SEES Sadler Energy and Environmental Services	Client	Berkeley Homes		
	Development	Latchmere House, Church Road, Ham, Richmond TW10 5HH.		
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	Reason for version	Design Stage		

Energy Strategy

Project Name: Latchmere House, Richmond

Table of Contents

1.0 Introduction

1.1 Development Details

This Energy Strategy has been commissioned by Berkeley Homes in respect of a development proposal for HM Resettlement Prison, Latchmere House, Church Road, Ham, Richmond TW10 5HH. The full proposals include the construction of 73 dwellings through the conversion of the existing Latchmere House into 7 Flats and the demolition of existing buildings and the erection of 66 new build dwellings and builds upon the original Sustainably and Energy Assessment completed by Hoare LEA in February 2014.

The development runs across two separate planning authorities, the North East of the development is within the London Borough Richmond Upon Thames and includes plots 1 to 23, 55-62. The South West half of the development is under the authority of Royal Borough of Kingston Upon Thames and included plots 24-54 and 63-66.

The report has been commission to respond to both local planning authorities, both of which have different requirements.

The Royal Borough of Kingston Upon Thames Planning Decision reference DC/ANO/14/0451/FUL dated 31st March 2015 and the latter appeals decision reference APP/L5810/W/14/3002030 dated 3rd July 2015, in particular conditions 10 as detailed below and

> *No development shall take place, except for works of demolition, until a scheme to provide for the following has been submitted to and approved in writing by the local planning authority. The development shall be carried out in accordance with the approved scheme.*
>
> *a) All dwelling to meet the target for water use of 105 litres or less per person per day, excluding an allowance of 5 litres or less per person per day for external use.*
>
> *b) The development overall to achieve a 19% reduction in CO2 emissions over that required by the Building Regulations, 2013.*
>
> Condition 10: APP/L5810/W/14/3002030 pg 14. (03.07.2015)

Condition 15 of the original planning conditions, DC/ANO/14/0451/FUL, required that the development meets Code for Sustainable Homes (2010 – 2013 Addendum) to level 4, inline with MW3 of the Royal Borough of Kingston Upon Thames Unitary Development Plans First Alterations, Policies 5.3 Minimising Carbon Emission and 5.3 Sustainable Design and Development of the London Plan (July 2011) and Policy DM1 (Sustainable Design and Construction Standards) of the LDF Core Strategy adopted April 2012.

The London Borough Richmond Upon Thames planning decision reference 16/0523/VRC dated 18th April 2016, in particular conditions NS10 as detailed below:

NS10:

No development shall take place, except for works of demolition, until a scheme to provide for the following has been submitted to and approved in writing by the local planning authority. The development shall be carried out in accordance with the approved scheme.

a) All dwelling to meet the target for water use of 105 litres or less per person per day, excluding an allowance of 5 litres or less per person per day for external use.

b) The development overall to achieve a 35% reduction in CO2 emissions over that required by the Building Regulations, 2013, unless otherwise agreed in writing with the Local Planning Authority.

As energy strategy has therefore been proposed for the site, consisting of significant improvements in the energy efficiency performance of the building fabric with a view to maximise the energy savings over the life of the buildings, reduce on-going operational and maintenance costs, and maximise the benefits to future residents. Overall, the energy strategy will deliver reductions in energy to achieve a minimum 19% of the predicted energy requirement over 2013 building regulations for the SW part of the scheme and a minimum of 35% for the NE Side of the development.

The energy strategy for the consented scheme is considered an optimum solution for the site due to a number of reasons as discussed below.

- Advanced practice energy efficiency standards for new dwellings that will help to deliver alongside renewable and low carbon technologies a 19% reduction in Carbon over the site.
- ‘Fabric first’ approach - By using a fabric first approach, the demand for fossil fuels is reduced and therefore the residents are hedged against potential increases in fuel costs. The savings from energy bills and carbon emissions are also locked in for the life of the property.
- Future proofing - By concentrating on the difficult fabric elements to reduce carbon, the residents are enabled to upgrade their homes further with simple ‘bolt-on’ measures such as solar water heating or photovoltaic. The proposed strategy also allows residents to change their heating systems to newer emerging technologies in the knowledge that they already have a robust fabric. These measures would further reduce fuel bills and the CO2 emissions.

The purpose of this report is to set out client’s commitment to reduce energy and carbon emissions from the development by advanced practice energy efficiency standards with

renewable technology with the view to achieve either 19 or 35 percent reduction in Carbon over the site depending on the planning authority condition.

With regards to the conversion of Latchmere House, it will not be practical to meet current best practise building fabric within the constraints of the refurbishment, and as such this will be upgraded where possible to meet the requirements of L1B.

2.0 Summary of proposals

2.1 Proposed fabric

Since the strategy was originally developed there have been major changes to national, regional and local planning and energy policy. This has included a shift away from policies designed to stimulate the market for building integrated renewables and low carbon technologies to a more structured approach towards reducing energy demand and total carbon emissions. This growing focus on improved energy efficiency has resulted in a wider range of advanced performance building materials and products being available in the market and the previous strategy is no longer considered optimal in sustainability terms.

The Fabric Energy Efficiency has been calculated using L1A Conservation of Fuel and Power in New Dwellings (2013 edition) using SAP 2013 and L1B Fuel and Power in existing dwellings, 2010 edition (incorporating 2010, 2011 and 2013 amendments.)

Our client has designed the dwelling to improve fabric and efficiency performance thus future proofing reduction in $C0_2$ for the life of the dwelling. The proposed fabric specification is a follows achieving <50kWh/m2/year for the detached dwellings as a minimum for the new build dwellings, whilst the conversion of the existing property, Latchmere House, will be completed to the highest fabric standards achievable within the limitation of the conversion.

Heat loss floors:	0.11 W/m_2K
External walls:	0.17 W/m_2K
Roofs:	0.11 W/m_2K
Windows:	1.33 W/m_2K double glazed
Air leakage:	up to 5.0 m_3/hm_2 @ 50 Pa
Ventilation	Greenwood DMEV
Low energy lighting	100%
Thermal Bridging (accredited construction details)	y= < 0.08
Party Walls	Fully filled with edges sealed

The developer has provided SAP calculations which have been compiled by a qualified SAP assessor and all dwellings meet building regulation compliance. Space heating for all dwellings is provided by Baxi Megaflo 24 with full zone control and delayed start stat and load/weather compensator.

Carbon dioxide emissions have been calculated and all the dwellings achieve a ≥19.00% improvement over building regulation Part L1A 2013.

3.0 Proposed Technology

3.1. Photovoltaics

SAP ratings have been provided also by Sadler Energy and Environmental Services Ltd. Space heating for all dwellings is provided Gas Boiler with pumped hot water system with programmer and full zone control.

The specific energy consumption figures for space heating and hot water were then extracted from the SAP 2012 Dwelling Emission Rate (DER) for the actual dwelling emissions and the Target Emission Rate (TER) for notional dwelling used to meet Building Regulation Compliance. The results were then collated for the appropriate number of dwellings of each type and orientation to determine the overall figures for the development.

3.1.2 Description of technology

Photovoltaic panels convert energy from sunlight into electricity. They work in daylight, so do not require direct sunlight and are suitable for cloudy climate of the UK. However more energy will be produced in direct sunlight and in very shady positions on the photovoltaic panel will not function.

PV depends on the orientation of properties, roof pitch and weather on the level of efficiency achieved. The biggest barrier is cost but to offset these cost the government are offering small grants to assist with the purchasing cost of the PV system. Consideration as to the type of buildings the PV cells are put onto in view of the high initial cost and to optimise on the efficiency of the PV array. The PV systems are most efficient during the day, all year. Domestic properties do not fully benefit from this as the demand in the early morning and evening when the PV Cells are least efficient. Therefore consideration to installing the PV systems on commercial properties, and also the general design on large areas of available roof space offers good opportunity to maximise the efficiency of the PV system.

A typical domestic system would be between 1kWp to 2kWp which would have an output of 750 kWh per year per kWp. Systems would cost in the region of £6,000-£8,000.00 per kWp. The costs can vary from the type of system implemented, integrated tiles re more expensive than flat plat collectors but efficiency vary between the two systems. These factors should be taken into consideration when choosing the type of system.

3.1.3 Site Assessment

The South West side of the development under the planning authority of The Royal Borough of Kingston Upon Thames, which includes plots 24-54 and 63-65 and requires a minimum of 19% reduction in carbon emissions and is summarised in the following table.

	CO_2/year BASELINE	**CO_2/year ACTUAL**	**% Improvement**
SW Side of Development CO_2 emissions	101358.876	82972.515	**18.14%**

The North East side of the development under the planning authority of The London Borough of Richmond Upon Thames, which includes plots 1-13, which are earmarked for affordable housing. Plots 14-23 and 55-62, which all require a minimum of 35% reduction in carbon emissions and is summarised in the following table.

	CO_2/year BASELINE	**CO_2/year ACTUAL**	**% Improvement**
NE Side of Development CO_2 emissions	69819.5267	44602.178	**36.12%**

A full breakdown of the results, including individual PV Requirements can be found at the end of this document.

4.0 Conclusions

The report outlines the proposed fabric specification alongside amount of renewable energy required with different specification options to demonstrate that the development proposals are compatible with achieving a 19% and 35% site wide CO_2 reduction over the 2013 Building Regulation, as required by The Royal Borough of Kingston Upon Thames and The London Borough of Richmond Upon Thames planning authorities respectively, and that as the design progress there is reason to expect that compliance will be achieved.

Below is a summary of the site saving in Carbon (CO_2/year) which has been calculated using the Carbon Emission from space heating, hot water, pumps, fans, lighting and appliances in CO2/year from the house types as used in Appendix 2.

	CO_2/year BASELINE	**CO_2/year ACTUAL**	**% Improvement**
Kingston Planning Authority CO_2 emissions requirements	101358.876	82972.515	**18.14%**
Richmond Planning Authority CO_2 emissions requirement	69819.5267	44602.178	**36.12%**

In conclusion the site achieves a more robust approach to delivering an energy savings and sustainable development on site, minimising CO_2 emissions over the life of the buildings alongside the current proposed renewable energy technology to demonstrate that the development proposals are compatible with achieving Code level 4 (November 2010 2014 Addendum) and at least a 19% site wide reduction in CO_2.

A separate report has been submitted showing the Code for Sustainable Homes Assessment and water consumptions.

5.0 Appendices

Plots under the authority of The Royal Borough of Kingston Upon on Thames.

Target Emission Rates (TER)

			Space Heating		Hot Water		Pumps Fans		Lights Appliances	
Dwelling Type	Qty	Floor Area	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)
24	1	214.76	9305.266	2009.9374	2651.126	572.6432	205.3397	106.5713	667.0935	346.2215
25	1	214.76	9305.266	2009.9374	2651.126	572.6432	205.3397	106.5713	667.0935	346.2215
26	1	151.74	5721.9052	1235.9315	2634.0044	568.9449	169.2398	87.8355	549.8423	285.3682
27	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	87.8355	549.8423	87.8355
28	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	87.8355	549.8423	87.8355
29	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	87.8355	549.8423	87.8355
30	1	151.74	5721.9052	1235.9315	2634.0044	568.9449	169.2398	87.8355	549.8423	285.3682
31	1	174.1	6926.7809	1496.1847	2638.8299	569.9873	180.3158	93.5839	610.7478	316.9781
32	1	174.1	5957.4079	1286.8001	2646.8031	571.7095	180.3158	93.5839	610.7478	316.9781
33	1	174.1	6926.7809	1496.1847	2638.8299	569.9873	180.3158	93.5839	610.7478	316.9781
34	1	214.76	9305.266	2009.9374	2651.126	572.6432	205.3397	106.8713	667.0935	346.2215
35	1	214.76	9305.266	2009.9374	2651.126	572.6432	205.3397	106.8713	667.0935	346.2215
36	1	209.45	9447.7804	2040.7206	2648.105	571.9907	201.9239	104.7985	640.2941	332.3126
37	1	209.45	9447.7804	2040.7206	2648.105	571.9907	201.9239	104.7985	640.2941	332.3126
38	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
39	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
40	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215

41	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
42	1	191.25	7587.4879	1638.8974	2646.0256	571.5415	190.808	99.0671	629.2515	326.5815
43	1	191.25	7587.4879	1638.8974	2646.0256	571.5415	190.808	99.0671	629.2515	326.5815
44	1	261.67	13773.934	2975.1698	2664.6897	575.573	235.7076	122.3323	735.0978	381.5158
45	1	209.45	9203.3633	1987.9265	2649.4397	572.27902	201.9239	104.7985	640.2941	332.3126
46	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
47	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
48	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
49	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
50	1	209.45	9203.3633	1987.9265	2649.4397	572.279	201.9239	104.7985	640.2941	104.7985
51	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
52	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
53	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
54	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
63	1	261.67	13888.709	2999.9612	2664.7418	575.5842	235.7076	122.3323	735.0978	381.5158
64	1	243.03	10562.817	2281.5684	2666.4572	575.9547	227.6316	118.1408	653.3032	339.0644
65	1	261.67	13826.382	2986.4984	2664.8868	575.6156	235.7076	122.3323	735.0978	381.5158
66	1	279.96	13027.336	2813.9045	2679.1278	578.6916	245.8706	127.6068	723.9322	375.7208

Total Floor Area (m_2) (SAP Box 5)	7245.46
Total space heating (kWh/year) (SAP Box 85)	308910.7852
CO_2 from space heating (kg/year) (SAP Box 101)	66724.7294
Total hot water (kWh/year) (SAP Box 86a)	92775.2367
CO_2 from hot water (kg/year) (SAP Box 103)	20039.45042
Total electricity for pumps and fans (kWh/year) (SAP Box 87)	7042.5182

CO_2 from electricity for pumps and fans (kg/year) (SAP Box 108)	3655.7427	
Total electricity for lights and appliances (Kwh/year) (SAP Box 53)		22657.1591
CO_2 from electricity for lights and appliances (kg/year) (SAP Box 109)		10938.9531
Energy saving/generation technologies (kWh/year)		0
Total Energy demand from development (kWh/year)		**431385.6992**
CO_2 saving/generation technologies (kg/year)		0
Total CO_2 emissions from development (kg/year)		**101358.8756**

Plots under the authority of The Royal Borough of Kingston Upon on Thames.

Dwelling Emission Rates (DER)

			Space Heating		Hot Water		Pumps Fans		Lights Appliances	
Dwelling Type	Qty	Floor Area	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)
24	1	214.76	9305.266	2009.9374	2651.126	572.6432	205.3397	106.5713	667.0935	346.2215
25	1	214.76	9305.266	2009.9374	2651.126	572.6432	205.3397	106.5713	667.0935	346.2215
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27	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	87.8355	549.8423	87.8355
28	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	87.8355	549.8423	87.8355
29	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	87.8355	549.8423	87.8355
30	1	151.74	5721.9052	1235.9315	2634.0044	568.9449	169.2398	87.8355	549.8423	285.3682
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40	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
41	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
42	1	191.25	7587.4879	1638.8974	2646.0256	571.5415	190.808	99.0671	629.2515	326.5815

43	1	191.25	7587.4879	1638.8974	2646.0256	571.5415	190.808	99.0671	629.2515	326.5815
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53	1	214.76	8871.7255	1916.2927	2653.478	573.1512	205.3397	106.5713	667.0935	346.2215
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CO_2 from hot water (kg/year) (SAP Box 103)	20039.45042
Total electricity for pumps and fans (kWh/year) (SAP Box 87)	7042.5182
CO_2 from electricity for pumps and fans (kg/year) (SAP Box 108)	3655.7427
Total electricity for lights and appliances (Kwh/year) (SAP Box 53)	22657.1591

CO_2 from electricity for lights and appliances (kg/year) (SAP Box 109)	10938.9531
Energy saving/generation technologies (kWh/year)	35426.5131
Total Energy demand from development (kWh/year)	**395959.1861**
CO_2 saving/generation technologies (kg/year)	18386.3609
Total CO_2 emissions from development (kg/year)	**82972.51472**

Plots under the authority of The London Borough of Richmond Upon on Thames.

Target Emission Rates (TER)

			Space Heating		Hot Water		Pumps Fans		Lights Appliances	
Dwelling Type	Qty	Floor Area	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)
1	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
2	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
3	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
4	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
5	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
6	1	102.38	3302.8509	713.4158	2577.5587	556.7527	135.903	70.5337	434.526	225.519
7	1	102.38	3302.8509	713.4158	2577.5587	556.7527	135.903	70.5337	434.526	225.519
8	1	102.38	3302.8509	713.4158	2577.5587	556.7527	135.903	70.5337	434.526	225.519
9	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
10	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
11	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
12	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
13	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
14 B4	1	206.14	9254.3503	1998.9397	2651.2454	572.669	75	38.925	657.0738	341.0213
15 B3	1	193.74	7505.2409	1621.132	2653.6245	573.1829	75	38.925	627.8225	325.8399
16 B3	1	193.74	7505.2409	1621.132	2653.6245	573.1829	75	38.925	627.8225	325.8399
17 B3	1	193.74	7505.2409	1621.132	2653.6245	573.1829	75	38.925	627.8225	325.8399
18 B3	1	193.74	8806.5931	1902.2241	2650.2138	572.4462	75	38.925	644.3839	334.4353
19 D1	1	151.74	6072.0281	1311.5581	2635.8304	569.3394	75	38.925	549.8423	285.3682
20 D1	1	151.74	5629.2692	1215.9222	2639.8732	570.2126	75	38.925	549.8423	285.3682

21 D1	**1**	**151.74**	**5629.2692**	**1215.9222**	**2639.8732**	**570.2126**	**75**	**38.925**	**549.8423**	**285.3682**
22 D1	**1**	**151.74**	**5629.2692**	**1215.9222**	**2639.8732**	**570.2126**	**75**	**38.925**	**549.8423**	**285.3682**
23 D1	**1**	**151.74**	**6072.0281**	**1311.5581**	**2635.8304**	**569.3394**	**75**	**38.925**	**549.8423**	**285.3682**
55 E1	**1**	**209.45**	**9954.6397**	**2150.2022**	**2650.9782**	**572.6113**	**75**	**38.925**	**640.2941**	**332.3126**
56 B4	**1**	**182.05**	**8183.6653**	**1767.6717**	**2642.4405**	**570.7672**	**75**	**38.925**	**599.9122**	**311.3544**
57 B4	**1**	**182.05**	**7276.9921**	**1571.8303**	**2653.2304**	**573.0978**	**75**	**38.925**	**627.8225**	**325.8399**
58 B4	**1**	**182.05**	**7276.9921**	**1571.8303**	**2653.2304**	**573.0978**	**75**	**38.925**	**627.8225**	**325.8399**
59 B4	**1**	**182.05**	**7276.9921**	**1571.8303**	**2653.2304**	**573.0978**	**75**	**38.925**	**627.8225**	**325.8399**
60 B4A	**1**	**197.4**	**8549.7794**	**1846.7524**	**2648.1739**	**572.0056**	**75**	**38.925**	**636.497**	**330.3419**
61 F1	**1**	**261.67**	**14107.528**	**3047.2261**	**2669.1984**	**576.5468**	**75**	**38.925**	**735.0978**	**381.5158**
62 F1	**1**	**261.67**	**14107.528**	**3047.2261**	**2669.1984**	**576.5468**	**75**	**38.925**	**735.0978**	**381.5158**

Total Floor Area (m_2) (SAP Box 5)	4775.61
Total space heating (kWh/year) (SAP Box 85)	194009.3635
CO_2 from space heating (kg/year) (SAP Box 101)	41905.8864
Total hot water (kWh/year) (SAP Box 86a)	81273.8942
CO_2 from hot water (kg/year) (SAP Box 103)	17555.1615
Total electricity for pumps and fans (kWh/year) (SAP Box 87)	3144.3886
CO_2 from electricity for pumps and fans (kg/year) (SAP Box 108)	1632.0189
Total electricity for lights and appliances (Kwh/year) (SAP Box 53)	16813.9867
CO_2 from electricity for lights and appliances (kg/year) (SAP Box 109)	8726.4599
Energy saving/generation technologies (kWh/year)	0

Total Energy demand from development (kWh/year)	**295241.633**
CO_2 saving/generation technologies (kg/year)	0
Total CO_2 emissions from development (kg/year)	**69819.5267**

Plots under the authority of The London Borough of Richmond Upon on Thames.

Dwelling emission Rate (DER)

			Space Heating		Hot Water		Pumps Fans		Lights Appliances	
Dwelling Type	Qty	Floor Area	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)	Energy (kWh/year)	CO_2 (kg/year)
1	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
2	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
3	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
4	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
5	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
6	1	102.38	3302.8509	713.4158	2577.5587	556.7527	135.903	70.5337	434.526	225.519
7	1	102.38	3302.8509	713.4158	2577.5587	556.7527	135.903	70.5337	434.526	225.519
8	1	102.38	3302.8509	713.4158	2577.5587	556.7527	135.903	70.5337	434.526	225.519
9	1	102.38	3610.9747	779.9705	2573.407	555.8559	135.903	70.5337	413.7828	214.7533
10	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
11	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
12	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
13	1	114	4023.079	868.951	2601.8706	562.0041	142.8154	74.1414	465.8022	241.7514
14 B4	1	206.14	8769.4627	1894.2039	2648.6775	572.1143	204.2237	105.9921	657.0738	341.0213
15 B3	1	193.74	7104.8872	1534.6556	2641.7158	572.7706	196.564	102.0167	627.8225	325.8399
16 B3	1	193.74	7104.8872	1534.6556	2641.7158	572.7706	196.564	102.0167	627.8225	325.8399

17 B3	1	193.74	7104.8872	1534.6556	2641.7158	572.7706	196.564	102.0167	627.8225	325.8399
18 B3	1	193.74	8346.4638	1802.8362	2647.7552	571.9151	200.9777	104.3074	644.3839	334.5353
19 D1	1	151.74	5721.9052	1235.9315	2634.0044	568.9449	169.2398	87.8355	549.8423	285.3682
20 D1	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	57.8355	549.8423	285.3682
21 D1	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	57.8355	549.8423	285.3682
22 D1	1	151.74	5472.5982	1182.0812	2636.4937	569.4826	169.2398	57.8355	549.8423	285.3682
23 D1	1	151.74	5721.9052	1235.9315	2634.0044	568.9449	169.2398	87.8355	549.8423	285.3682
55 E1	1	209.45	9203.3633	1987.9265	2649.4397	572.279	201.9239	104.7985	640.2941	332.3126
56 B4	1	182.05	7725.7648	1668.7652	2640.2359	570.291	189.1541	98.171	599.9122	311.3544
57 B4	1	182.05	6865.3338	1482.9121	2651.2589	572.6719	196.564	102.0167	627.8225	325.8399
58 B4	1	182.05	6865.3338	1482.9121	2651.2589	572.6719	196.564	102.0167	627.8225	325.8399
59 B4	1	182.05	6865.3338	1482.9121	2651.2589	572.6719	196.564	102.0167	627.8225	325.8399
60 B4A	1	197.4	8075.1569	1744.2339	2645.6555	571.4616	198.8308	103.1932	636.497	330.3419
61 F1	1	261.67	13826.382	2986.4984	2664.8868	575.6156	235.7076	122.3323	735.0978	381.5158
62 F1	1	261.67	13826.382	2986.4984	2664.8868	575.6156	235.7076	122.3323	735.0978	381.5158

Total Floor Area (m_2) (SAP Box 5)	4775.61
Total space heating (kWh/year) (SAP Box 85)	187211.9594
CO_2 from space heating (kg/year) (SAP Box 101)	40437.6466
Total hot water (kWh/year) (SAP Box 86a)	81198.5519
CO_2 from hot water (kg/year) (SAP Box 103)	17545.3672
Total electricity for pumps and fans (kWh/year) (SAP Box 87)	5286.497
CO_2 from electricity for pumps and fans (kg/year) (SAP Box 108)	2653.7734
Total electricity for lights and appliances (Kwh/year) (SAP Box 53)	16813.9867
CO_2 from electricity for lights and appliances (kg/year) (SAP Box 109)	8726.5599

Energy saving/generation technologies (kWh/year)	47709.3825
Total Energy demand from development (kWh/year)	**242801.6125**
CO_2 saving/generation technologies (kg/year)	24761.1695
Total CO_2 emissions from development (kg/year)	**44602.1776**

PV Requirements by Plot

Plot Number	Elevation	PV Requirements KwP
1	South East	1.5
2	South East	1.5
3	South East	1.5
4	South East	1.5
5	South East	1.5
6	South East	1.5
7	South East	1.5
8	South East	1.5
9	South East	1.5
10	South East	1.5
11	South East	1.5
12	South East	1.5
13	South East	1.5
14	West	2.4
15	West	2.4
16	West	2.4
17	West	2.4
18	West	2.4
19	West	2.4
20	North West	1.3
21	North West	1.3
22	North West	1.3
23	North West	1.3
24	North West	1.6
25	North West	1.6
26	North West	1.3
27	North West	1.3
28	North West	1.3
29	North West	1.3
30	North West	1.3
31	North West	1.4
32	North West	1.3
33	North West	1.4
34	North West	1.6
35	North West	1.6
36	North West	1.6
37	South East	1.2
38	South West	1.2

39	South West	1.2
40	South West	1.2
41	South West	1.2
42	South West	1.2
43	South West	1.2
44	South	1.8
45	South East	1.2
46	South East	1.2
47	South East	1.2
48	South East	1.2
49	South East	1.2
50	South East	1.2
51	South East	1.2
52	South East	1.2
53	South East	1.2
54	South East	1.2
55	South East	2.4
56	South	2
57	South	2
58	South	2
59	South	2
60	South	2
61	North East	3
62	North East	3
63	South West	1.9
64	South West	1.2
65	North East	2.5
66	North East	2.5

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