New Dwellings
45-49 Station Road
Hampton

Residential
Energy Report

October 2015

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CONTENTS

Revision Log		
First Issue	20151028	Planning Report

Our ref: X:\SRH\Reports\SRH Sustainability Report October 2015 A

1.0 Introduction

Clive Chapman Sustainability Consultants have been appointed to carry out a sustainability assessment and energy statement for the new build dwellings of a proposed development at 45-49 Station Road, Hampton.

The scheme involves the demolition of the existing car showroom and workshops, and redevelopment of the site to comprise of a new car showroom, associated car repair workshop, and eight new-build residential units. Of the eight dwellings, six are three-bedroom dwellings, and two are two-bedroom flats located on the first floor above the car showroom fronting Station Road.

A sustainability assessment for the commercial aspect of the scheme is provided as a separate report and has been prepared by Metroplis Green.[1]

For new build dwellings, the London Borough of Richmond upon Thames (LBRuT) has a Sustainable Construction Checklist, the current sustainability criteria are listed below. A detailed study has been carried out to assess options to meet these criteria:

- Assessment of the development using the London Borough of Richmond Thames Sustainable Construction Checklist (September 2015).
- A maximum water consumption of 105 litres per person, per day.
- A minimum reduction in carbon dioxide emissions of 35% over Building Regulations Approved Document L1A 2010, 2013 edition.
- Endeavour to achieve reductions of 20% of the predicted carbon dioxide emissions by on-site renewable energy generation (Policy DM SD 2).

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[1] See submitted report 'BREEAM Pre-assessment' for further information.

2.0 LBRUT Sustainable Construction Checklist

2.1 SCC Requirements:

The Sustainable Construction Checklist states that all developments and applications undertaken in the London Borough of Richmond will be expected to be assessed against the following seven checklist items:

2.2 SCC Assumptions and Compliance:

Category	**Score**
Minimum Policy Compliance	8
Energy Use and Pollution	15
Transport[1]	9
Biodiversity	15
Flooding and Drainage	3
Improving Resource Efficiency	7
Design Standards and Accessibility	5
TOTAL	63

The score above, assesses the development as a whole (commercial and residential uses) as the SCC (Sep 2015) does not have methods to determine a mixed use scheme. Elements that contribute to the sustainability of the site – that do not fall within residential use – should not be overlooked in determining the assessment of the overall development.

An overall score of 63 credits will be achieve a A rating. Please see Appendix A for the completed Sustainable Construction Checklist.

3.0 Water Efficiency Measures

At construction stage, the Water Efficiency Calculator for new dwellings will be used to calculate the water usage for the dwellings.

Suggested flow rates of fittings to meet the required maximum of 105 litres/per person/day are listed here:

WC full/part flush:	5/3 litres
Basin/Kitchen taps:	6 litres/minute
Bath capacity:	160 litres to overflow
Shower (if separate from bath taps):	7 litres/minute

4.0 Energy Efficiency Measures

This section sets out the detailed analysis and results of the annual CO_2 emission calculations of the proposed dwelling. The dwelling has been modelled using the Government Standard Assessment Procedure (SAP) 2012 to determine the impact of building services options and to investigate the use of renewable energy sources, their impact on emissions, and their approximate cost of installation. The reductions of CO_2 emissions achieved through the application of renewable energy technologies have been tested and calculated in accordance with London Borough of Richmond upon Thames' Sustainable Construction Checklist Guidance adopted in September 2015.

Notes:
Please note that assumptions will have to be confirmed by an M&E Consultant and that any changes will have an impact on the SAP results and therefore the achieved reduction in CO2 and % Renewables.

4.1 Suitable Renewable/Low or Zero Carbon Technologies

The London Plan was published in 2004 and stipulates that the development plans for all London Boroughs should eventually comply with the requirements. The Mayor's Energy Hierarchy, described in the London Plan, comprises three stages of application: use less energy, use renewable energy and supply energy efficiently. This hierarchy has been adopted for this project and various high efficiency communal services systems and renewable energy systems have been investigated.

The LBRuT Sustainable Construction Checklist (SCC) requires the development to reduce the predicted site CO_2 emissions by at least 35% over Building Regulations Approved Document L1A 2010, 2013 edition through the use of high efficiency building fabric and on-site renewable energy generation. In addition, it is encouraged that the developments seek to provide 20% reductions in CO_2 through the use of onsite renewable technologies (Policy DM SD 2).

The feasibility of renewable energy systems for this development has been investigated using the broad guidelines published by the Mayor of London in the document *Integrating Renewable Energy into New Developments: A toolkit for planners, Developers and Consultants*. (Normally referred to as *The Toolkit*.) The Toolkit includes a list of renewable energy system options which should be considered for specific building types in London.

The table below summarises the systems available and their suitability for this project:

Renewable energy technologies suitable for London

System	Preliminary Assessment	Decision
Wind generators	Planning and local community issues associated with noise and visual obstruction. Average wind speeds in urban/suburban locations are unlikely to achieve the required speed of 6 m/s.	Rejected.
Photovoltaic, roof top	The proposed dwellings have either pitched or flat roofs suitable for the application of photovoltaic panels. They are a commonly used renewable technology and not prohibitively expensive.	**Likely to be suitable for this site.**
Solar water heating	The building has a pitched roof that can be used for Solar Thermal tubes. However, the contribution of solar hot water towards the LBRuT 20% renewables target is significantly lower than the contribution of Photovoltaic Panels. The reason being that the solar water panels reduce the running times of the gas boiler for space & hot water generation, whereas PVs reduce the electricity consumption of the building, and electricity generation has a larger carbon footprint.	May be suitable for this site.
Biomass CHP	Limited suppliers to the London area. Biomass CHP is a renewable and energy efficient system providing electricity and space and hot water heating. However, CHP systems are more suitable for applications where there is a high heat demand throughout the year. The building fabric has been designed to be efficient and airtight, and therefore should not require high levels of heating.	Rejected.
Ground source heat pumps for heating (space and hot water)	Ground area available to each unit is not sufficient enough to accommodate horizontal pipe system. Ground may be accessible for vertical pipe systems. The most appropriate use would be a low temperature system such as underfloor heating. Secondary heating unit for hot water would be needed.	Rejected.
Ground sourced inc. borehole cooling, either direct or via a chiller	There is no need of a mechanical cooling system for the proposed dwellings.	Rejected.

Acceptable renewable energy technologies (not covered in detail in the toolkit); 'London renewables, Toolkit for planners, developers and consultants' September 2004

System	Preliminary Assessment	Decision
Micro-hydro, small and low head	Some limited applications in London.	Rejected
Gas from anaerobic digestion	Technology being developed.	Rejected
Geothermal heat, hot rocks	Could be available in London but unlikely due to geology under London.	Rejected
Solar air collectors	Very small energy contribution and difficult to calculate and measure.	Rejected
Ground cooling air systems	No experience currently in the UK.	Rejected
Fuel cells using hydrogen from renewable sources	Not currently commercially available.	Rejected

LZC technologies (not covered in the toolkit; www.lowcarbonbuildings.org.uk/micro/)

System	*Preliminary Assessment*	*Decision*
External and Exhaust Air source heat pumps for heating (space and hot water)	Air is an easily accessible means of heating, the most appropriate use would be low temperature system such as under floor heating. However, as it runs on electricity the contribution of the system to the 20% renewable target is very low.	Rejected
Micro Combined Heat and Power (CHP)	Micro CHP units are energy efficient systems generating electricity and providing space and hot water heating. These gas fired systems are available for domestic use, although are more suitable for dwellings with a high annual heat demand. Also these systems are fairly cost prohibitive in comparison with other more efficient renewable technologies.	Rejected
Biomass heating. Fuels – wood, pellets, woodchips, some industrial waste products.	Biomass heating is a renewable energy technology. However, the system requires extensive space for storing the fuel (chips/pellets). The London Plan advises that the use of Biomass should be limited.	Rejected

4.2 Energy Effeciency Measures: Options, Calculations and Results

Options have been modelled using NHER SAP 2012 to calculate the energy use of the properties and predict the reduction of CO_2 emissions achieved through the application of building envelope upgrades and renewable energy technologies.

The two proposed dwellings that have been analysed represent the worst case scenarios out of the two flat and six house types. They have been picked as worse case scenarios based upon their orientation, number of exposed sides, number of openings, size, and available roof space to accommodate renewable technologies. The other dwellings not modelled should therefore perform similarly or exceed the values shown in these calculations.

No community heating schemes are in close proximity to the site, therefore this option was not investigated further.

4.2.1 FLAT 1

Option	Specification	DER/TER Variance **BREGS L1A 2012 TARGET 0%** **LBRUT TARGET -35%**	**% reduction through renewables**
Flat Base Case	**DER** U values in accordance with BRegs L1A 2013 minimum allowable limiting parameters -Floors u =0.25W/m²K -External wall u =0.3W/m²K -Party Walls u =0.2W/m²K -Roofs u =0.2W/m²K -Windows / Doors u =2.0W/m²K U-value of first floor subject to heat loss to commercial premises below (heated, but on a different schedule) is	**61.84%**	**n/a**

	assumed to be reduced by a factor of 2 in accordance with guidance in "The Governments Standard Assessment Procedure for Energy Rating of Dwellings" SAP 2012. u =0.12W/m^2K -Air tightness 10 m^3/hrm^2 -50% energy efficient lighting -Thermal bridging: default 0.15. Services in accordance with CSH Table Cat 1.2 Standard CO2 emissions Calculation -Instantaneous regular boiler 88% efficient (SEDBUK 2009)		
Flat Improved Case	Improved build ups/services chosen to reach BRegs L1A 2013 -Insulated ground floor u =0.11W/m^2K -External walls u =0.15W/m^2K -Party wall to flat u =0W/m^2K -Main roof u =0.12W/m^2K -Windows u =1.1W/m^2K -Front Door u =1.0W/m^2K -First floor heat loss to commercial below u =0.1W/m^2K -Thermal bridging: 0.0507 calculated. -Air tightness 4.5 m^3/hrm^2 -Instantaneous Combi boiler 90% efficient -100% energy efficient lighting -1 no. 320 Wp Sunpower panels* Overall approx. 3.2m^2, 0.64kWp, mounted at 30˚ angle on pitched roof all panels South West facing.	**-4.12%**	**4.59%**
Flat Proposed Case	Build ups/services as 'Improved Case' with additional **PV** to meet LBRUT requirement: -First floor heat loss to commercial below u =0.1W/m^2K - 6no. 320kWp Sunpower PV panels Overall approx. 9.8m^2, 1.92kWp, mounted at 30˚ angle on pitched roof, all panels South West facing.	**-48.67%**	**27.97%**

* In reality, it is unlikely that this small number of PVs would be an appropriate installation but is included for illustration purposes

4.2.1 House 1 – End Terrace

Option	Specification	DER/TER Variance **BREGS L1A 2012 TARGET 0%** **LBRUT TARGET -35%**	**% reduction through renewables**
House Base Case	**DER** U values in accordance with BRegs L1A 2013 minimum allowable limiting parameters -Floors u =0.25W/m^{2}K -Basement Floor u =0.25W/m^{2}K -External wall u =0.3W/m^{2}K -Basment wall u =0.3W/m^{2}K -Party Walls u =0.2W/m^{2}K -Roofs u =0.2W/m^{2}K -Glass bay roof u =0.2W/m^{2}K -Windows / Doors u =2.0W/m^{2}K -Glass Bay Curtain wall u =2.0W/m^{2}K -Air tightness 10 m^3/hrm^2 -50% energy efficient lighting -Thermal bridging: default 0.15. Services in accordance with CSH Table Cat 1.2 Standard CO2 emissions Calculation -Instantaneous regular boiler 88% efficient (SEDBUK 2009)	**94.08%**	**n/a**
House Improved Case	Improved build ups/services chosen to reach BRegs L1A 2013 -Insulated ground floor u =0.11W/m^{2}K -Insulated basement Floor u =0.11W/m^{2}K -External wall u =0.15W/m^{2}K -Basment wall u =0.17W/m^{2}K -Party Walls u =0.2W/m^{2}K -Roofs u =0.12W/m^{2}K -Glass bay roof u =0.18W/m^{2}K -Windows u =1.1W/m^{2}K -Front Door u =1.1W/m^{2}K -Glass Bay Curtain wall u =1.2W/m^{2}K -Thermal bridging: 0.0639 calculated. -Air tightness 4.5 m^3/hrm^2 -Regular gas boiler 89.6% efficient -100% energy efficient lighting -3 no. 245 Wp Sunpower panels* Overall approx. 4.8m^2, 0.735kWp, mounted at 30˚ angle on pitched roof all panels South East	**-1.14%**	**-7.8%**

	facing.		
House Case 1	Build ups/services as 'Improved Case' with additional **PV** and **MVHR** to meet LBRUT requirement: - 6no. 320kWp Sunpower PV panels Overall approx. $9.8m^2$, 1.92kWp, mounted at 30˚ angle on pitched roof, 3 panels South East facing, 3 panels North West facing.	**-36.49%**	**19.30%**
House Case 2	Build ups/services as 'Improved Case' with additional **PV** and **MVHR** to meet LBRUT requirement: - 3no. 320kWp Sunpower PV panels Overall approx. $9.8m^2$, 1.92kWp, mounted at 30˚ angle on pitched roof, all panels South East facing	**-21.46%**	**11.0%**

* In reality, it is unlikely that this small number of PVs would be an appropriate installation but is included for illustration purposes.

4.3 Conclusion

It can be seen that both worst case residential unit types:

- Can achieve the LBRUT requirement to reduce the carbon dioxide emissions by at least 35% over Building Regulations AD L1A 2010, 2013 edition, and
- Both endeavour to offset the predicted carbon emissions by 20% through the use of renewable Energy Technologies.

Flat

As seen from the results, the worst case flat exceeds the required LBRuT targets by achieving a 48% reduction in CO_2 emissions, with a 27% reduction provided by photovoltaic panels (PVs). PV panels seem the most appropriate for the two flats because they can be positioned on the rear of the roof, ensuring that they do not impact the street scene along Station Road. They also require little maintenance, which is suitable for a flat of its nature.

House

We have shown on the submitted planning drawings and roof plan (see pg. 13) PV panels in accordance with the proposed 'House Case 1', which complies with the LBRuT requirement to reduce CO_2 emissions by at least 35%.

However, we recommend that the 'House Case 2' would be more suitable (without PV's on the front 'West' elevation) from a visual impact point of view, especially considering that the site is within a Conservation Area.

Other renewable technologies have been explored to improve 'House Case 2' without the additional PVs to the front elevation, although have been dismissed for the following reasons:

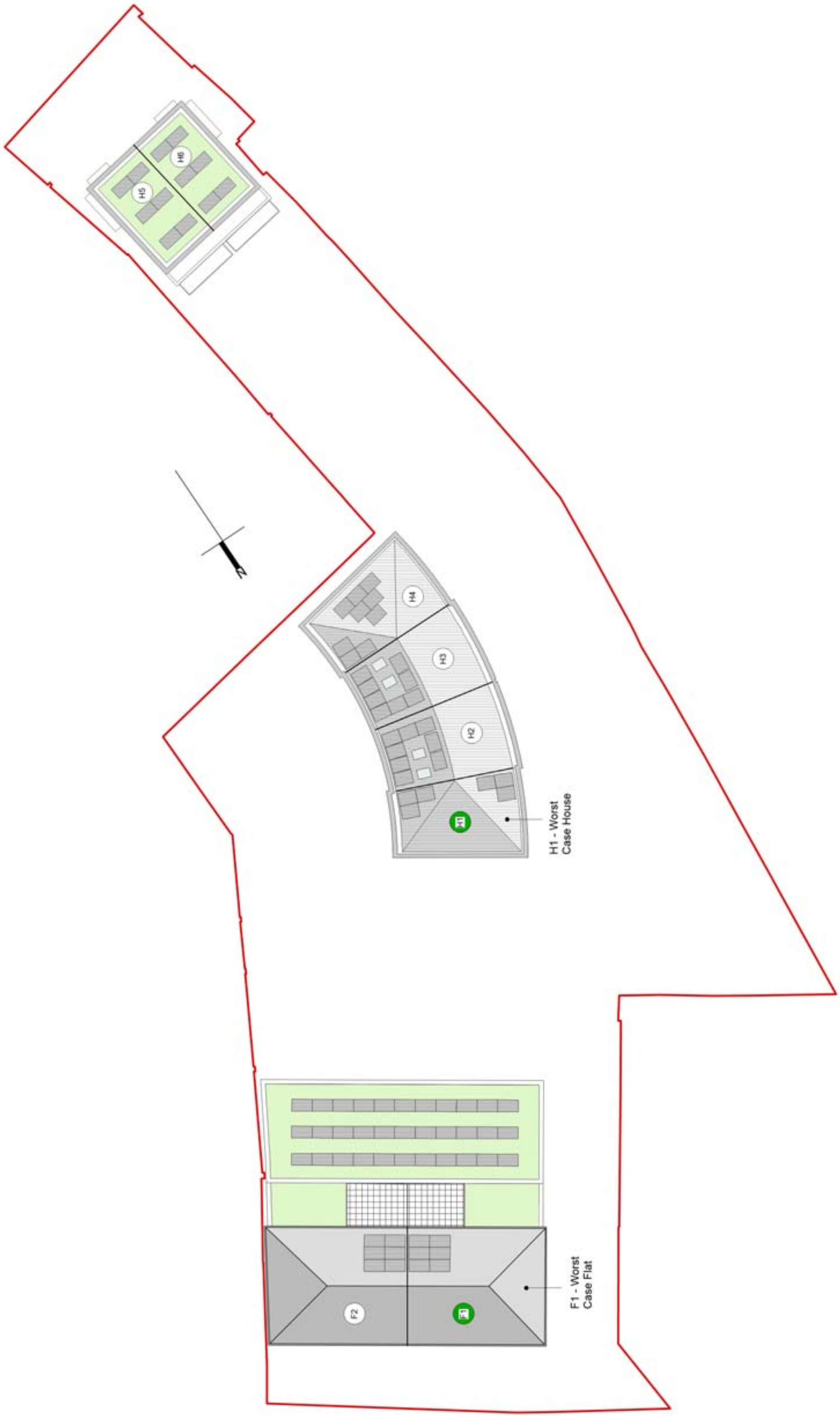
- Ground source heat pumps: Insufficient individual land footprint to be accommodated.

- Air source heat pumps: We have used these systems on other projects and have found them to be unneighbourly in terms of noise impact. This would be unacceptable for both the proposed terraced housing and existing neighbouring properties.
- Solar thermal: Orientation is not suitable to receive substantial hot water heating gains.

The recommended ‘House Case 2’ achieves a 21.46% CO_2 emission reduction over BRegs Part L 2013. Although this falls below LBRuT’s required target of 35% reduction, it must be noted that this dwelling is the worst case scenario. The other houses are likely to meet or surpass LBRuT’s target requirements based on their improved orientation/positioning. In addition, the roof size and orientation of the other houses can accommodate more PVs (see attached roof plan pg.13), without compromising the front elevations. Further improvements above the LBRuT target CO_2 reductions to these other five dwellings and two flats could be seen to offset the single unit (House Case 2) that is predicted to be below target level.

If the PV location of the proposed ‘House Case 1’ is seen to be contentious, we would be willing to discuss these matters with the LBRuT Urban design team, and for the recommended ‘House Case 2’ to be considered as an alternative.

Proposed roof layout:



4.4 Cost of options

A review of the most current information relating to the suitable option has been carried out to establish the likely costs of the complete system, and the sizing implications.

The cost for PV Panels has been based on quotations given by MCS installers and comparable developments.

The financial viability will need to be assessed against the financial incentives available and the overall development proposal.

Proposed Flat Case – Gas Combi-Boiler with 1.92 kWp 320Wp Photovoltaic Panels

1.92kWp (6 x 320Wp) Sunpower PV, which equals approx. 9.8m^2 of PV panels: £5,000.
Gas Combi-boiler, supply & installation: £2,500.

Total estimated cost for Boiler & PVs: £7,500.

House Case 1 – Gas Boiler, MVHR, and 1.92 kWp 320Wp Photovoltaic Panels

1.92kWp (6 x 320Wp) Sunpower PV, which equals approx. 9.8m^2 of PV panels: £5,000.
Gas boiler, supply & installation: £ TBC
MVHR system & installation: £ TBC

Total estimated cost for Boiler, MVHR, and PV’s: £ TBC

Grants available

For financial incentives for heat and electricity generating renewables, such as the Feed-In-Tariff (FIT) and the Domestic Renewable Heat Incentive (RHI) please refer to Appendix D.

PV’s are eligible for the Feed-In-Tariff (FIT) when an overall SAP D Rating has been achieved. Therefore, for each kWh of electricity generated, a guaranteed tariff will be paid over 20 years (see appendix D).

4.5 Calculations

FLAT

	Total kgCO2/yr		
Unit	Base Case	Improved Case	Proposed Case
Space Heating	1577	694	666
Secondary Heating	N/A	N/A	N/A
Hot Water Heating	587	521	521
Fixed Electrical	39	39	39
Lighting	282	188	188
Cooking	180	180	180
Appliances	1339	1339	1339
TOTAL	**4004**	**2961**	**2933**
% reduction overall[1]	n/a	26.05%	26.75%
Less amount of renewables	n/a	**136**	**820**
% reduction through renewables[2]	n/a	4.59%	27.97%
DER/TER variance	61.84%	-4.12%	-48.67%

HOUSE – END TERRACE

	Total kgCO2/yr			
Unit	Base Case	Improved Case	Case 1	Case 2
Space Heating	2141	1095	647	647
Secondary Heating	508	N/A	N/A	N/A
Hot Water Heating	649	589	596	596
Fixed Electrical	39	39	190	190
Lighting	470	274	274	274
Cooking	189	189	189	189
Appliances	1805	1805	1805	1805
TOTAL	**5800**	**3990**	**3700**	**3700**
% reduction overall[1]	n/a	31.2%	36.2%	36.2%
Less amount of renewables	n/a	**314**	**716**	**410**
% reduction through renewables[2]	n/a	7.8%	19.3%	11.0%
DER/TER variance	94.08%	-1.14%	-36.49%	-21.46%

[1] This is the total % reduction in kgCO2/year displaced by incorporation of energy efficiency measures.

[2] This is the total % reduction in kgCO2/year by the incorporation of renewable energy – after the incorporation of energy efficiency measures.

5.0 Appendices

Appendix A - LBRuT Sustainable Construction Checklist

LBRUT Sustainable Construction Checklist - Draft for Consultation, September 2015

This document forms part of the Sustainable Construction Checklist SPD. This document **must** be filled out as part of the planning application for the following developments: all residential development providing **one or more new residential units (including conversions leading to one or more new units)**, and all other forms of development providing **100sqm or more of non-residential floor space**. Developments including new non-residential development of less than 100sqm floor space, extensions less than 100sqm, and other conversions are strongly encouraged to comply with this checklist. Where further information is requested, please either fill in the relevant section, or refer to the document where this information may be found in detail, e.g. Flood Risk Assessment or similar. **Further guidance** on completing the Checklist may be found in the Justification and Guidance section of this SPD.

Property Name (if relevant): 45-49 Station Road
Application No. (if known):

Address (include. postcode): 45-49 Station Road, Hampton, TW12 2BU
Completed by: Metropolis Green Ltd
Clive Chapman Architects

For Non-Residential
Size of development (m2): 372

For Residential
Number of dwellings: 8

1 MINIMUM COMPLIANCE (RESIDENTIAL AND NON-RESIDENTIAL)

Energy Assessment

Has an energy assessment been submitted that demonstrates the expected energy and carbon dioxide emissions saving from energy efficiency and renewable energy measures, including the feasibility of CHP/CCHP and community heating systems? If yes, please tick. Yes

Carbon Dioxide emissions reduction

What is the carbon dioxide emissions reduction against a Building Regulations Part L (2013) baseline 35%

Policy DM SD 1 and London Plan Policy 5.2 (2015) require a 35% reduction in CO_2 emissions beyond Building Regulations 2013.

Percentage of **total** site CO2 emissions saved through renewable energy installation? 20.35%

1A MINIMUM POLICY COMPLIANCE (NON-RESIDENTIAL AND DOMESTIC REFURBISHMENT)

Please check the Guidance Section of this SPD for the policy requirements

Environmental Rating of development:

Non-Residential new-build (100sqm or more)
BREEAM Level: Excellent — Have you attached a pre-assessment to support this? ☑

Extensions and conversions for residential dwellings
BREEAM Domestic Refurbishment: Please Select — Have you attached a pre-assessment to support this? ☐

Extensions and conversions for non-residential buildings
BREEAM Level: Please Select — Have you attached a pre-assessment to support this? ☐

Score awarded for Environmental Rating:
BREEAM: Good = *0* , Very Good = 4, Excellent = *8,* Outstanding = *16*

Subtotal 8

1B MINIMUM POLICY COMPLIANCE (RESIDENTIAL)

Water Usage

Internal water usage limited to 105 litres person per day. (Excluding an allowance 5 litres per person per day for external water consumption). Calculations using the water efficiency calculator for new dwellings have been submitted. ☑ *1*

Subtotal 1

2. ENERGY USE AND POLLUTION

2.1 Need for Cooling

Score

a. How does the development incorporate cooling measures? Tick all that apply:

Energy efficient design incorporating specific heat demand to less than or equal to 15 kWh/sqm ☐ *6*
Reduce heat entering a building through providng/improving insulation and living roofs and walls ☑ *2*
Reduce heat entering a building through shading ☑ *3*
Exposed thermal mass and high ceilings ☐ *4*
Passive ventilation ☑ *3*
Mechanical ventilation with heat recovery ☑ *1*
Active cooling systems, i.e. Air Conditioning Unit ☐ *0*

2.2 Heat Generation

b. How have the heating and cooling systems, with preference to the heating system hierarchy, been selected (defined in London Plan policy **5.6**)? Tick all heating and cooling systems that will be used in the development:

Connection to existing heating or cooling networks powered by renewable energy ☐ *6*
Connection to existing heating or cooling networks powered by gas or electricity ☐ *5*
Site wide CHP network powered by renewable energy ☐ *4*
Site wide CHP network powered by gas ☐ *3*
Communal heating and cooling powered by renewable energy ☐ *2*
Communal heating and cooling powered by gas or electricity ☐ *1*
Individual heating and cooling ☑ *0*

2.3 Pollution: Air, Noise and Light

a. Does the development plan to implement reduction strategies for dust emissions from construction sites? ☐ *2*

b. Does the development plan include a biomass boiler? ☐ *-*

If yes, please refer to the biomass guidelines for the Borough of Richmond, please see guidance for supplementary information. If the proposed boiler is of a qualifying size, you may need to completed the information request form found on the Richmond website. ☐ *-*

c. Please tick only one option below

Has the development taken measures to reduce existing noise and enhance the existing soundscape of the site? ☑ *3*
Has the development taken care to not create any new noise generation/transmission issues in its intended operation? ☐ *1*

d. Has the development taken measures to reduce light pollution impacts on character, residential amenity and biodiversity? ☑ *3*

e. Have you attached a Lighting Pollution Report? ☐ *-*

Subtotal **15**

Please give any additional relevant comments to the Energy Use and Pollution Section below

A customer car parking will be incorporated into the site, which will minimise on-street car parking within the local area, and 10 cycle storage space will be provided for the employees/users of the car
Light Pollution: A more domestic approach to lighting rather than industrial.
Noise Pollution: Reduction in the size and scope of the existing workshops should positively improve noise pollution to the area.

3. TRANSPORT

3.1 Provision for the safe efficient and sustainable movement of people and goods

a. Does your development provide opportunities for occupants to use innovative travel technologies?

Please explain:

b. Does your development include charging point(s) for electric cars? ☑ *2*

c. **For major developments ONLY**: Has a Transport Assessment been produced for your development based on TfL's Best Practice Guidance?

If you have provided a Transport Assessment as part of your planning application, please tick here and move to Section 3 of this Checklist. ☐ *5*

d. **For smaller developments ONLY**: Have you provided a Transport Statement? ☑ *5*

e. Does your development provide cycle storage? (Standard space requirements are set out in the the Council's Parking Standards - DM DPD Appendix 4) ☑ *2*

If so, for how many bicycles? 24
Is this shown on the site plans? ☑ *-*

f. Will the development create or improve links with local and wider transport networks? If yes, please provide details. ☐ *2*

Subtotal **9**

Please give any additional relevant comments to the Transport Section below

An customer car parking will be incorporated into the site, which will minimise on-street car parking within the local area, and 10 cycle storage space will be provided for the employees/users of the ca
For the residential units, 2 secure cycle spaces are allocated to each of the 3-bed houses, and 1 secure cycle space is allocated to each of the 2-bed flats. Total of 14 assigned to residential

4 BIODIVERSITY

4.1 Minimising the threat to biodiversity from new buildings, lighting, hard surfacing and people

a. Does your development involve the loss of an ecological feature or habitat, including a loss of garden or other green space? (Indicate if yes) ☐ -2

If so, please state how much in sqm? ____ sqm

b. Does your development involve the removal of any tree(s)? (Indicate if yes) -☐

If so, has a tree report been provided in support of your application? (Indicate if yes) -☐

c. Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes) -☑

d. Please indicate which features and/or habitats that your development will incorporate to improve on site biodiversity:

Pond, reedbed or extensive native planting	6	☐	Area provided:		sqm
An extensive green roof	5	☑	Area provided:	247	sqm
An intensive green roof	4	☐	Area provided:		sqm
Garden space	4	☑	Area provided:		sqm
Additional native and/or wildlife friendly planting to peripheral areas	3	☑	Area provided:		sqm
Additional planting to peripheral areas	2	☑	Area provided:		sqm
A living wall	2	☐	Area provided:		sqm
Bat boxes	0.5	☑			
Bird boxes	0.5	☑			
Other	0.5	☐			

Subtotal 15

Please give any additional relevant comments to the Biodiversity Section below

5 FLOODING AND DRAINAGE

5.1 Mitigating the risks of flooding and other impacts of climate change in the borough

a. Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) ☐ -2

Have you submitted a Flood Risk Assessment? (Indicate if yes) ☐ -

b. Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick all that apply)

Store rainwater for later use	☐	5
Use of infiltration techniques such as porous surfacing materials to allow drainage on-site	☑	3
Attenuate rainwater in ponds or open water features	☐	4
Store rainwater in tanks for gradual release to a watercourse	☐	3
Discharge rainwater directly to watercourse	☐	2
Discharge rainwater to surface water drain	☐	1
Discharge rainwater to combined sewer	☑	0

c. Please give the change in area of permeable surfacing which will result from your development proposal: 1790 sqm

Please provide details of the permeable surfacing below

please represent a loss in permeable area as a negative number

Subtotal 3

Please give any additional relevant comments to the Flooding and Drainage Section below

Site is within Flood Zone 1
See 'SRH-05E Site Plan' for further information regarding permeable materials

6 IMPROVING RESOURCE EFFICIENCY

6.1 Reduce waste generated and amount disposed of by landfill though increasing level of re-use and recycling

a. Will demolition be required on your site prior to construction? *[Points will only be awarded if 10% or greater of demolition waste is reused/recycled* ☑ 1

If so, what percentage of demolition waste will be reused in the new development? ____ %

What percentage of demolition waste will be recycled? 10 %

b. Does your site have any contaminated land? ☑ 1

Have you submitted an assessment of the site contamination? ☑ 2

Are plans in place to remediate the contamination? ☐ 2

Have you submitted a remediation plan? ☐ 1

Are plans in place to include composting on site? ☐ 1

6.2 Reducing levels of water waste

a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply):

Fitting of water efficient taps, shower heads etc	☑	1
Use of water efficient A or B rated appliances	☑	1
Rainwater harvesting for internal use	☐	4
Greywater systems	☐	4
Fit a water meter	☑	1

Subtotal 7

Please give any additional relevant comments to the Improving Resource Efficiency Section below

Intrusive site contamination report to be submitted shortly

7 ACCESSIBILITY

7.1 Ensure flexible adaptable and long-term use of structures

a. **If the development is residential,** will it meet the requirements of the nationally described space standard for internal space and layout? ☑ *1*

If the standards are not met, in the space below, please provide details of the functionality of the internal space and layout

AND

b. **If the development is residential**, will it meet Building Regulation Requirement M4 (2) 'accessible and adaptable dwellings'? ☑ *2*

If this is not met, in the space below, please provide details of any accessibility measures included in the development.

For major residential developments, are 10% or more of the units in the development to Building Regulation Requirement M4 (3) 'wheelchair user dwellings'? ☐ *1*

OR

c. **If the development is non-residential,** does it comply with requirements included in Richmond's Design for Maximum Access SPG ☑ *2*

Please provide details of the accessibility measures specified in the Maximum Access SPG that will be included in the development

See Design and Access Statement for further information

Subtotal 5

Please give any additional relevant comments to the Design Standards and Accessibility Section below

See Design and Access Statement for further information

LBRUT Sustainable Construction Checklist- Scoring Matrix for ***New Construction*** **(Non-Residential and domestic refurb)**

TOTAL ***63***

Score	Rating	Significance
80 or more	*A+*	Project strives to achieve highest standard in energy efficient sustainable development
71-79	*A*	Makes a major contribution towards achieving sustainable development in Richmond
51-70	*B*	Helps to significantly improve the Borough's stock of sustainable developments
36-50	*C*	Minimal effort to increase sustainability beyond general compliance
35 or less	*FAIL*	Does not comply with SPD Policy

LBRUT Sustainable Construction Checklist- Scoring Matrix for New Construction **Residential new-build**

Score	Rating	Significance
81 or more	**A++**	Project strives to achieve highest standard in energy efficient sustainable development
64-80	*A+*	Project strives to achieve highest standard in energy efficient sustainable development
55-63	*A*	Makes a major contribution towards achieving sustainable development in Richmond
35-54	*B*	Helps to significantly improve the Borough's stock of sustainable developments
20-34	*C*	Minimal effort to increase sustainability beyond general compliance
19 or less	*FAIL*	Does not comply with SPD Policy

Authorisation:

I herewith declare that I have filled in this form to the best of my knowledge

Signature ______________________ Date 27.10.2015

Appendix B – Proposed Flat Case

SAP worksheet Flat 1

Sap 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 Lizzie Stokes	Assessor number	1031
Client		Last modified	22/10/2015
Address	45-49 Station Road, Hampton, TW12 2BU		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		6.40	(1a)	x	2.76	(2a)	=	17.66	(3a)
+1		77.16	(1b)	x	2.75	(2b)	=	212.19	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	83.56	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	229.85	(5)

2. Ventilation rate

				m^3 per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(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) =	30	÷ (5) =	0.13	(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		4.50	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.36	(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) =	0.30	(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	0.39	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.30	0.32	0.34	0.36	(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	
	0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

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

0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(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			2.30	x	1.00	=	2.30			(26)
Window			13.10	x	1.05	=	13.80			(27)
Ground floor			6.40	x	0.11	=	0.70			(28a)
Exposed floor			68.77	x	0.07	=	4.81			(28b
Party wall			29.77	x	0.00	=	0.00			(32)
External wall			71.94	x	0.15	=	10.79			(29a)
Roof			76.73	x	0.12	=	9.21			(30)
Total area of external elements ∑A, m²			239.24							(31)

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 41.62 (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 12.12 (36)

Total fabric heat loss (33) + (36) = 53.74 (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	
43.56	43.34	43.12	42.12	41.93	41.05	41.05	40.89	41.39	41.93	42.31	42.71	(38)

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

97.30	97.08	96.86	95.86	95.67	94.79	94.79	94.63	95.13	95.67	96.05	96.45

Average = ∑(39)1...12/12 = 95.86 (39)

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

1.16	1.16	1.16	1.15	1.14	1.13	1.13	1.13	1.14	1.14	1.15	1.15

Average = ∑(40)1...12/12 = 1.15 (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 94.21 (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
103.64	99.87	96.10	92.33	88.56	84.79	84.79	88.56	92.33	96.10	99.87	103.64

∑(44)1...12 = 1130.58 (44)

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

153.69	134.42	138.71	120.93	116.03	100.13	92.78	106.47	107.74	125.56	137.06	148.84

∑(45)1...12 = 1482.37 (45)

Distribution loss 0.15 x (45)m

23.05	20.16	20.81	18.14	17.41	15.02	13.92	15.97	16.16	18.83	20.56	22.33	(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	45.97	48.97	45.53	45.13	41.82	43.21	45.13	45.53	48.97	49.25	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	204.65	180.38	187.68	166.46	161.16	141.94	135.99	151.60	153.28	174.53	186.31	199.80	(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	204.65	180.38	187.68	166.46	161.16	141.94	135.99	151.60	153.28	174.53	186.31	199.80	

∑(64)1...12 = 2043.80 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	63.84	56.19	58.36	51.59	49.86	43.75	41.65	46.68	47.21	53.99	57.89	62.23	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	151.62	151.62	151.62	151.62	151.62	151.62	151.62	151.62	151.62	151.62	151.62	151.62	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	51.24	45.51	37.01	28.02	20.95	17.68	19.11	24.84	33.34	42.33	49.40	52.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	338.39	341.90	333.05	314.21	290.43	268.08	253.15	249.64	258.49	277.33	301.11	323.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.69	52.69	52.69	52.69	52.69	52.69	52.69	52.69	52.69	52.69	52.69	52.69	(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)	-101.08	-101.08	-101.08	-101.08	-101.08	-101.08	-101.08	-101.08	-101.08	-101.08	-101.08	-101.08	(71)
Water heating gains (Table 5)	85.81	83.61	78.44	71.66	67.02	60.76	55.99	62.75	65.57	72.57	80.40	83.64	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	581.66	577.25	554.74	520.12	484.63	452.75	434.47	443.45	463.62	498.45	537.13	565.99	(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	1.00	x	6.58	x	19.64	x 0.9 x	0.63	x	0.70	=	51.29	(80)
East	1.00	x	6.52	x	19.64	x 0.9 x	0.63	x	0.70	=	50.82	(76)

Solar gains in watts ∑(74)m...(82)m	102.12	199.76	328.98	479.80	588.01	601.94	573.07	492.26	382.62	237.04	127.33	83.98	(83)
Total gains - internal and solar (73)m + (83)m	683.78	777.01	883.72	999.92	1072.64	1054.69	1007.54	935.71	846.24	735.49	664.46	649.97	(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)	0.99	0.98	0.96	0.89	0.75	0.56	0.41	0.46	0.71	0.93	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.15	20.27	20.48	20.72	20.87	20.93	20.94	20.94	20.90	20.69	20.37	20.13	(87)

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

19.95	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.97	19.96	19.96	19.96	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.86	0.69	0.48	0.32	0.36	0.63	0.90	0.98	0.99	(89)

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

19.18	19.31	19.51	19.74	19.87	19.91	19.92	19.92	19.89	19.72	19.41	19.17	(90)

Living area fraction Living area ÷ (4) = 0.38 (91)

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

19.55	19.67	19.88	20.11	20.25	20.30	20.31	20.31	20.28	20.08	19.78	19.53	(92)

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

19.55	19.67	19.88	20.11	20.25	20.30	20.31	20.31	20.28	20.08	19.78	19.53	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.98	0.95	0.86	0.71	0.50	0.35	0.39	0.66	0.91	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	675.90	759.80	837.47	862.74	756.35	531.34	350.33	367.76	555.81	668.27	649.71	644.00	(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]													
	1483.69	1434.19	1295.57	1074.47	817.69	540.30	351.42	369.75	587.57	907.25	1217.60	1478.46	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	601.00	453.19	340.83	152.45	45.64	0.00	0.00	0.00	0.00	177.80	408.88	620.84	

∑(98)1...5, 10...12 = 2800.62 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) 33.52 (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 (%)		90.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	661.16	498.56	374.95	167.71	50.21	0.00	0.00	0.00	0.00	195.60	449.81	682.99	

∑(211)1...5, 10...12 = 3080.99 (211)

Water heating

Efficiency of water heater

88.10	87.78	87.04	85.33	82.83	80.80	80.80	80.80	80.80	85.60	87.48	88.22	(217)

Water heating fuel, kWh/month

232.28	205.51	215.63	195.07	194.57	175.67	168.31	187.62	189.70	203.90	212.98	226.49

∑(219a)1...12 = 2407.74 (219)

Annual totals

Space heating fuel - main system 1	3080.99
Water heating fuel	2407.74

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)		361.97	(232)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-1580.83	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4344.87	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3080.99	x	3.48	x 0.01 =	107.22	(240)
Water heating	2407.74	x	3.48	x 0.01 =	83.79	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	361.97	x	13.19	x 0.01 =	47.74	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-1580.83	x	13.19	x 0.01 =	-208.51	(252)
Total energy cost				(240)...(242) + (245)...(254) =	160.13	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.52	(257)
SAP value	92.70	
SAP rating (section 13)	93	(258)
SAP band	A	

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	3080.99	x	0.22	=	665.49	(261)
Water heating	2407.74	x	0.22	=	520.07	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1185.57	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	361.97	x	0.52	=	187.86	(268)
Energy saving/generation technologies						
pv savings	-1580.83	x	0.52	=	-820.45	(269)
Total CO_2, kg/year				(265)...(271) =	591.90	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	7.08	(273)
EI value					93.83	
EI rating (section 14)					94	(274)
EI band					A	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3080.99	x	1.22	=	3758.81	(261)
Water heating	2407.74	x	1.22	=	2937.44	(264)
Space and water heating				(261) + (262) + (263) + (264) =	6696.25	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)

Electricity for lighting	361.97	x	3.07	=	1111.26	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-1580.83	x	3.07	=	-4853.15	(269)
Primary energy kWh/year					3184.61	(272)
Dwelling primary energy rate kWh/m2/year					38.11	(273)

Appendix C – Proposed House Case

SAP worksheet House 1

Sap 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 Lizzie Stokes	Assessor number	1031
Client		Last modified	21/10/2015
Address	45-49 Station Road, Hampton, Middlesex, TW12 2BU		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		30.83	(1a)	x	2.20	(2a)	=	67.83	(3a)
+1		52.27	(1b)	x	2.80	(2b)	=	146.36	(3b)
+2		53.75	(1c)	x	2.70	(2c)	=	145.13	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	136.85	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			359.31	(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	0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(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		4.50	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.23	(18)
Number of sides on which the dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.21	(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	0.27	0.26	0.25	0.23	0.22	0.20	0.20	0.19	0.21	0.22	0.23	0.24	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.37	0.36	0.36	0.33	0.32	0.30	0.30	0.29	0.31	0.32	0.33	0.35	(24a)

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

0.37	0.36	0.36	0.33	0.32	0.30	0.30	0.29	0.31	0.32	0.33	0.35	(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			1.80	x	1.00	=	1.80			(26)
Window			14.63	x	1.05	=	15.41			(27)
Ground floor			20.77	x	0.11	=	2.28			(28a)
Basement floor			29.61	x	0.11	=	3.26			(28)
Ground floor			0.26	x	0.20	=	0.05			(28a)
Party wall			67.08	x	0.00	=	0.00			(32)
External wall			92.67	x	0.15	=	13.90			(29a)
External wall			5.17	x	1.10	=	5.69			(29a)
Basement wall			44.75	x	0.17	=	7.61			(29)
Basement wall			1.71	x	0.15	=	0.26			(29)
Roof			52.01	x	0.12	=	6.24			(30)
Roof			0.35	x	0.18	=	0.06			(30)
Total area of external elements ∑A, m²			263.73							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	56.56	(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		16.86	(36)
Total fabric heat loss	(33) + (36) =	73.43	(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)	43.38	42.76	42.15	39.06	38.44	35.36	35.36	34.74	36.59	38.44	39.68	40.91	(38)
Heat transfer coefficient, W/K (37)m + (38)m	116.81	116.19	115.57	112.49	111.87	108.79	108.79	108.17	110.02	111.87	113.11	114.34	
Average = ∑(39)1...12/12 =												112.34	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.85	0.85	0.84	0.82	0.82	0.79	0.79	0.79	0.80	0.82	0.83	0.84	
Average = ∑(40)1...12/12 =												0.82	(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	103.33	(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)	113.67	109.53	105.40	101.27	97.13	93.00	93.00	97.13	101.27	105.40	109.53	113.67	
∑(44)1...12 =												1239.99	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	168.56	147.43	152.13	132.63	127.26	109.82	101.76	116.77	118.17	137.71	150.33	163.24	
∑(45)1...12 =												1625.82	(45)
Distribution loss 0.15 x (45)m	25.28	22.11	22.82	19.89	19.09	16.47	15.26	17.52	17.73	20.66	22.55	24.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	200.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.84	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.13	(54)
Enter (50) or (54) in (55)	1.13	(55)

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

35.11	31.71	35.11	33.97	35.11	33.97	35.11	35.11	33.97	35.11	33.97	35.11	(56)

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

35.11	31.71	35.11	33.97	35.11	33.97	35.11	35.11	33.97	35.11	33.97	35.11	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

226.93	200.15	210.50	189.12	185.63	166.30	160.13	175.14	174.65	196.08	206.81	221.61	(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

226.93	200.15	210.50	189.12	185.63	166.30	160.13	175.14	174.65	196.08	206.81	221.61

∑(64)1...12 = 2313.07 (64)

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

102.74	91.20	97.28	89.29	89.01	81.70	80.53	85.52	84.48	92.49	95.17	100.97	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	174.65	174.65	174.65	174.65	174.65	174.65	174.65	174.65	174.65	174.65	174.65	174.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	74.71	66.36	53.97	40.86	30.54	25.78	27.86	36.21	48.61	61.72	72.03	76.79	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.42	461.16	449.22	423.81	391.74	361.59	341.46	336.72	348.65	374.06	406.14	436.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	(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)	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	(71)
Water heating gains (Table 5)	138.09	135.71	130.75	124.01	119.64	113.48	108.24	114.95	117.33	124.31	132.18	135.72	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	785.82	779.82	750.53	705.27	658.51	617.45	594.15	604.48	631.19	676.68	726.95	765.38	(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	1.00	x	3.74	x	10.63	x 0.9 x	0.63	x	0.70	=	15.78	(74)

East	1.00	x	1.99	x	19.64	x 0.9 x	0.63	x	0.70	=	15.51	(76)
South	1.00	x	7.66	x	46.75	x 0.9 x	0.63	x	0.70	=	142.14	(78)
North	0.77	x	1.24	x	10.63	x 0.9 x	0.63	x	0.70	=	4.03	(74)

Solar gains in watts ∑(74)m...(82)m	177.46	301.00	410.85	511.38	577.78	576.57	554.59	504.08	445.24	332.16	212.27	152.10	(83)
Total gains - internal and solar (73)m + (83)m	963.28	1080.81	1161.38	1216.65	1236.29	1194.02	1148.74	1108.56	1076.43	1008.84	939.21	917.48	(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)	0.99	0.99	0.97	0.91	0.78	0.58	0.42	0.45	0.68	0.92	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.42	20.52	20.66	20.82	20.92	20.96	20.96	20.96	20.95	20.83	20.61	20.41	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.21	20.21	20.21	20.23	20.24	20.26	20.26	20.26	20.25	20.24	20.23	20.22	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.96	0.89	0.74	0.51	0.35	0.38	0.62	0.90	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.67	19.78	19.92	20.09	20.17	20.22	20.22	20.22	20.20	20.10	19.88	19.68	(90)

Living area fraction Living area ÷ (4) = 0.23 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.84	19.95	20.08	20.25	20.34	20.38	20.39	20.39	20.37	20.27	20.04	19.84	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.69	19.80	19.93	20.10	20.19	20.23	20.24	20.24	20.22	20.12	19.89	19.69	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.88	0.73	0.51	0.34	0.37	0.62	0.89	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	955.09	1060.77	1111.08	1075.20	906.09	609.63	395.27	414.87	662.59	899.58	919.48	911.45	(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]	1797.90	1730.83	1552.65	1260.18	949.93	612.79	395.45	415.18	673.47	1064.66	1447.15	1771.54	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	627.05	450.28	328.53	133.19	32.62	0.00	0.00	0.00	0.00	122.82	379.92	639.90	

∑(98)1...5, 10...12 = 2714.31 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) 19.83 (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 (%)												90.60	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	692.11	497.00	362.61	147.01	36.00	0.00	0.00	0.00	0.00	135.56	419.34	706.29	

∑(211)1...5, 10...12 = 2995.92 (211)

Water heating

Efficiency of water heater	87.49	87.01	86.10	84.00	81.34	79.90	79.90	79.90	79.90	83.71	86.52	87.58	(217)
Water heating fuel, kWh/month	259.39	230.02	244.49	225.14	228.23	208.14	200.42	219.20	218.59	234.25	239.04	253.03	

∑(219a)1...12 = 2759.94 (219)

Annual totals

Space heating fuel - main system 1		2995.92	
Water heating fuel		2759.94	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	290.41		(230a)
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		365.41	(231)
Electricity for lighting (Appendix L)		527.78	(232)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-1381.32	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5267.73	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2995.92	x	3.48	x 0.01 =	104.26	(240)
Water heating	2759.94	x	3.48	x 0.01 =	96.05	(247)
Pumps and fans	365.41	x	13.19	x 0.01 =	48.20	(249)
Electricity for lighting	527.78	x	13.19	x 0.01 =	69.61	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-1381.32	x	13.19	x 0.01 =	-182.20	(252)
Total energy cost				(240)...(242) + (245)...(254) =	255.92	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.59	(257)
SAP value	91.75	
SAP rating (section 13)	92	(258)
SAP band	A	

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	2995.92	x	0.22	=	647.12	(261)
Water heating	2759.94	x	0.22	=	596.15	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1243.27	(265)

Pumps and fans	365.41	x	0.52	=	189.65	(267)
Electricity for lighting	527.78	x	0.52	=	273.92	(268)
Energy saving/generation technologies						
pv savings	-1381.32	x	0.52	=	-716.91	(269)
Total CO_2, kg/year				(265)...(271) =	989.93	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	7.23	(273)
EI value					92.71	
EI rating (section 14)					93	(274)
EI band					A	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2995.92	x	1.22	=	3655.03	(261)
Water heating	2759.94	x	1.22	=	3367.13	(264)
Space and water heating				(261) + (262) + (263) + (264) =	7022.16	(265)
Pumps and fans	365.41	x	3.07	=	1121.81	(267)
Electricity for lighting	527.78	x	3.07	=	1620.28	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-1381.32	x	3.07	=	-4240.66	(269)
Primary energy kWh/year					5523.59	(272)
Dwelling primary energy rate kWh/m2/year					40.36	(273)

Appendix D

Renewable Energy Technologies, Supporting Data

Photovoltaic Panels:

Photovoltaic systems convert sunlight into electricity through semi-conductor cells connected together and mounted into modules. Modules are connected to an inverter to turn their direct current (DC) output into alternating current (AC) electricity for use in the home and / or to export to the national grid. PV systems require only daylight, not sunlight to generate electricity, so energy can still be produced in overcast or cloudy conditions.

PV collectors can be 'bolted on' to a suitable roof, be integrated into the fabric of the roof and to the façade. In order to achieve the optimum results, any obstructions should be minimized and be placed on a pitch between 30-40˚.

Typical domestic systems range from 1 – 3.5kW$_p$ rating and can provide between 750 and 3,000kWh per year. From the DTI (domestic field trial performance analysis) domestic systems contribute on average 43% of the electrical load. Depending on the system, the efficiency of PVs range up to 15%.

PV Panels mounted above tiled roof

PV Panels semi-integrated to tiled roof

Fully installed the costs for roof mounted systems are approximately £2,500/kWp. There should be very little maintenance required as the technology has no moving parts. Technically reliable, they are generally guaranteed to last between 20-25 years.

Feed-In Tariffs and Selling Electricity:

In order to incentivise the generation of low carbon electricity, the Government launched the Feed-In-Tariff in April 2010. The tariff is a guaranteed payment which will be received for every kWh produced by an eligible technology. The amount received depends upon the type of technology and the date of installation, details of which are set-out at www.fitariffs.co.uk.

The technologies eligible for FITs include: wind; solar photovoltaics; hydro; anaerobic digestion; and domestic scale gas microCHP units.

In addition to the guaranteed FITs, producing electricity from renewable sources reduces the amount of conventionally generated electricity that needs to be bought from suppliers, further reducing costs. Any electricity produced in excess of the user's requirements can be sold back to the grid.

All applicable systems and installers need to be MCS certified and the house requires at least an EPC band D in solar to be eligible to receive the FIT.

New PV systems installed after April 2014 can be eligible for an index linked tariff per kWh generated. The tariff period is guaranteed for 20 years.

The tariff for exporting renewable electricity to the grid is 4.85p per kWh for all new solar PV installations between 1st April 2015 – 31st March 2016.