

About Southern Energy Consultants Ltd

Southern Energy Consultants Ltd are a construction consultancy specialising in sustainability, energy conservation, the application of renewable technologies and statutory utilities infrastructure design and management. As a consultancy we do not sell or have financial interest in any products so are able to take an objective view of developments to assist developers with incorporating cost effective and practical solutions.

Our services include Planning Energy Statements, energy calculations for Building Regulation compliance, Code for Sustainable Homes assessments and utilities design and management. Our team of consultants include registered SAP, SBEM and Code for Sustainable Homes assessors, Planning Specialists, Renewable Energy Specialists, CAD Specialist, Utilities Specialists and Civil Engineers.

Within SEC Ltd we have over 25 years experience working with and for National Developers, Construction and Design and Build Contractors we apply our expertise not only to assist with developers understanding of new energy and sustainability obligations but also in a way that ensures that the needs and responsibilities of all stakeholders are wholly respected.

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Planning Condition Discharge: Supporting Document

Contents

1.0	Introduction	3
2.0	Baseline Carbon Dioxide Emissions and Energy Efficiency Measures	5
3.0	Renewable Energy – Feasibility and Installations	8
4.0	Conclusion	13
Appendix		14
	Emissions Reduction Calculation – Apartments	
	Design SAP Specification	
	Solar PV Layout Plan by Eco2Solar	

1. Introduction

- 1.1 This Energy Statement has been commissioned by Bellway Homes (the Applicant) and carried out by Southern Energy Consultants in response to planning condition 33 of the planning consent (Ref: 171814, dated 19th November 2018) for their development at Cardiff Road Reading. The development is located within the Reading Borough Council authority boundary and includes the construction of 96 residential dwellings of mixed type and tenure, together with provision of car parking facilities, communal space and landscaping at the former Cox & Wyman building.
- 1.2 This Statement first details the contents of condition 33 and its underpinning policy, before, in subsequent Sections, proceeding to detail the Applicant's comprehensive response.

Planning Condition 33

- 1.3 Planning Condition 33 states the following: *"The development hereby permitted shall not be occupied until written documentary evidence has been submitted to, and receipt acknowledged in writing by, the local planning authority demonstrating that 50% of the dwellings hereby permitted have achieved a minimum of a 19% improvement in the dwelling emission rate over the target emission rate, as defined in The Building Regulations for England Approved Document L1a: Conservation of Fuel and Power in New Dwellings (2013 edition). Such evidence shall be in the form of an As Built Standard Assessment Procedure, produced by an accredited energy assessor."*
- 1.4 Condition 33 is justified through Policy CS1 (Sustainable Construction and Design) of Reading Borough Council's Core Strategy (2008 version). Policy CS1 sets out an overarching strategy in relation to climate change, energy efficiency, energy conservation measures, inclusion of renewable energy sources, reduction in carbon emissions, and inclusion of appropriate flood minimisation measures in new development, including the construction of new building and the redevelopment and refurbishment of existing building stock.
- 1.5 With regards to Condition 33's requirement for 50% of dwellings in the Cardiff Road development to deliver a 19% reduction in emissions compared to a regulatory baseline

standard, this is equivalent to the Level 4 energy/emissions standard of the now lapsed Code for Sustainable Homes.

- 1.6 The aim of this Statement is to set out the Applicant's approach which will comply with Condition 33 and Policy CS1 by delivering a 19% reduction in emissions for 48 of the 96 (thus 50%) proposed dwellings at Cardiff Road. The Applicant's preference is to deliver this outcome by focusing on the 48 apartments proposed at Cardiff Road, as these avail the best opportunities to integrate on-site, decentralised renewable energy technologies to meet the 19% reduction target for 50% of all dwellings.
- 1.7 In order to arrive at the optimal strategy for the Cardiff Road development, Southern Energy Consultants have carried out Standard Assessment Procedure (SAP) calculations on the proposed dwellings, using Government approved Elmhurst software. A feasibility study has then been carried out to consider the potential for incorporating renewable or low carbon technologies into the development.
- 1.8 Section 2 of this Statement and the Appendix sets out the baseline emissions for the apartments. All 96 dwellings across the site will meet the regulatory baseline standard for emissions as set by Part L1A, however, this Statement will focus only on the 48 apartments given the specific 19% emissions reduction target set by Condition 33. The Applicant's array of best practice energy efficiency measures are outlined, which will not only ensure compliance with the baseline standard but also deliver reductions in emissions.
- 1.9 Section 3 sets out a brief feasibility study on the most suitable renewable or low carbon technology for the apartments to deliver a 19% reduction in emissions. The Statement then outlines the level of renewable energy output necessary for the Applicant to deliver compliance with the objectives of Condition 33, and provides further SAP data in the Appendix to verify this outcome.

2. Baseline Carbon Dioxide Emissions and Energy Efficiency Measures

Calculation of Baseline Emissions for Apartments

- 2.1 In order that an energy assessment can be conducted, the baseline for carbon dioxide emissions first has to be calculated for the 48 apartments (plots 49 to 96) which will then deliver a 19% reduction against this standard. The estimated regulated carbon dioxide emissions for the dwellings have been calculated using SAP (2012) methodology and the most up-to-date Elmhurst software. SAP calculates the regulated carbon dioxide emissions associated with space heating, hot water and fixed electrical items.
- 2.2 The Appendix provides a plot-by-plot breakdown of the baseline carbon dioxide emissions for the apartments, which total to **58,624 kgCO₂/year**. They are thus required to deliver reductions of at least **11,139 kgCO₂/year** in order to comply with Condition 33, and these will be sourced via a combination of best practice energy efficiency measures and renewable energy installations.

Applicant's Measures to Better the Baseline Scenario

- 2.3 In addition to the passive solar gains secured by orientating the majority of dwelling living areas in a southerly, south-westerly or south-easterly direction and maximising opportunities to increase the area of glazing on these elevations, the Applicant will comply with and better the baseline scenario by meeting the fabric performance for the main thermal elements (walls, roofs, floors and glazing) listed in Table 1 overleaf. The fabric performance standards are in all cases superior to the limiting standards set by Part L1a of Building Regulations (2013). A detailed SAP Specification is provided in the Appendix to this Statement, which outlines the Applicant's construction specification for all thermal elements.

Table 1: Fabric Performance Standards to Comply with Baseline Scenario

Thermal Element	Maximum Area-Weighted U-value (W/m²K) Allowable Under 2013 Building Regulations	Applicant's Proposed U-value (W/m²K) required to Meet 2013 Building Regulations Baseline	% Improvement on 2013 Allowable U-Value Standard
Main external walls	0.30	0.20	33.33
Roof (joists)	0.20	0.11	45.00
Roof (flat)	0.20	0.12	40.00
Ground floor	0.25	0.10-0.12	52.00-60.00
Windows	2.00	1.30	35.00

- 2.4 The space heating requirement of the development will be reduced as a consequence of the fabric measures detailed above. In addition, the Applicant will specify Ideal Logic ESP1 35 boilers with a SEDBUK 2009 efficiency of more than 89%. The proposed apartments will also benefit from enhanced heating controls to maximise efficiency in use. As well as having independent temperature controls such as thermostatic radiator valves, all apartments will be supplied with programmers, timers and room thermostats.
- 2.5 Air tightness standards will be improved by the Applicant adopting predominantly LABC psi values for non-repeating thermal bridges, which better the thermal heat loss results delivered via traditional Accredited Construction Details. The Applicant's details incorporate thermal heat loss improvements by reducing air leakage loss and convective bypass of insulation. This approach will assist all apartments in delivering a reduction in air permeability from 10m³/hm² to not more than 5m³/hm².
- 2.6 Ventilation will be provided via a high-efficiency, low energy, centralised extract system (Titon CME2 Plus HA). It is not proposed to provide any mechanical cooling to the proposed apartments. Instead it is the intention of the Applicant to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical

measures such as good thermal insulation and an air tight build. Openable windows will be installed as a necessary fixture in all dwellings to facilitate natural ventilation. These will help facilitate cross-ventilation, convective-ventilation and night purging.

- 2.7 All internal lighting throughout the Cardiff Road development will be of the dedicated low energy type. External lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices.

Impact on Best Practice Energy Efficiency Measures

- 2.8 The Appendix to this Statement demonstrates that the measures listed in paragraphs 2.3 to 2.7 will reduce carbon dioxide emissions from the baseline scenario of **58,624 kgCO₂/year** to **53,610 kgCO₂/year**. This is a reduction of **5,014 kgCO₂/year**, or 8.55% in proportional terms. A further reduction of **6,125 kgCO₂/year** must be delivered by renewable or low carbon technologies in order for the apartments to deliver a 19% reduction in emissions and satisfy the target set by Condition 33.

3. Renewable Energy – Feasibility and Installations

Feasibility of Renewable Energy and Low Carbon Technologies

3.1 This section of the Statement conducts a thorough review of the renewable energy and low carbon technologies that could theoretically be applied to the apartments at the Cardiff Road development. Renewable energy is defined as the flows of energy that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of oceans, from the sun and also from biomass. This definition has been widened by the UK Government through the use of the term ‘Low or Zero Carbon Technologies’ (LZC), which include heat pumps and gas-fired CHP – technologies not always considered as being renewable. The technologies to be evaluated in this Statement are as follows:

- Combined Heat and Power
- Biomass
- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

District Heating and Combined Heat and Power (CHP)

3.2 CHP is a form of district heating that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high carbon dioxide emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. As both the electricity and heat from the generator is used, the efficiency of the system is increased above that of a conventional power plant where the heat is not utilised. CHP is suitable for dense, mixed-use developments where there is a very high, constant and varied heat demand.

3.3 The suitability of district heating and CHP to this development has been investigated in terms of appropriateness and how well the technology aligns itself with the Applicant's priorities for this energy strategy, which are to provide the greatest reductions in carbon dioxide emissions and minimise pollutants using an affordable approach. While CHP would enable reductions in carbon dioxide emissions beyond the baseline case, the following reasons make it unsuited to the apartments at Cardiff Road:

- **Diversity and extent of heat demand** – CHP is best suited to developments where there is a diversity of energy demand. A mixed-use scheme, or a large residential scheme (>1,000 homes) will have extended periods of the day in which there is a continuous demand for heat. In these circumstances, the district heating network and CHP engine can operate consistently to generate electricity, with heat as a by-product. On a small-sized residential scheme such as this, heat demand will be intermittent, even during peak periods.
- **Thermal storage** – To compensate for fluctuations in the demand for heat, thermal buffers will be required to store CHP thermal output. To store heat without the need for dumping will require a large store that can take > 4 hours of charging. On a scheme of this size, such a thermal store could double the usual size of any plant room. Furthermore, to improve stratification, buffers should be at least 1.5 times as tall as they are wide, with a potential impact on height requirements.
- **Distributional heat losses** – thermal stores are a source of standing heat losses, as are even the best insulated distribution networks. When communal systems satisfy only a small and intermittent demand, these standing losses will represent a large part (>30%) of total demand. Carbon dioxide emissions savings gained within the dwellings through association with CHP may be considerably reduced by the additional heat losses associated with the network.
- **Plant room size and location** – to incorporate a plant room to serve the apartments would require a considerable amount of space. The most suitable location in terms of space would be the designated amenity space, but the installation of such infrastructure would be in conflict with the Applicant's objective to deliver a vibrant development with land uses suitable for children and young families.

- **Minimising heat demands** – the Applicant’s proposed energy strategy is based on the adoption of best practice standards for energy efficiency, an approach resulting in reduced space heating demands.
- **Installed costs** – the installed cost of any CHP / district heating network benefit from economies of scale. On a small-sized scheme such as Cardiff Road, any economies of scale would be negligible or non-existent.
- **Running costs** – the fixed costs associated with the management and operation of a communal plant room would need to be shared by future occupants as part of an energy standing charge. The smaller the scheme, the greater the cost for the individual occupant. In addition, CHP engines impose additional running costs as contracts for maintenance and replacement costs are typically handled by specialist companies.
- **Absence of other local infrastructure** – there are no other CHP / district heating networks in the vicinity of the development with which to forge a connection to serve the Cardiff Road development.

Biomass

- 3.4 Biomass community heating is an alternative to conventional fossil fuel heating but, as per the reasons used against the installation of gas-fuelled CHP, should be discounted as an option for the proposed dwellings. Biomass boilers within individual dwellings are usually installed with a standard gas boiler as back-up in case the occupier runs out of fuel. Although they are reducing in size, they are still large enough to require a dedicated room with additional space for the fuel – there is insufficient space available for such infrastructure in the vast majority of proposed apartment types. The management of fuel deliveries and ash dispersal is also complex, which would necessitate a dedicated operative as opposed to residents of the future dwellings at Cardiff Road. Furthermore, the emissions of Nitrous Oxide and particulate matter that are associated with biomass installations would have the capacity to worsen local air pollution.

Ground and Air Source Heat Pumps (GSHPs)

- 3.5 Neither of these technologies has been considered for implementation at Cardiff Road due to their higher carbon dioxide emissions compared to the proposed gas boiler specification. Although both technologies are renowned for delivering reductions in carbon dioxide emissions, they do so from a much higher baseline than when gas is the specified fuel for space heating and hot water generation. Electricity consumption is also associated with much higher Nitrous Oxide emissions than Class 5 gas boilers.

Hydroelectric power

- 3.6 Hydroelectric power plants generate electricity using the gravitational force of flowing or falling water. However, there are no rivers of sufficient scale in the vicinity of the Cardiff Road development to facilitate a hydroelectric power installation.

Wind Turbines

- 3.7 Wind turbines are a modern, high-technology descendant of the windmills that have been around for centuries. In modern windmills the kinetic energy of the wind is used to turn a turbine to generate electricity as opposed to moving water or turning a grist mill wheel. A site with an average wind speed of 5m/s or more is generally considered to be suitable for installing a wind turbine. The average wind speed at the Cardiff Road development is 4.7m/s at 10m AOD and is below the level required to generate significant carbon dioxide reductions or commercial take-up. The installation of a single, large wind turbine to serve the apartments would also be controversial due to the nature of the locality. Even if space could be found within the development to accommodate a very high (15-20m) turbine, their installation would then present a significant visual blight to surrounding communities.

Solar thermal and photovoltaic panels

- 3.8 Solar thermal heating panels contribute to the hot water demand of a dwelling. Water or glycol (heat transfer liquid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store where heat is exchanged with water from the conventional system. The proposed dwellings generally contain suitable attributes

(orientation, available roof-space and limited shadowing) for solar photovoltaic installations to be designed-in, although solar thermal installations are unsuitable. In part this is because the smaller apartments have very little space to accommodate a hot water cylinder. The specification of gas combination boilers also reduces the energy demand for heating and storing hot water. Furthermore, the long pipe runs necessary for communal solar thermal installations result in reduced heat transfer and limit the capacity to deliver reductions in emissions.

- 3.9 There are few constraints on the capacity for solar photovoltaic panels to deliver reductions in emissions. For all dwellings on the site, roof-space is available with limited overshadowing, sufficient for solar photovoltaic installations to be very effective. Further SAP calculations have been undertaken on the apartments to verify the level of solar photovoltaic output necessary to ensure compliance with the 19% emissions reduction target. The Appendix demonstrates that 14 kWp of solar photovoltaic output is necessary, equating to a total of approximately 85m² in panel area. Table 2 below summarises the reductions in the apartment's emissions delivered by the Applicant via their proposed approach of best practice energy efficiency measures and 14 kWp of solar photovoltaic panels.

Table 2: Emissions Reductions – Cardiff Road Apartments

	Carbon Dioxide Emissions (KgCO₂/yr)
Baseline scenario	58,624
Reduction from energy efficiency measures	(5,014)
Reduction from solar photovoltaic panels	(6,125)
Net emissions	47,485
% reduction	19.00

- 3.10 It is evident from Table 2 that the Applicant's proposed strategy will reduce the apartments' emissions by a total of **11,139 kgCO₂/year** to **47,485 kgCO₂/year**. This is sufficient to deliver the 19% reduction required by Condition 33. The Appendix includes a layout plan by Eco2Solar showing the proposed location of solar PV panels.

4. Conclusion

- 4.1 This Energy Statement has set out the Applicant's proposed energy strategy for the Cardiff Road, Reading development. In response to the stipulations of Planning Condition 33, the Applicant has proposed an approach that seeks to minimise energy consumption and carbon dioxide emissions at the point of demand through the installation of highly efficient fabric, ventilation and heating systems, together with the benefits of passive solar gains, all features which will help to lower the fuel bills of future occupants. In addition, by specifying **14 kWp** of solar photovoltaic output to serve the 48 apartments, these dwellings (50% of the total proposed for the site) will deliver a **19% reduction** in carbon dioxide emissions, as required by Condition 33 and its underpinning Policy CS1 of Reading Borough Council's Core Strategy.
- 4.2 The proposed strategy will be adopted on site and verified through the eventual production of as-built SAP documents and Energy Performance Certificates.

Appendix

Emissions Reduction Calculation – Apartments
Design SAP Specification
Solar PV Layout Plan by Eco2Solar

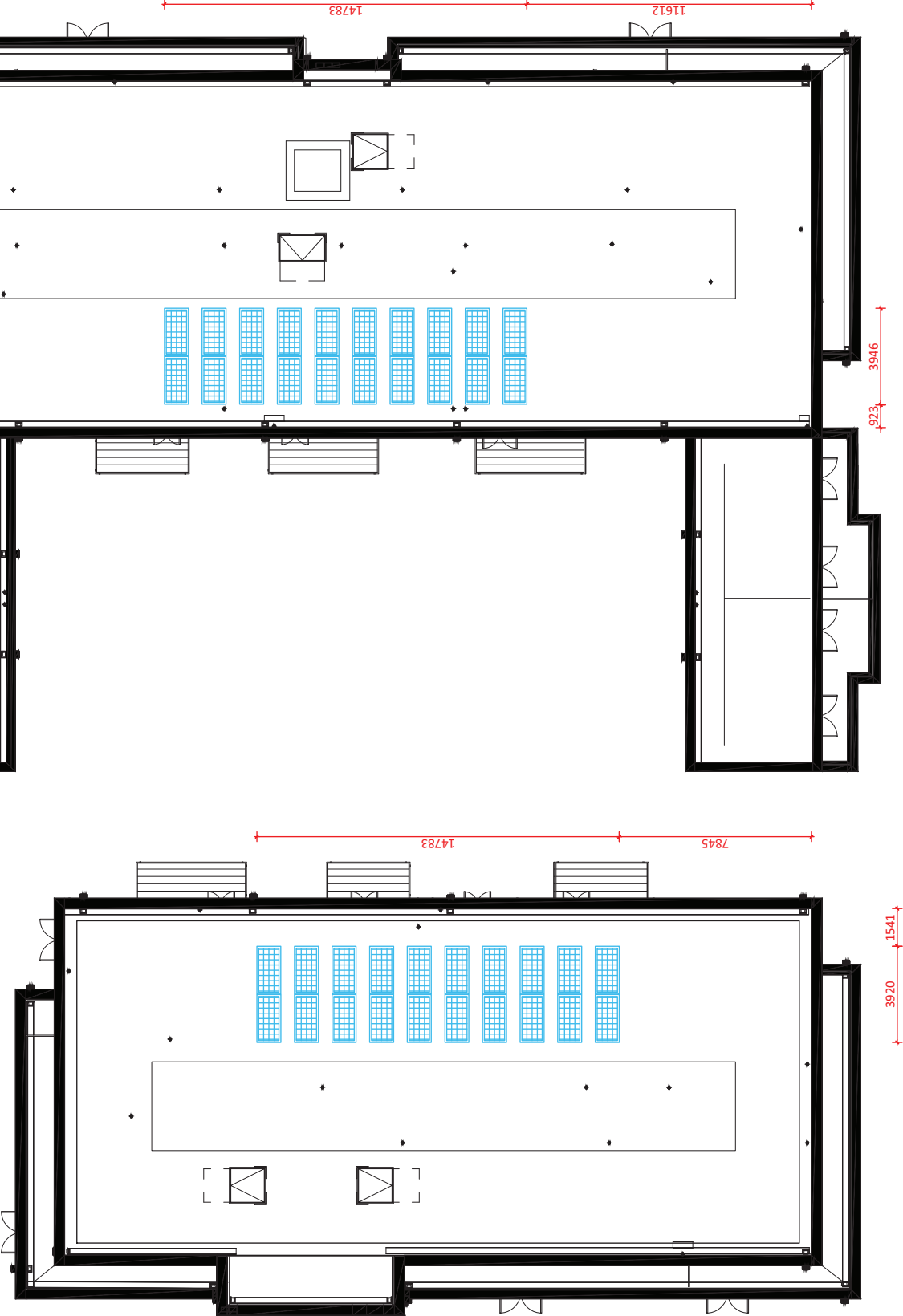
CARDIFF ROAD EMISSIONS REVIEW

Date 12/10/2019

House Name	House Number	DER	TER	Total floor area	Total DER kg/year	Total TER kg/year	kWh Reduction required per plot to deliver 19% CO2 Reduction
Type GFF	Plot 49	18.10	19.08	95.26	1724	1818	500.00
Type GFF	Plot 51	16.99	18.72	77.22	1312	1446	275.00
Type GFF	Plot 50	15.22	17.12	85.42	1300	1462	225.00
Type FFF	Plot 52	17.50	18.87	54.54	954	1029	250.00
Type FFF	Plot 58	16.32	18.44	52.09	850	961	150.00
Type FFF	Plot 57	14.76	16.91	56.79	838	960	125.00
Type FFF	Plot 53	19.44	21.08	51.52	1002	1086	250.00
Type FFF	Plot 54	19.63	21.30	52.58	1032	1120	250.00
Type FFF	Plot 55	20.04	21.64	52.25	1047	1131	260.00
Type FFF	Plot 56	16.05	18.00	61.93	994	1115	175.00
Type SFF	Plot 59	20.29	21.37	54.54	1107	1166	325.00
Type SFF	Plot 65	18.09	20.01	52.09	942	1042	200.00
Type SFF	Plot 64	16.43	18.50	56.79	933	1051	175.00
Type SFF	Plot 60	17.33	19.14	51.49	892	986	185.00
Type SFF	Plot 61	14.61	16.54	63.71	931	1054	160.00
Type SFF	Plot 62	14.79	16.61	63.58	940	1056	170.00
Type SFF	Plot 63	13.68	15.90	61.93	847	985	100.00
Type TFF	Plot 66	21.44	22.49	56.86	1219	1279	375.00
Type TFF	Plot 67	19.67	20.73	62.17	1223	1289	350.00
Type TFF	Plot 68	18.72	20.15	51.50	964	1038	250.00
Type TFF	Plot 69	18.65	20.12	51.50	960	1036	250.00
Type TFF	Plot 70	19.05	20.53	71.83	1368	1475	350.00
Type TFF	Plot 71	21.36	22.47	53.07	1134	1192	325.00
Type GFF	Plot 72	17.22	18.64	87.54	1507	1632	360.00
Type GFF	Plot 73	19.50	21.21	50.70	989	1075	240.00
Type GFF	Plot 74	16.80	18.68	70.10	1178	1309	225.00
Type GFF	Plot 75	14.62	16.51	93.15	1362	1538	225.00
Type FFF	Plot 76	13.67	15.32	91.29	1248	1399	225.00
Type FFF	Plot 77	16.58	18.63	51.86	860	966	160.00
Type FFF	Plot 78	14.12	16.23	71.90	1015	1167	150.00
Type FFF	Plot 79	11.37	13.12	99.70	1134	1308	150.00
Type FFF	Plot 80	18.03	19.57	61.64	1111	1206	275.00
Type FFF	Plot 81	19.11	20.85	53.80	1028	1122	250.00
Type FFF	Plot 82	18.59	19.99	66.04	1228	1320	325.00
Type SFF	Plot 83	15.78	17.23	91.29	1441	1573	325.00
Type SFF	Plot 84	18.29	20.20	51.86	949	1048	200.00
Type SFF	Plot 85	15.73	17.69	71.90	1131	1272	200.00
Type SFF	Plot 86	13.12	14.71	99.70	1308	1467	250.00
Type SFF	Plot 87	14.55	16.41	61.64	897	1012	150.00
Type SFF	Plot 88	14.50	16.20	65.31	947	1058	175.00
Type SFF	Plot 89	13.68	15.70	66.04	903	1037	140.00
Type TFF	Plot 90	22.22	22.61	63.28	1406	1431	500.00
Type TFF	Plot 91	23.53	24.56	47.55	1119	1168	350.00
Type TFF	Plot 92	22.90	24.05	48.68	1115	1171	325.00
Type TFF	Plot 93	17.36	18.77	86.86	1508	1630	375.00
Type TFF	Plot 94	17.73	19.05	61.78	1095	1177	275.00
Type TFF	Plot 95	19.29	20.33	65.34	1260	1328	375.00
Type TFF	Plot 96	20.55	21.76	66.04	1357	1437	375.00
		837.00	913.74	3135.65	53610	58624	12275.00

19% KgCO ₂ Target TER Reduction	Fabric Gains KgCO ₂ /yr	Residual KgCO ₂ Emissions reduction
11139	5014	6125

CARDIFF ROAD, READING
BLOCK A



ROOF PLAN

SOLAR PV ARRANGEMENT
CARDIFF ROAD, READING
BLOCK A

STRINGS

STRING 1	STRING 2	STRING 3	STRING 4	STRING 5	STRING 6	STRING 7	STRING 8

SYSTEM TYPE: FLAT ROOF
SYSTEM NAME: PB III
POSITION: LANDSCAPE
PITCH: 10°
MODULE QTY: 40

CLIENT: BELLWAY HOMES
PROJECT NAME: CARDIFF ROAD, READING
PLOT NUMBER: BLOCK A

DRAWN BY: D. SMITH
CHECKED BY: L. SHUCK
SCALE @ A3: 1:175
DATE: 11/11/2019

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