439.87	189.98	0.00	0.00	0.00	0.00	454.23	780.41	1078.74	

∑(98)1...5, 10...12 = | 5635.06 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 63.11 | (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		88.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1208.86	976.95	845.55	495.35	213.94	0.00	0.00	0.00	0.00	511.52	878.84	1214.79

∑(211)1...5, 10...12 = | 6345.79 | (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	87.14	87.02	86.73	85.96	84.16	79.50	79.50	79.50	79.50	85.95	86.82	87.18	(217)

Water heating fuel, kWh/month

238.79	210.82	222.28	201.20	201.52	190.80	183.42	201.03	200.59	208.64	218.22	233.00

∑(219a)1...12 = 2510.32 (219)

Annual totals

Space heating fuel - main system 1			6345.79	
Water heating fuel			2510.32	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			501.40	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	9432.51	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6345.79	x	3.48	x 0.01 =	220.83	(240)
Water heating	2510.32	x	3.48	x 0.01 =	87.36	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	501.40	x	13.19	x 0.01 =	66.13	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	504.22	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.58	(257)
SAP value	78.00	
SAP rating (section 13)	78	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6345.79	x	0.22	=	1370.69	(261)
Water heating	2510.32	x	0.22	=	542.23	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1912.92	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	501.40	x	0.52	=	260.23	(268)
Total CO_2, kg/year				(265)...(271) =	2212.07	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	24.77	(273)
EI value					77.93	
EI rating (section 14)					78	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6345.79	x	1.22	=	7741.87	(261)
Water heating	2510.32	x	1.22	=	3062.59	(264)
Space and water heating				(261) + (262) + (263) + (264) =	10804.45	(265)

Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	501.40	x	3.07	=	1539.30	(268)
Primary energy kWh/year					12574.00	(272)
Dwelling primary energy rate kWh/m2/year					140.82	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	6 The Old School Park Lane, Richmond, London, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		39.96	(1a)	x	2.31	(2a)	=	92.31	(3a)
+1		36.77	(1b)	x	2.11	(2b)	=	77.58	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.73	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			169.89	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		4	x 10 =	40	(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, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.24	(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		2		(9)
Additional infiltration			0.10	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.00	(12)
If no draught lobby, enter 0.05, else enter 0			0.05	(13)
Percentage of windows and doors draught proofed		100.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0.05	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0.79	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.79	(18)
Number of sides on which the dwelling is sheltered			3	(19)
Shelter factor	1 - [0.075 x (19)] =		0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.61	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)

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

0.78	0.76	0.75	0.67	0.65	0.58	0.58	0.56	0.61	0.65	0.68	0.72	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system — N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h — N/A (23c)

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

0.80	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(24d)

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

0.80	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			1.98	x 1.80	= 3.56			(26)
Window			17.24	x 1.68	= 28.95			(27)
Roof window			0.83	x 1.33	= 1.10			(27a)
Ground floor			39.96	x 0.22	= 8.79			(28a)
External wall			47.88	x 0.30	= 14.36			(29a)
Party wall			25.71	x 0.00	= 0.00			(32)
Roof			38.04	x 0.16	= 6.09			(30)
Roof			24.01	x 0.18	= 4.32			(30)
Total area of external elements ∑A, m²			169.94					(31)

Fabric heat loss, W/K = ∑(A × U) — (26)...(30) + (32) = 67.18 (33)

Heat capacity Cm = ∑(A x κ) — (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K — 450.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K — 25.49 (36)

Total fabric heat loss — (33) + (36) = 92.67 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	44.92	44.26	43.62	40.60	40.04	37.41	37.41	36.92	38.42	40.04	41.18	42.37	(38)
Heat transfer coefficient, W/K (37)m + (38)m	137.59	136.93	136.29	133.27	132.70	130.07	130.07	129.59	131.09	132.70	133.85	135.04	

Average = ∑(39)1...12/12 = 133.27 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.79	1.78	1.78	1.74	1.73	1.70	1.70	1.69	1.71	1.73	1.74	1.76	

Average = ∑(40)1...12/12 = 1.74 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N — 2.40 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 91.15 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	100.26	96.62	92.97	89.33	85.68	82.03	82.03	85.68	89.33	92.97	96.62	100.26

∑(44)1...12 = 1093.80 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	148.69	130.05	134.19	116.99	112.26	96.87	89.77	103.01	104.24	121.48	132.60	144.00

∑(45)1...12 = 1434.14 (45)

Distribution loss 0.15 x (45)m

22.30	19.51	20.13	17.55	16.84	14.53	13.46	15.45	15.64	18.22	19.89	21.60	(46)

Water storage loss calculated for each month (55) x (41)m

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)

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

199.65	176.07	185.15	166.31	163.22	146.19	140.72	153.97	153.55	172.44	181.92	194.96	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

199.65	176.07	185.15	166.31	163.22	146.19	140.72	153.97	153.55	172.44	181.92	194.96

∑(64)1...12 = 2034.14 (64)

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

62.18	54.75	57.36	51.23	50.07	44.54	42.59	46.99	46.99	53.13	56.42	60.62	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	119.89	119.89	119.89	119.89	119.89	119.89	119.89	119.89	119.89	119.89	119.89	119.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.68	21.03	17.10	12.95	9.68	8.17	8.83	11.48	15.40	19.56	22.83	24.34	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	212.47	214.68	209.12	197.29	182.36	168.33	158.95	156.75	162.30	174.13	189.06	203.10	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.99	34.99	34.99	34.99	34.99	34.99	34.99	34.99	34.99	34.99	34.99	34.99	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-95.92	-95.92	-95.92	-95.92	-95.92	-95.92	-95.92	-95.92	-95.92	-95.92	-95.92	-95.92	(71)
Water heating gains (Table 5)	83.57	81.47	77.10	71.15	67.29	61.86	57.24	63.16	65.26	71.41	78.36	81.48	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	381.69	379.14	365.29	343.36	321.30	300.33	286.99	293.35	304.94	327.07	352.22	370.88	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	4.93	x	19.64	x 0.9 x	0.72	x	0.70	=	33.82	(80)
East	0.77	x	7.99	x	19.64	x 0.9 x	0.72	x	0.70	=	54.81	(76)
North	0.77	x	4.32	x	10.63	x 0.9 x	0.72	x	0.70	=	16.04	(74)
East	1.00	x	0.83	x	26.24	x 0.9 x	0.72	x	0.70	=	9.88	(76)

Solar gains in watts ∑(74)m...(82)m

114.55	223.87	371.56	551.66	688.12	710.52	673.88	570.21	434.86	266.09	142.71	94.33	(83)

Total gains - internal and solar (73)m + (83)m

496.24	603.01	736.85	895.02	1009.42	1010.85	960.87	863.56	739.79	593.16	494.93	465.20	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) — 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	1.00	0.99	0.92	0.76	0.58	0.66	0.93	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.74	19.88	20.13	20.49	20.79	20.96	20.99	20.98	20.84	20.44	20.04	19.73	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.47	19.48	19.49	19.51	19.52	19.54	19.54	19.55	19.53	19.52	19.51	19.50	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	0.97	0.86	0.62	0.40	0.47	0.84	0.99	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.36	18.50	18.76	19.13	19.40	19.53	19.54	19.55	19.47	19.10	18.69	18.37	(90)

Living area fraction — Living area ÷ (4) = 0.24 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.69	18.83	19.09	19.46	19.74	19.87	19.89	19.89	19.80	19.42	19.01	18.70	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.69	18.83	19.09	19.46	19.74	19.87	19.89	19.89	19.80	19.42	19.01	18.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	0.97	0.88	0.65	0.44	0.52	0.86	0.99	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	496.09	602.41	733.42	870.22	883.94	662.08	426.07	447.78	635.32	587.50	494.53	465.11	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1980.11	1908.00	1715.73	1406.85	1066.37	685.96	428.07	452.48	747.11	1170.76	1594.51	1958.15	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1104.11	877.36	730.84	386.37	135.73	0.00	0.00	0.00	0.00	433.94	791.98	1110.82	

∑(98)1...5, 10...12 = 5571.16 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 72.61 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		88.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1243.37	988.01	823.02	435.10	152.84	0.00	0.00	0.00	0.00	488.68	891.87	1250.93

∑(211)1...5, 10...12 = 6273.83 (211)

Water heating

Efficiency of water heater

87.24	87.10	86.75	85.78	83.47	79.50	79.50	79.50	79.50	85.94	86.90	87.28	(217)

Water heating fuel, kWh/month

228.86	202.16	213.44	193.88	195.54	183.88	177.01	193.67	193.15	200.65	209.34	223.38	

∑(219a)1...12 = 2414.95 (219)

Annual totals

Space heating fuel - main system 1		6273.83	
Water heating fuel		2414.95	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		418.15	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	9181.92	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6273.83	x	3.48	x 0.01 =	218.33	(240)
Water heating	2414.95	x	3.48	x 0.01 =	84.04	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	418.15	x	13.19	x 0.01 =	55.15	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		487.42	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.68	(257)
SAP value	76.54	
SAP rating (section 13)	77	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6273.83	x	0.22	=	1355.15	(261)
Water heating	2414.95	x	0.22	=	521.63	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1876.77	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	418.15	x	0.52	=	217.02	(268)
Total CO_2, kg/year				(265)...(271) =	2132.72	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	27.80	(273)
EI value					76.52	
EI rating (section 14)					77	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6273.83	x	1.22	=	7654.07	(261)

Water heating	2414.95	x	1.22	=	2946.23	(264)
Space and water heating			(261) + (262) + (263) + (264) =		10600.30	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	418.15	x	3.07	=	1283.72	(268)
Primary energy kWh/year					12114.27	(272)
Dwelling primary energy rate kWh/m2/year					157.88	(273)

DER Worksheet
Design - Draft

NHER

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	Plot 7 The Old School Park Lane, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		54.80	(1a)	x	2.35	(2a)	=	128.78	(3a)
+1		48.78	(1b)	x	2.70	(2b)	=	131.71	(3b)
+2		27.71	(1c)	x	2.70	(2c)	=	74.82	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	131.29	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			335.30	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		4	x 10 =	40	(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, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.12	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.27	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.23	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(24d)

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

0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.72	x	1.20	=	4.46			(26)
Window			12.46	x	1.33	=	16.52			(27)
Roof window			6.39	x	1.33	=	8.47			(27a)
Basement floor			54.80	x	0.10	=	5.48			(28)
External wall			110.66	x	0.20	=	22.13			(29a)
Basement wall			51.47	x	0.18	=	9.26			(29)
Party wall			61.28	x	0.00	=	0.00			(32)
Roof			38.64	x	0.10	=	3.86			(30)
Roof			10.03	x	0.12	=	1.20			(30)
Roof			1.11	x	0.15	=	0.17			(30)
Total area of external elements ∑A, m²			289.28							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	71.57	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		19.77	(36)
Total fabric heat loss	(33) + (36) =	91.33	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	60.04	59.85	59.67	58.83	58.67	57.94	57.94	57.81	58.22	58.67	58.99	59.33	(38)
Heat transfer coefficient, W/K (37)m + (38)m	151.37	151.19	151.01	150.17	150.01	149.27	149.27	149.14	149.56	150.01	150.33	150.66	
Average = ∑(39)1...12/12 =												150.17	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.15	1.15	1.15	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.15	
Average = ∑(40)1...12/12 =												1.14	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.90	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	103.03	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	113.34	109.22	105.09	100.97	96.85	92.73	92.73	96.85	100.97	105.09	109.22	113.34	
∑(44)1...12 =												1236.40	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	168.08	147.00	151.69	132.25	126.89	109.50	101.47	116.44	117.83	137.32	149.89	162.77	
∑(45)1...12 =												1621.12	(45)
Distribution loss 0.15 x (45)m	25.21	22.05	22.75	19.84	19.03	16.43	15.22	17.47	17.67	20.60	22.48	24.42	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

50.96	46.03	50.96	49.32	49.35	45.73	47.25	49.35	49.32	50.96	49.32	50.96	(61)

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

219.03	193.03	202.65	181.56	176.25	155.23	148.72	165.79	167.14	188.27	199.21	213.73	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

219.03	193.03	202.65	181.56	176.25	155.23	148.72	165.79	167.14	188.27	199.21	213.73

∑(64)1...12 = 2210.62 (64)

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

68.62	60.38	63.18	56.30	54.53	47.84	45.55	51.05	51.51	58.40	62.17	66.86	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.07	24.93	20.27	15.35	11.47	9.69	10.47	13.60	18.26	23.18	27.06	28.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.27	302.37	294.55	277.89	256.86	237.09	223.89	220.78	228.61	245.27	266.30	286.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	(71)
Water heating gains (Table 5)	92.24	89.86	84.92	78.20	73.29	66.45	61.23	68.62	71.54	78.49	86.34	89.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	489.05	486.63	469.21	440.91	411.10	382.70	365.05	372.48	387.88	416.42	449.18	474.25	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.58	x	46.75	x 0.9 x	0.72	x	0.70	=	172.76	(78)
Horizontal	1.00	x	4.50	x	26.00	x 0.9 x	0.72	x	0.70	=	53.07	
West	0.77	x	0.94	x	19.64	x 0.9 x	0.72	x	0.70	=	6.45	(80)
East	0.77	x	0.94	x	19.64	x 0.9 x	0.72	x	0.70	=	6.45	(76)
West	1.00	x	1.89	x	26.61	x 0.9 x	0.72	x	0.70	=	22.81	(80)

Solar gains in watts ∑(74)m...(82)m

261.54	464.51	677.60	896.24	1045.58	1053.70	1009.55	897.50	754.15	525.53	316.93	221.34	(83)

Total gains - internal and solar (73)m + (83)m

750.59	951.14	1146.81	1337.14	1456.68	1436.40	1374.60	1269.98	1142.03	941.95	766.11	695.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C)		21.00	(85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.98	0.93	0.82	0.63	0.47	0.53	0.79	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.73	19.94	20.24	20.59	20.85	20.97	20.99	20.99	20.91	20.54	20.05	19.69	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.96	19.96	19.96	19.97	19.97	19.97	19.97	19.97	19.97	19.97	19.96	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.97	0.91	0.76	0.54	0.36	0.42	0.71	0.95	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.80	19.01	19.31	19.65	19.87	19.96	19.97	19.97	19.92	19.60	19.13	18.76	(90)

Living area fraction	Living area ÷ (4) =	0.14	(91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.93	19.14	19.44	19.78	20.01	20.10	20.11	20.11	20.06	19.73	19.25	18.89	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.93	19.14	19.44	19.78	20.01	20.10	20.11	20.11	20.06	19.73	19.25	18.89	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.91	0.76	0.56	0.38	0.43	0.72	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	748.40	942.28	1112.85	1211.39	1112.38	799.46	521.85	548.86	819.47	892.47	760.53	694.19	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2214.33	2152.27	1953.42	1633.70	1246.41	820.75	524.30	553.50	891.13	1369.93	1827.10	2213.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1090.65	813.11	625.38	304.06	99.72	0.00	0.00	0.00	0.00	355.23	767.93	1130.04	

	∑(98)1...5, 10...12 =	5186.12	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	39.50	(99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		91.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	1188.07	885.74	681.24	331.22	108.62	0.00	0.00	0.00	0.00	386.96	836.53	1230.98	

	∑(211)1...5, 10...12 =	5649.37	(211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	87.10	86.85	86.33	85.08	82.63	79.50	79.50	79.50	79.50	85.34	86.71	87.18	(217)

Water heating fuel, kWh/month

251.49	222.25	234.74	213.40	213.31	195.26	187.07	208.54	210.24	220.61	229.74	245.17

∑(219a)1...12 = 2631.82 (219)

Annual totals

Space heating fuel - main system 1			5649.37	
Water heating fuel			2631.82	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			495.67	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	8851.86	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5649.37	x	3.48	x 0.01 =	196.60	(240)
Water heating	2631.82	x	3.48	x 0.01 =	91.59	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	495.67	x	13.19	x 0.01 =	65.38	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	483.46	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.15	(257)
SAP value	83.93	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	5649.37	x	0.22	=	1220.26	(261)
Water heating	2631.82	x	0.22	=	568.47	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1788.74	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	495.67	x	0.52	=	257.25	(268)
Total CO_2, kg/year				(265)...(271) =	2084.92	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.88	(273)
EI value					84.15	
EI rating (section 14)					84	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5649.37	x	1.22	=	6892.23	(261)
Water heating	2631.82	x	1.22	=	3210.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		10103.05	(265)

Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	495.67	x	3.07	=	1521.71	(268)
Primary energy kWh/year					11855.01	(272)
Dwelling primary energy rate kWh/m2/year					90.30	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	Plot 8 The Old School Park Lane, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		50.54	(1a)	x	2.35	(2a)	=	118.77	(3a)
+1		44.62	(1b)	x	2.70	(2b)	=	120.47	(3b)
+2		41.85	(1c)	x	2.70	(2c)	=	113.00	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	137.01	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			352.24	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(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, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.11	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.26	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.20	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.26	0.26	0.25	0.22	0.22	0.19	0.19	0.19	0.20	0.22	0.23	0.24	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	(24d)

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

0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.53	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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.72	x	1.20	=	4.46			(26)
Window			12.46	x	1.33	=	16.52			(27)
Roof window			6.39	x	1.33	=	8.47			(27a)
Basement floor			50.54	x	0.10	=	5.05			(28)
External wall			97.25	x	0.20	=	19.45			(29a)
Basement wall			34.76	x	0.18	=	6.26			(29)
Party wall			69.11	x	0.00	=	0.00			(32)
Roof			27.09	x	0.10	=	2.71			(30)
Roof			18.49	x	0.12	=	2.22			(30)
Roof			1.11	x	0.15	=	0.17			(30)
Total area of external elements ∑A, m²			251.81							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	65.31	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.35	(36)
Total fabric heat loss	(33) + (36) =	82.66	(37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
62.06	61.91	61.76	61.05	60.92	60.31	60.31	60.19	60.54	60.92	61.19	61.47	(38)

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

144.72	144.57	144.42	143.71	143.58	142.96	142.96	142.85	143.20	143.58	143.85	144.12	

Average = ∑(39)1...12/12 = 143.71 (39)

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

1.06	1.06	1.05	1.05	1.05	1.04	1.04	1.04	1.05	1.05	1.05	1.05	

Average = ∑(40)1...12/12 = 1.05 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.91	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	103.34	(43)

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	
113.67	109.54	105.41	101.27	97.14	93.01	93.01	97.14	101.27	105.41	109.54	113.67	

∑(44)1...12 = 1240.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

168.58	147.44	152.14	132.64	127.27	109.83	101.77	116.78	118.18	137.72	150.34	163.26	

∑(45)1...12 = 1625.94 (45)

Distribution loss 0.15 x (45)m

25.29	22.12	22.82	19.90	19.09	16.47	15.27	17.52	17.73	20.66	22.55	24.49	(46)

Water storage loss calculated for each month (55) x (41)m

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

50.96	46.03	50.96	49.32	49.50	45.87	47.39	49.50	49.32	50.96	49.32	50.96	(61)

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

219.53	193.46	203.10	181.96	176.77	155.69	149.17	166.28	167.49	188.68	199.65	214.22	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

219.53	193.46	203.10	181.96	176.77	155.69	149.17	166.28	167.49	188.68	199.65	214.22	

∑(64)1...12 = 2216.02 (64)

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

68.79	60.53	63.33	56.43	54.69	47.98	45.69	51.21	51.62	58.53	62.32	67.02	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	145.56	145.56	145.56	145.56	145.56	145.56	145.56	145.56	145.56	145.56	145.56	145.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.95	25.72	20.91	15.83	11.84	9.99	10.80	14.03	18.84	23.92	27.92	29.76	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.99	309.16	301.16	284.13	262.62	242.41	228.91	225.74	233.74	250.77	272.28	292.49	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-116.45	-116.45	-116.45	-116.45	-116.45	-116.45	-116.45	-116.45	-116.45	-116.45	-116.45	-116.45	(71)
Water heating gains (Table 5)	92.46	90.07	85.12	78.38	73.51	66.64	61.41	68.82	71.70	78.67	86.55	90.08	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	497.07	494.62	476.86	448.00	417.64	388.72	370.79	378.26	393.94	423.03	456.41	482.00	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.58	x	46.75	x 0.9 x	0.72	x	0.70	=	172.76	(78)
Horizontal	1.00	x	4.50	x	26.00	x 0.9 x	0.72	x	0.70	=	53.07	
West	0.77	x	0.94	x	19.64	x 0.9 x	0.72	x	0.70	=	6.45	(80)
East	0.77	x	0.94	x	19.64	x 0.9 x	0.72	x	0.70	=	6.45	(76)
West	1.00	x	1.89	x	26.61	x 0.9 x	0.72	x	0.70	=	22.81	(80)

Solar gains in watts ∑(74)m...(82)m

261.54	464.51	677.60	896.24	1045.58	1053.70	1009.55	897.50	754.15	525.53	316.93	221.34	(83)

Total gains - internal and solar (73)m + (83)m

758.61	959.13	1154.46	1344.24	1463.22	1442.42	1380.34	1275.77	1148.09	948.57	773.34	703.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Utilisation factor for gains for living area n1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	0.98	0.93	0.80	0.61	0.45	0.51	0.77	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.84	20.04	20.33	20.66	20.89	20.98	21.00	20.99	20.93	20.60	20.14	19.80	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.04	20.04	20.04	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.04	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.91	0.75	0.53	0.36	0.41	0.70	0.95	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.98	19.18	19.46	19.78	19.97	20.04	20.05	20.05	20.01	19.73	19.28	18.94	(90)

Living area fraction — Living area ÷ (4) = 0.12 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.08	19.28	19.56	19.88	20.08	20.15	20.16	20.16	20.12	19.83	19.38	19.04	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.08	19.28	19.56	19.88	20.08	20.15	20.16	20.16	20.12	19.83	19.38	19.04	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.90	0.75	0.54	0.37	0.42	0.70	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	756.76	951.06	1121.29	1214.05	1099.49	778.96	507.06	533.76	807.91	898.64	768.33	702.17	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2138.50	2078.30	1886.17	1577.78	1203.00	793.08	508.47	536.57	861.65	1324.95	1766.33	2138.41	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1028.02	757.50	569.07	261.88	77.01	0.00	0.00	0.00	0.00	317.17	718.56	1068.56	

∑(98)1...5, 10...12 = 4797.79 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 35.02 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		91.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1119.85	825.17	619.91	285.28	83.89	0.00	0.00	0.00	0.00	345.50	782.75	1164.01

∑(211)1...5, 10...12 = 5226.35 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	87.01	86.74	86.15	84.74	82.11	79.50	79.50	79.50	79.50	85.09	86.60	87.10	(217)

Water heating fuel, kWh/month

252.31	223.05	235.75	214.73	215.29	195.84	187.63	209.16	210.68	221.75	230.55	245.95

∑(219a)1...12 = 2642.70 (219)

Annual totals

Space heating fuel - main system 1			5226.35	
Water heating fuel			2642.70	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			511.34	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	8455.39	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5226.35	x	3.48	x 0.01 =	181.88	(240)
Water heating	2642.70	x	3.48	x 0.01 =	91.97	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	511.34	x	13.19	x 0.01 =	67.45	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	471.18	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.09	(257)
SAP value	84.83	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	5226.35	x	0.22	=	1128.89	(261)
Water heating	2642.70	x	0.22	=	570.82	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1699.72	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	511.34	x	0.52	=	265.38	(268)
Total CO_2, kg/year				(265)...(271) =	2004.02	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.63	(273)
EI value					85.25	
EI rating (section 14)					85	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5226.35	x	1.22	=	6376.14	(261)
Water heating	2642.70	x	1.22	=	3224.10	(264)
Space and water heating				(261) + (262) + (263) + (264) =	9600.24	(265)

Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	511.34	x	3.07	=	1569.80	(268)
Primary energy kWh/year					11400.30	(272)
Dwelling primary energy rate kWh/m2/year					83.21	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mrs Nicola Battista	Assessor number	3998
Client	The Halebourne Group	Last modified	26/08/2014
Address	Plot 9 The Old School Park Lane, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		54.80	(1a)	x	2.35	(2a)	=	128.78	(3a)
+1		48.78	(1b)	x	2.70	(2b)	=	131.71	(3b)
+2		27.71	(1c)	x	2.70	(2c)	=	74.82	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	131.29	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			335.30	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(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, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.12	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.27	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.23	(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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(24d)

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

0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.72	x	1.20	=	4.46			(26)
Window			12.46	x	1.33	=	16.52			(27)
Roof window			6.39	x	1.33	=	8.47			(27a)
Basement floor			54.80	x	0.10	=	5.48			(28)
External wall			110.66	x	0.20	=	22.13			(29a)
Basement wall			51.47	x	0.18	=	9.26			(29)
Party wall			61.28	x	0.00	=	0.00			(32)
Roof			38.64	x	0.10	=	3.86			(30)
Roof			10.03	x	0.12	=	1.20			(30)
Roof			1.11	x	0.15	=	0.17			(30)
Total area of external elements ∑A, m²			289.28							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	71.57	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		19.77	(36)
Total fabric heat loss	(33) + (36) =	91.33	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	60.04	59.85	59.67	58.83	58.67	57.94	57.94	57.81	58.22	58.67	58.99	59.33	(38)
Heat transfer coefficient, W/K (37)m + (38)m	151.37	151.19	151.01	150.17	150.01	149.27	149.27	149.14	149.56	150.01	150.33	150.66	
Average = ∑(39)1...12/12 =												150.17	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.15	1.15	1.15	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.15	
Average = ∑(40)1...12/12 =												1.14	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.90	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	103.03	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	113.34	109.22	105.09	100.97	96.85	92.73	92.73	96.85	100.97	105.09	109.22	113.34	
∑(44)1...12 =												1236.40	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	168.08	147.00	151.69	132.25	126.89	109.50	101.47	116.44	117.83	137.32	149.89	162.77	
∑(45)1...12 =												1621.12	(45)
Distribution loss 0.15 x (45)m	25.21	22.05	22.75	19.84	19.03	16.43	15.22	17.47	17.67	20.60	22.48	24.42	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

50.96	46.03	50.96	49.32	49.35	45.73	47.25	49.35	49.32	50.96	49.32	50.96	(61)

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

219.03	193.03	202.65	181.56	176.25	155.23	148.72	165.79	167.14	188.27	199.21	213.73	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

219.03	193.03	202.65	181.56	176.25	155.23	148.72	165.79	167.14	188.27	199.21	213.73

∑(64)1...12 = 2210.62 (64)

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

68.62	60.38	63.18	56.30	54.53	47.84	45.55	51.05	51.51	58.40	62.17	66.86	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	144.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.07	24.93	20.27	15.35	11.47	9.69	10.47	13.60	18.26	23.18	27.06	28.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.27	302.37	294.55	277.89	256.86	237.09	223.89	220.78	228.61	245.27	266.30	286.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	37.49	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	-115.93	(71)
Water heating gains (Table 5)	92.24	89.86	84.92	78.20	73.29	66.45	61.23	68.62	71.54	78.49	86.34	89.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	489.05	486.63	469.21	440.91	411.10	382.70	365.05	372.48	387.88	416.42	449.18	474.25	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.58	x	46.75	x 0.9 x	0.72	x	0.70	=	172.76	(78)
Horizontal	1.00	x	4.50	x	26.00	x 0.9 x	0.72	x	0.70	=	53.07	
West	0.77	x	0.94	x	19.64	x 0.9 x	0.72	x	0.70	=	6.45	(80)
East	0.77	x	0.94	x	19.64	x 0.9 x	0.72	x	0.70	=	6.45	(76)
West	1.00	x	1.89	x	26.61	x 0.9 x	0.72	x	0.70	=	22.81	(80)

Solar gains in watts ∑(74)m...(82)m

261.54	464.51	677.60	896.24	1045.58	1053.70	1009.55	897.50	754.15	525.53	316.93	221.34	(83)

Total gains - internal and solar (73)m + (83)m

750.59	951.14	1146.81	1337.14	1456.68	1436.40	1374.60	1269.98	1142.03	941.95	766.11	695.59	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00	(85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.98	0.93	0.82	0.63	0.47	0.53	0.79	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.73	19.94	20.24	20.59	20.85	20.97	20.99	20.99	20.91	20.54	20.05	19.69	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.96	19.96	19.96	19.97	19.97	19.97	19.97	19.97	19.97	19.97	19.96	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.97	0.91	0.76	0.54	0.36	0.42	0.71	0.95	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.80	19.01	19.31	19.65	19.87	19.96	19.97	19.97	19.92	19.60	19.13	18.76	(90)

Living area fraction	Living area ÷ (4) =	0.14	(91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.93	19.14	19.44	19.78	20.01	20.10	20.11	20.11	20.06	19.73	19.25	18.89	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.93	19.14	19.44	19.78	20.01	20.10	20.11	20.11	20.06	19.73	19.25	18.89	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.91	0.76	0.56	0.38	0.43	0.72	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	748.40	942.28	1112.85	1211.39	1112.38	799.46	521.85	548.86	819.47	892.47	760.53	694.19	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2214.33	2152.27	1953.42	1633.70	1246.41	820.75	524.30	553.50	891.13	1369.93	1827.10	2213.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1090.65	813.11	625.38	304.06	99.72	0.00	0.00	0.00	0.00	355.23	767.93	1130.04	

	∑(98)1...5, 10...12 =	5186.12	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	39.50	(99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		91.80	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	1188.07	885.74	681.24	331.22	108.62	0.00	0.00	0.00	0.00	386.96	836.53	1230.98	

	∑(211)1...5, 10...12 =	5649.37	(211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	87.10	86.85	86.33	85.08	82.63	79.50	79.50	79.50	79.50	85.34	86.71	87.18	(217)

Water heating fuel, kWh/month

251.49	222.25	234.74	213.40	213.31	195.26	187.07	208.54	210.24	220.61	229.74	245.17

∑(219a)1...12 = 2631.82 (219)

Annual totals

Space heating fuel - main system 1			5649.37	
Water heating fuel			2631.82	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			495.67	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	8851.86	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5649.37	x	3.48	x 0.01 =	196.60	(240)
Water heating	2631.82	x	3.48	x 0.01 =	91.59	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	495.67	x	13.19	x 0.01 =	65.38	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	483.46	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.15	(257)
SAP value	83.93	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	5649.37	x	0.22	=	1220.26	(261)
Water heating	2631.82	x	0.22	=	568.47	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1788.74	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	495.67	x	0.52	=	257.25	(268)
Total CO_2, kg/year				(265)...(271) =	2084.92	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.88	(273)
EI value					84.15	
EI rating (section 14)					84	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5649.37	x	1.22	=	6892.23	(261)
Water heating	2631.82	x	1.22	=	3210.82	(264)
Space and water heating				(261) + (262) + (263) + (264) =	10103.05	(265)

Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	495.67	x	3.07	=	1521.71	(268)
Primary energy kWh/year					11855.01	(272)
Dwelling primary energy rate kWh/m2/year					90.30	(273)

APPENDIX C

Code for Sustainable Homes Ene7 Worksheet

Code for Sustainable Homes for Multiple Dwellings

NHER

Energy averaging for the Code for Sustainable Homes Ene 1 and Ene 2 is permitted where a building contains multiple dwellings. For Ene 1 the area weighted average DER and TER must be calculated in accordance with the block averaging methodology defined in clauses 4.6 and 4.14 of the ADL1A. For apartment blocks it is acceptable to assess Ene 2 based on area weighted average FEE. The area weighted FEE must be calculated in accordance with the methodology defined in clause 4.6 of ADL1A. The use of energy averaging to assess performance against Ene 2 is at the discretion of the developer and Assessor.

Assessor name	Mr Victor Battista	Assessor number	3472
		Created	26/08/2014

Energy Averaging

URN	Vrs	Address	Built Form	DER	TER	FEE	Floor Area (m^2)	DER x Floor Area	TER x Floor Area
0912006	2	6 The Old School Park Lane	Semi-detached	10.52	18.02	-1.0	76.73	807.20	1382.67
0912005	2	5 The Old School Park Lane	Enclosed mid	8.72	16.40	-1.0	89.29	778.61	1464.36
0912004	2	4 The Old School Park Lane	Enclosed end	11.02	18.00	-1.0	83.76	923.04	1507.68
0912003	2	3 The Old School Park Lane	Enclosed end	18.47	22.01	-1.0	60.01	1108.38	1320.82
0912002	2	2 The Old School Park Lane	Enclosed mid	9.42	16.83	-1.0	79.20	746.06	1332.94
						Total	**388.99**	**4363.29**	**7008.47**

Multiple dwelling DER = 11.22

Multiple dwelling TER = 18.02

Multiple dwelling FEE = -1.0

Ene 1 Results

Ene 1 using energy averaging = 37.7 % improvement*

4.1 credits

*100 x (1 - (DER/TER))

Ene 2 Results

Mid terrace and apartment blocks

Number of dwellings of this type = 2

FEE using energy averaging = -1

credits = 9

End terrace, semi-detached and detached

Number of dwellings of this type = 3

FEE using energy averaging = -1

credits = 9

Ene 2 credits using energy averaging for all dwelling types = 9

(Flats-MidTerrace-TFA x Flats-MidTerrace-Credits) + (Detached-Semi-TFA x Detached-Semi-Credits) / (TFA-All-Dwellings)

(168.49 x 9) + (220.5 x 9) / (388.99)

Plan Assessor version 6.1.0
SAP version 9.90

Code for Sustainable Homes for Multiple Dwellings

Energy averaging for the Code for Sustainable Homes Ene 1 and Ene 2 is permitted where a building contains multiple dwellings. For Ene 1 the area weighted average DER and TER must be calculated in accordance with the block averaging methodology defined in clauses 4.6 and 4.14 of the ADL1A. For apartment blocks it is acceptable to assess Ene 2 based on area weighted average FEE. The area weighted FEE must be calculated in accordance with the methodology defined in clause 4.6 of ADL1A. The use of energy averaging to assess performance against Ene 2 is at the discretion of the developer and Assessor.

Assessor name	Mr Victor Battista	Assessor number	3472
		Created	26/08/2014

Energy Averaging

URN	Vrs	Address	Built Form	DER	TER	FEE	Floor Area (m²)	DER x Floor Area	TER x Floor Area
0614009	2	Plot 9 The Old School Park Lane	End-terrace	7.71	16.03	-1.0	131.29	1012.25	2104.58
0614008	2	Plot 8 The Old School Park Lane	Mid-terrace	6.46	14.44	-1.0	137.01	885.08	1978.42
0614007	2	Plot 7 The Old School Park Lane	End-terrace	7.71	16.03	-1.0	131.29	1012.25	2104.58
						Total	**399.59**	**2909.58**	**6187.58**

Multiple dwelling DER = 7.28

Multiple dwelling TER = 15.48

Multiple dwelling FEE = -1.0

Ene 1 Results

Ene 1 using energy averaging = 53.0 % improvement*

5.4 credits

*100 x (1 - (DER/TER))

Ene 2 Results

Mid terrace and apartment blocks

Number of dwellings of this type = 1

FEE using energy averaging = -1

credits = 9

End terrace, semi-detached and detached

Number of dwellings of this type = 2

FEE using energy averaging = -1

credits = 9

Ene 2 credits using energy averaging for all dwelling types = 9

(Flats-MidTerrace-TFA x Flats-MidTerrace-Credits) + (Detached-Semi-TFA x Detached-Semi-Credits) / (TFA-All-Dwellings)

(137.01 x 9) + (262.58 x 9) / (399.59)

CSH Ene 7 Assessment Tool

Code Addendum 2014 - Revision 00 (England Only)

Job no:	The Old School, Park Lane, Richmond
Assessment date:	July 2014
Assessor name:	Victor Battista
Registration no:	200
Development name:	The Old School, Park Lane, Richmond

Ene 7 Dwelling Assessment

				Energy Type 1	2	3	4	5	6	7	8	9
			Description	Plot 7	Plot 8	Plot 9	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Standard case DER	SAP Worksheet Version 9.92	$kgCO_2/m^2/yr$	SAP box [273] or [384]	15.88	14.63	15.88	0.00	24.59	32.68	27.13	24.77	27.80
Floor area	SAP Worksheet Version 9.92	m^2	SAP box [4]	131.29	137.01	131.29		79.20	60.01	83.76	89.29	76.23
CO_2 emissions from electrical appliances		$kgCO_2/m^2/yr$		13.46	13.18	13.46		16.23	17.01	16.01	15.72	16.37
CO_2 emissions from Cooking		$kgCO_2/m^2/yr$		1.44	1.38	1.44		2.24	2.78	2.15	2.04	2.31
Standard case CO_2 emissions		$kgCO_2/m^2/yr$	Equivalent to SAP box [ZC8]	**30.77**	**29.19**	**30.77**		**43.06**	**52.47**	**45.28**	**42.52**	**46.48**

Actual case DER	SAP Worksheet Version 9.92	$kgCO_2/m^2/yr$	SAP box [273] or [384]	9.50	8.70	9.50	16.25	15.20	20.25	17.00	14.80	17.20
Are SAP Section 16 allowances sought?			Select from drop down menus	No	No	No	No	No	No	No	No	No
Residual CO_2 emissions offset from biomass CHP	SAP Worksheet Version 9.92	$kgCO_2/m^2/yr$	SAP Section 16 SAP box [ZC5]									
CO_2 reduction from additional allowable electricity	SAP Worksheet Version 9.92	$kgCO_2/m^2/yr$	SAP Section 16 SAP box [ZC7]									
Actual case CO_2 emissions		$kgCO_2/m^2/yr$	Equivalent to SAP box [ZC8]	**24.39**	**23.26**	**24.39**		**33.67**	**40.04**	**35.15**	**32.55**	**35.88**

Ene 7 Results

			Energy Type 1	2	3	4	5	6	7	8	9
		Description	Plot 7	Plot 8	Plot 9	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
% improvement in actual / standard case CO_2 emissions	%		**20**	**20**	**20**		**21**	**23**	**22**	**23**	**22**
Ene 7 Credits			**2**	**2**	**2**		**2**	**2**	**2**	**2**	**2**

All values to be taken from box numbers described within the worksheets set out within The Government's Standard Assessment Procedure for the Energy Ratings of SAP Worksheet Version 9.92, October 2013.

APPENDIX D

Code for Sustainable Homes Pre-Assessments

The Old School, Park Lane, Richmond, TW9 2AR

22 August 2014

House Type: **Dwellings 2 - 6 - Energy averaging used for Ene1 and 2 and to achieve CSH Level 4. All other Categories to achieve CSH Level 3.**

Category	Section	Description	Credits Available	Credits	Dwellings 2 - 6 Weighted Score	Code Level	Comment	Approved/Confirmed
Energy	Ene1	Dwelling Emissions energy averaged ≥ 32%	10	4.10	4.80	4	Ground Floor U-Value=0.10	
	Ene2	Building Fabric energy averaged	9	9.00	10.53	4	External Wall U-Value=0.25; Timber Walls U-Values =0.25 and 0.23	
							Party Wall U-Value=0.00 - fully filled and sealed	
							Roof Pitched=0.11; Roof Other=0.14	
							Windows U-Value=1.2; Rooflights U-value=1.40	
							Doors U-Value=1.2	
							Y-Value=0.07 Units 1-6; 0.069 for Units 7 and 9; 0.074 for Unit 8.	
							Air Permeability Rate=4	
							Mechanical Ventilation with heat recovery 94% efficient and with a SFP of 0.45 to Units 7 - 9 and extract fans to Units 1-6.	
							Condensing Combination Boiler=Sedbuk - Efficiency 89.5%	
							Heating Controls=Zone control and weather compensator and waste flue gas recovery system	
							100% Low energy light fittings	
	Ene3	Energy Display Devices	2	2	2.34	3	That the correctly specified energy display device is dedicated to the dwelling and the consumption data displayed by the correctly specified energy display device	
	Ene4	Drying Space	1	1	1.17	3	Drying= 6m+ of Drying Line	
	Ene5	White Goods A+ Rated plus Leaflet	2	1	1.17	3	A= Rated White Goods	
	Ene6	External Lighting	2	1	1.17	3	Energy Efficient External Lighting	
	Ene7	LZCT	2	2	2.34	3	PV Panels=1KwPeak (approx. 8m2 per roof)	
	Ene8	Cycle Storage	2	1	1.17	3	Safe, secure and weather-proof storage for 1 cycle, 2m long x 1.5m wide.	
	Ene9	Home Office	1	1	1.17	3	Provision in 2nd or 3rd Bedroom for 1.8m long desk and chair and also 2 double electric sockets and a telephone point.	
		Total	31	22.1	25.86			
Water	Wat1	Internal Potable Water	5	3	4.50	3	To achieve 105 litres/person/day. Waste water recovery system.	
	Wat2	External Water Use	1	1	1.50	3	Water butts - 200 litre for each property	
		Total	6	4	6.00			
Materials	Mat1	Environmental Impact of Materials	15	10	3.00	3	10 of 15 Credits taken	
	Mat2	Responsible Sourcing Basic Building Materials	6	3	0.90	3	3 Credits taken	
	Mat3	Responsible Sourcing Internal Elements	3	1	0.30	3	1 Credits taken	
		Total	24	14	4.20			
Surface Water	Sur1	Reduction of Surface Water Run-Off	2	2	1.10	3	Site is in an area of low flood risk	
	Sur2	Flood Risk	2	2	1.10	3	Site is in an area of low flood risk	
		Total	4	4	2.20			
Waste	Was1	Recycling and Storage	4	4	3.20	3	Local Authority collection, pre-collection sorting, 30 litre total capacity. Internal storage of 3 bins all with 7 litre minimum capacity	
	Was2	SWMP	3	1	0.80	3	1 Credit taken	
	Was3	Composting	1	1	0.80	3	Green waste bin provide by LBRUT	
		Total	8	6	4.80			
Pollution	Pol1	Global Warming Potential	1	1	0.70	3	All insulation to have GWP of less than 5	
	Pol2	N0x Emissions	3	3	2.10	3	Dry N0x levels for boiler to be less than 40mg/kWh.	
		Total	4	4	2.80			
Health & Wellbeing	Hea1	Daylighting	3	0	0.00	0	0 Credit not taken at this stage. Potential to gain credits on issue of detailed layouts and elevations. NB Home Office window has to achieve	
	Hea2	Sound Insulation	4	3	3.51	3	5dB Higher/lower taken. Lower value to account for the requirement for Party Walls to be insulated under Building Regulations 2010	
	Hea3	Private Space	1	1	1.17	3	Private outdoor space of 4.5m2 provided	
	Hea4	Lifetime Homes	4	0	0.00	0	30% Lifetime Homes compliant	
		Total	12	4	4.68			
Management	Man1	Home User Guide	3	3	3.33	3	To be provided and compiled using Checklist Man1 and in an appropriate format for users	
	Man2	Considerate Constructor's Scheme	2	1	1.11	3	The site will be signed up to the Considerate Constructor's Scheme and will be appropriately audited to achieve minimum credit	
	Man3	Site Impacts	2	1	1.11	3	A record to be maintained for on-site water usage and diesel consumption	
	Man4	Secured By Design	2	1	1.11	3	This credit is attained through the requirement of the LPA and the Design Guide to ensure that the requirements of Secured by Design are considered.	
		Total	9	6	6.66			
Ecology	Eco1	Environmental Value of The Site	1	1	1.33	3	Compliance has been assumed for Eco1 - Eco4. A qualified Ecologist should be appointed prior to works commencing on site	
	Eco2	Ecological Enhancement	1	1	1.33	3		
	Eco3	Protection of Ecological Features	1	1	1.33	3		
	Eco4	Change of Ecological Value of the Site	4	2	2.66	3		
	Eco5	Building Footprint	2	0	0.00	0		
		Total	9	5	6.65			
		Grand Total	107	69.1	63.85			
		Pre-Assessment Score (rounded down)			63			
		Code for Sustainable Homes Level			3			
		PASS/FAIL			PASS			

MONITOR energy consultancy

The Old School, Park Lane, Richmond, TW9 2AR

22 August 2014

House Type	Dwellings 7 - 9 - Energy averaging used for Ene1 and 2 and to achieve CSH Level 4. All other Categories to achieve CSH Level 3.							
					Dwellings 7 - 9 Weighted Score	Code Level		Approved/Confirmed
Category	Section	Description	Credits Available	Credits			Comment	
Energy	Ene1	Dwelling Emissions energy averaged ≥ 32%	10	5.40	6.32	4	Ground Floor U-Value=0.10	
	Ene2	Building Fabric energy averaged	9	9.00	10.53	4	External Wall U-Value=0.25; Timber Walls U-Values =0.25 and 0.23	
							Party Wall U-Value=0.00 - fully filled and sealed	
							Roof Pitched=0.11; Roof Other=0.14	
							Windows U-Value=1.2; Rooflights U-value=1.40	
							Doors U-Value=1.2	
							Y-Value=0.07 Units 1-6; 0.069 for Units 7 and 9; 0.074 for Unit 8.	
							Air Permeability Rate=4	
							Mechanical Ventilation with heat recovery 94% efficient and with a SFP of 0.45 to Units 7 - 9 and extract fans to Units 1-6.	
							Condensing Combination Boiler=Sedbuk - Efficiency 89.5%	
							Heating Controls=Zone control and weather compensator and waste flue gas recovery system	
							100% Low energy light fittings	
	Ene3	Energy Display Devices	2	2	2.34	3	That the correctly specified energy display device is dedicated to the dwelling and the consumption data displayed by the correctly specified energy display device	
	Ene4	Drying Space	1	1	1.17	3	Drying= 6m+ of Drying Line	
	Ene5	White Goods A+ Rated plus Leaflet	2	1	1.17	3	A= Rated White Goods	
	Ene6	External Lighting	2	1	1.17	3	Energy Efficient External Lighting	
	Ene7	LZCT	2	2	2.34	3	PV Panels=1KwPeak (approx. 8m2 per roof)	
	Ene8	Cycle Storage	2	1	1.17	3	Safe, secure and weather-proof storage for 1 cycle, 2m long x 1.5m wide.	
	Ene9	Home Office	1	1	1.17	3	Provision in 2nd or 3rd Bedroom for 1.8m long desk and chair and also 2 double electric sockets and a telephone point.	
		Total	31	23.4	27.38			
Water	Wat1	Internal Potable Water	5	3	4.50	3	To achieve 105 litres/person/day. Waste water recovery system.	
	Wat2	External Water Use	1	1	1.50	3	Water butts - 200 litre for each property	
		Total	6	4	6.00			
Materials	Mat1	Environmental Impact of Materials	15	10	3.00	3	10 of 15 Credits taken	
	Mat2	Responsible Sourcing Basic Building Materials	6	3	0.90	3	3 Credits taken	
	Mat3	Responsible Sourcing Internal Elements	3	1	0.30	3	1 Credits taken	
		Total	24	14	4.20			
Surface Water	Sur1	Reduction of Surface Water Run-Off	2	2	1.10	3	Site is in an area of low flood risk	
	Sur2	Flood Risk	2	2	1.10	3	Site is in an area of low flood risk	
		Total	4	4	2.20			
Waste	Was1	Recycling and Storage	4	4	3.20	3	Local Authority collection, pre-collection sorting, 30 litre total capacity. Internal storage of 3 bins all with 7 litre minimum capacity	
	Was2	SWMP	3	1	0.80	3	1 Credit taken	
	Was3	Composting	1	1	0.80	3	Green waste bin provide by LBRUT	
		Total	8	6	4.80			
Pollution	Pol1	Global Warming Potential	1	1	0.70	0	All insulation to have GWP of less than 5	
	Pol2	N0x Emissions	3	3	2.10	0	Dry N0x levels for boiler to be less than 40mg/kWh.	
		Total	4	4	2.80			
Health & Wellbeing	Hea1	Daylighting	3	0	0.00	0	0 Credit not taken at this stage. Potential to gain credits on issue of detailed layouts and elevations. NB Home Office window has to achieve	
	Hea2	Sound Insulation	4	3	3.51	3	5dB Higher/lower taken. Lower value to account for the requirement for Party Walls to be insulated under Building Regulations 2010	
	Hea3	Private Space	1	1	1.17	3	Private outdoor space of 4.5m2 provided	
	Hea4	Lifetime Homes	4	0	0.00	0	30% Lifetime Homes compliant	
		Total	12	4	4.68			
Management	Man1	Home User Guide	3	3	3.33	3	To be provided and compiled using Checklist Man1 and in an appropriate format for users	
	Man2	Considerate Constructor's Scheme	2	1	1.11	3	The site will be signed up to the Considerate Constructor's Scheme and will be appropriately audited to achieve minimum credit	
	Man3	Site Impacts	2	1	1.11	3	A record to be maintained for on-site water usage and diesel consumption	
	Man4	Secured By Design	2	1	1.11	3	This credit is attained through the requirement of the LPA and the Design Guide to ensure that the requirements of Secured by Design are considered.	
		Total	9	6	6.66			
Ecology	Eco1	Environmental Value of The Site	1	1	1.33	3	Compliance has been assumed for Eco1 - Eco4. A qualified Ecologist should be appointed prior to works commencing on site	
	Eco2	Ecological Enhancement	1	1	1.33	3		
	Eco3	Protection of Ecological Features	1	1	1.33	3		
	Eco4	Change of Ecological Value of the Site	4	2	2.66	3		
	Eco5	Building Footprint	2	0	0.00	0		
		Total	9	5	6.65			
		Grand Total	107	70.4	65.37			
		Pre-Assessment Score (rounded down)			65			
		Code for Sustainable Homes Level			3			
		PASS/FAIL			PASS			