

**Proposed development of 13 dwellings at land at 1-3 Castle Crescent,
Reading .**

Renewable Energy Assessment and Sustainability Statement



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Executive Summary

This Renewable Energy Assessment and Sustainability Statement set out the approach for a sustainable development and assesses methods of integrating renewable technologies on the proposed development of 13 residential units at the land at 1-3 Castle Crescent, Reading. Specifically, the Renewable Energy Assessment and Sustainability Strategy demonstrate the development's approach to meeting the following obligations:-

- Achieve Building Regulations Part L requirements
- Achieve Part G Potable Water target of less than 105 litres per person per day
- Meet Policy CS1 requirement of 19% CO₂ emissions reduction over prevailing Building Regulations using high levels of Fabric Energy Efficiency and renewable energy in 50% of the new dwellings.
- Meet Policy DM1 and DM2 of Site and Detailed Policies Adopted 2012

Passive Design

The minimum fabric standard set out in Table 0.a are expected to be implemented in all new units at the proposed development under Part L1A. As part of the planned development is an existing building, refurbishment and upgrading of the thermal elements will take place under Part L 1B. These target values are set out in Table 0.a below.

Table 0.a Summary of Building Fabric Standards for Units above Part L 2013 Building Regulations limiting requirement for new and existing thermal elements.

	Residential - New elements (W/m ² K)	Refurbishment of existing elements/Improvement
Walls External (cavity ins.)	018	0.7/0.55
Walls External/internal insulation (cavity ins.)	018	0.7/0.3
Roof Insulation at ceiling	0.13	0.35/0.16
Roof Insulation at rafter	0.15	0.35/0.18
Glazing	1.3	
Air Permeability (m ³ /m ² hr @ 50pa)	3 or 5	

In addition to the fabric standards, the following measures are proposed as part of the passive design of buildings at the land at 1-3 Castle Crescent.

- Design the ventilation approach to ensure good fresh air supply throughout the year and to allow passive cooling in summer.
- Where possible, orientate the exposed facades of dwellings north and south with principal rooms (especially living and working accommodation) on the south side.
- High levels of thermal mass to ensure passive heat capture.
- In the refurbished buildings ensure an high environmental performance against prevailing Building Regulations Part L1B.

Energy Efficiency

Most of the variations in energy efficiencies are due to occupancy choices. Therefore it is expected that the following measures will be considered to influence behaviour.

- Residents will be provided with information on EU energy labelling for white goods, including estimates of typical annual energy costs for each grade of efficiency.

Low and Zero carbon Technologies

A summary of the potential renewable energy strategy across the development is shown in Table 0.b

Table 0.b Renewable energy strategies for new development at Castle Crescent, Reading .

Building	Summary of Proposed Energy Strategies
All Residential Unit	<i>For all apartments:-</i>
	- Very high fabric energy efficiency to reduce overall energy demand - High efficiency natural gas condensing combination boiler - 90% efficiency - Houses will have approximately 8 m² of roof mounted solar photovoltaic tiles installed per unit where required to achieve 19% CO₂ reduction in 50% of the new dwellings and a site wide Renewables requirement. - Ground/Air Source heat pumps will be considered where outdoor space allows

The Castle Crescent Development will achieve National Building Regulations Targets and the local authority requirements for a sustainable development, where required.

Key issues are:-

- Meeting the requirements of the changes to National Building Regulations in particular Part L 2010
- High levels of energy efficiency and a reduction in CO₂ emissions through fabric measures and Low and Zero Carbon Technologies on the new building.
- The use of water conservation methods such as Sustainable Drainage Techniques (SUDs), Low flow taps and showers, water saving toilets and rainwater collection equipment
- Use of sustainable building materials with low embodied energy, carbon contents and a focus on local sourcing.
- Renewable technologies such as PV tiles with low visual impact and high aesthetic qualities.
- Site waste management and storage of waste to ensure minimal waste to landfill and maximum recycling.
- Focus on sustainable transport and delivery of pedestrian and cycle friendly routes with strong links with local centres.
- Deliver high levels of biodiversity onsite.

1.0 Reason for the Report

Carbon Green Consulting Ltd have been appointed to form a Renewable Energy Assessment and Sustainability Statement to demonstrate the energy efficiency and sustainability measures that may be employed on the proposed development at the land at 1-3 Castle Crescent, Reading

This Statement has been prepared by Carbon Green Consulting Ltd in response to the National Planning Policy Framework which requires all developments to be sustainable, to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations.

The following documents have been referred to in this statement to demonstrate compliance:

The National Planning Policy Framework March 2012
Reading Core Strategy 2008 - Altered 2015
Site and Detailed Policies Document Adopted Oct 2012 and Altered Jan 2015
Supplementary Planning Document "Sustainable Design and Construction (2011) revised 2015
Sustainable Design Checklist
New Conditions after CfSH withdrawal - Reading Borough Council
Part L1A Conservation of Fuel and Power in New Dwellings 2013
Part L1B Conservation of Fuel and Power in New Buildings 2013

It is the intention of the developer to deliver a highly sustainable development at 1-3 Castle Crescent, Reading and therefore this Renewable Energy Assessment and Sustainability Statement has considered current policies within the adopted Reading Core Strategy - Altered 2015, as well as Supplementary Planning Document "Sustainable Design and Construction 2011 and Site and Detailed Policies Document 2012.

In addition, in view of the recent Housing Standards Review and the subsequent confirmation by the government in the Ministerial Written Statement, March 2015, that The Code for Sustainable Homes has been withdrawn, current and Draft Local Plan policies associated with the Code are now outdated.

As a result, this development proposal will continue to adhere to all building related sustainability elements under the relevant policies and broader guidance, but outside the framework of the Code.

1.1 Expected Outcomes

The Energy Assessment and Sustainability Statement for the proposed development will demonstrate the requirement for reduction in energy demand set out in The National Planning Policy Framework and deliver sustainable development to minimise energy demand. It will demonstrate how a site wide sustainability strategy, utilising a variety of sustainability measures, will achieve all the requirements detailed in the adopted Core Strategy and other supporting documents as above.

1.2 Disclaimer

The report has been drafted using all reasonable skill, care and diligence of a competent engineer. No responsibility is accepted for the use of this document and its content by any parties other than the Client. Any third parties rely upon the report and its content at their own risk and shall be responsible for their own checking of any detail herein.

2.0 Introduction

This report, along with other technical reports, accompanies a full application for a residential development comprising: 13 residential units and associated landscaping and open space;

The Renewable Energy Assessment will provide strategies to reduce CO₂ emissions and reduce energy demand using Zero Carbon or Low Carbon (renewable) energy sources (LZCs) as, where appropriate and required by Policies DM1 and DM 2 and the Sustainable Design and Construction Supplementary Planning Document (SPD) 2011.

The Sustainability Statement will provide additional measures in reducing energy, water and CO₂ emissions across the proposed development during the building phases and post construction, giving due weight to policies within the adopted Core Strategy and Sustainable Design and Construction Supplementary Planning Document.

3.0 Energy and CO₂

Current Building Regulations changed in 2014 with a further improvement of 6% in CO₂ emissions for residential development over 2010 Building Regulations standards and 9% for non-domestic development. In addition, the new Fabric Energy Efficiency Standard (FEES) requires new development to achieve set targets for energy use.

Under the Adopted Reading Core Strategy Policy CS1, a Renewable Energy Assessment is required to demonstrate 19% CO₂ emissions reduction below Part L1A of current Building Regulations using both fabric methods and renewable energy sources in 50% of new residential units. As 5no. of the proposed dwellings will be developed under Part L1B these will adhere to the requirements there in. Therefore it is required that 4no. of the 8no. proposed new dwellings remaining should demonstrate compliance.

In addition, Policy DM 1 in the Sites and Detailed Policies Document 2012 requires developments to meet the challenge of climate change and has a focus on the use of renewable energy sources.

Anticipating approval in 2015, this report will illustrate how the proposed development will achieve the required CO₂ reduction from renewable energy sources demonstrated through example energy modelling using the Standard Assessment Procedure for New Buildings (SAP).

Currently the proposed development at 1-3 Castle Crescent lies outside any area with District Heat opportunities. In addition, a basic search has revealed that there are no district heat mains in the locality and therefore there is no current potential for connection. Therefore, this document will not explore these options further.

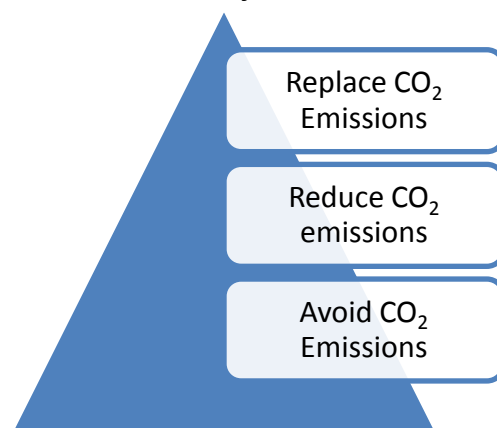
4.0 Renewable Energy Assessment

The proposal applies best practice measures for the minimisation of carbon emissions associated with energy use. This section gives detail on the proposed dwellings which will implement passive design principles, energy efficiency measures and Low Zero Carbon technologies (LZCs), demonstrating the developer's leadership in this area.

In delivering a low carbon and highly sustainable development the proposal plans to closely follow the energy hierarchy set out in Figure 4a.

Therefore, the first three steps of the hierarchy will be adhered to :- *Avoid emissions, Reduce emissions, Replace Emissions*.

Figure 4.a Carbon Emission Reduction Hierarchy



The proposed development at 1-3 Castle Crescent, Reading will aim to minimise the amount of energy used across the site and therefore the first objective is to adopt the energy hierarchy as a fundamental principle.

As below in Table 4.a the estimated mix of dwelling types and layouts illustrated in the Design and Access Statement will allow a degree of flexibility in avoiding, reducing and replacing emissions and achieving the regulatory targets and conditions.

Table 4.a Mix of dwellings at 1-3 Castle Crescent, Reading

TYPE	BEDS	AREA SQFT	AREA M2
APT 01	1 BED	654.47	60.80
APT 02	1 BED	551.67	51.25
APT 03	1 BED	657.70	61.10
APT 04	1 BED	571.58	53.10
APT 05	2 BED	903.12	83.90
NEW APARTMENT BLOCK			
APARTMENT PLOT 1	3 BED	913.89	84.90
APARTMENT PLOT 2	1 BED	470.40	43.70
APARTMENT PLOT 3	2 BED	794.40	73.80
APARTMENT PLOT 4	1 BED	568.35	52.80
APARTMENT PLOT 5	2 BED	550.05	51.10
APARTMENT PLOT 6	2 BED	678.15	63.00
APARTMENT PLOT 7	2 BED	919.27	85.40
APARTMENT PLOT 8	3 BED	960.17	89.20
TOTAL		9193.22	854.05

4.1 Avoiding Emissions

4.1.1 Passive Design

Reducing the overall demand for regulated energy (energy used for heating, lighting and hot water) by building warm, draft free homes is a primary focus for all new developments. The new development will meet and exceed Part L of the Building Regulations.

The building designs for the proposal will employ energy efficiency features across the development, including high levels of insulation in all elements (floors, walls, ceilings) to minimise energy requirements.

These will adhere to high Fabric Energy Efficiency Standards as assessed by SAP.

The minimum fabric standards set out in Table 4.b are expected to be implemented in the proposed residential development.

Table 4.b Summary of Building Fabric Standards for Units above Part L 2013 Building Regulations limiting requirement for new and existing thermal elements.

	Residential - New elements (W/m ² K)	Refurbishment of existing elements/Improvement
Walls External (cavity ins.)	018	0.7/0.55
Walls External/internal insulation (cavity ins.)	018	0.7/0.3
Roof Insulation at ceiling	0.13	0.35/0.16
Roof Insulation at rafter	0.15	0.35/0.18
Glazing	1.3	
Air Permeability (m ³ /m ² hr @ 50pa)	< 5	

4.1.2 Energy Efficiency

Orientation and layout will have a significant effect on reducing the heating and cooling requirements in the development. The design team are cognisant of the need to align all living and working areas with south facing glazing, ensuring solar gain is maximised during winter. Minimising heat loss through reductions in exposed walls and smaller building footprints will shape the building designs across the development.

As far as possible units will be designed to include high window to wall ratios and roof lights where feasible, to increase internal day time natural light and reduce the requirement for artificial lighting.

All units on the development will be designed to include either adequate external clothes drying space for each unit or alternatively compliance internal drying space to reduce reliance on the use of drying machines.

4.1.3 Thermal Bridging

As external elements (floors, walls and ceilings) have become significantly more energy efficient, more marginal gains are becoming important in maximising energy efficiency, such as design details around junctions. Care will be taken to ensure building designs minimise the risks of thermal bridging through mindful detailing of junctions and around openings and in existing elements where further insulation is required.

4.1.4 Air Tightness and Ventilation

The better the standard of fabric insulation in houses, the more significant becomes ventilation as a heat loss route.

Air tightness plays a critical role in ensuring that dwellings are comfortable and warm to live in. If drafts are allowed within the home, warm air can escape and cold air can leak in. This has the potential to increase energy use for heating and therefore the CO₂ emissions of the proposed

scheme. The developer will target the levels of air tightness on the proposed development as shown in Table 4.b. In the existing element of the development every effort will be made to achieve the highest quality finish to remove the risk of draughts.

Current regulations sets a minimum air leakage target in new dwellings of $10\text{m}^3(\text{h.m}^2)$ @ 50 Pascals. The new development will target an average air leakage target in all dwellings of $5\text{m}^3(\text{h.m}^2)$ @ 50 Pascals and $3\text{m}^3(\text{h.m}^2)$ @ 50 Pascals when required. This is achievable through good design and a more educated and skilled approach at the construction stage.

The provision of a comfortable environment in homes relies on the supply of fresh air and extraction of air from kitchens, bathrooms and toilets. Windows will be designed and positioned to allow cross ventilation and exposed facades should be oriented north and south with principle rooms on the south side.

4.1.5 Thermal Mass

The proposed new development will make provision for maximising thermal mass in all building designs demonstrated by the use of heavier weight building materials such as masonry (brick and block) or the design of thermal mass into lighter weight structures (timber frame). This will enable storage of solar heat energy in summer, reducing the risk of overheating and ensure a more comfortable internal temperature. The development will consider thermal mass in solid floors such as solid tiled flooring and polished concrete, which delivers considerable benefits in reducing energy use in winter for heating.

In-use studies from Scotland demonstrate up to 15% energy saving from solar gain in standard homes with simple, well designed solar heat capture methods. The design team will consider the balance of thermal mass with the increased embodied carbon this may cause.

4.2 Reduce Emissions

4.2.1 Introduction

Once the need for energy has been avoided using measures in the previous section, reducing the emissions from the home and equipment within the home is the next stage in the carbon hierarchy. Careful specification of systems and good management of energy in the operation of the building is critical.

4.2.2 Behavioural Change

Most of the variation between new homes in the efficiency of their use of energy is due to occupant choices. Therefore, it is expected that the following measures will be implemented at the development at 1-3 Castle Crescent to influence this behaviour:

- Residents will be provided with information on EU energy labelling for white goods, including estimates of typical annual energy costs for each grade of efficiency.
- Residents will be provided with energy display devices with simple default displays including traffic light indicators and information on the cost of energy used as in Figure 4.c.

4.2.3 Energy Display Devices

It is recommended that energy display devices are provided for residents as they highlight where energy is used. These devices are able to display the following:

- Local time.
- Current mains energy consumption (kilowatts and kilowatt hours).
- Current emissions (g or kg CO₂).
- Current tariff.

- Current cost (in pounds and pence). For pre-payment customers this should be "real time" data and for "credit" paying customers cost should be displayed on a monthly basis. Display accurate account balance information (amount in credit or debit).
- Visual presentation of data (i.e. non-numeric) to allow consumers to easily identify high and low level of usage.
- Historical consumption data so that consumers can compare their current and previous usage in a meaningful way. This should include cumulative consumption data in any of the following forms: day, week, month or billing period.



Figure 4.c Examples of energy display devices for homes.

4.3 Replace Emissions

4.3.1 Introduction

There is a requirement under the Adopted Reading Core Strategy Policy CS1 to achieve CO₂ reductions using renewable energy sources (Low Zero Carbon Technologies or LZC's).

The proposed development will target a 19% carbon saving from the use of both fabric measures and low or zero carbon technologies in 50% of the new dwellings . Part L models are yet to be built for the residential units, therefore the benchmarks in Table 4.b have been used, coupled to the specification below to produce the predicted CO₂ baseline outputs in Table 4.c.

- High levels of Insulation in floors walls and ceilings (Table 4.b)
- Junctions use Accredited Construction Details (ACDs)
- 90% efficient Gas Combi Boiler
- Window orientation maximised for solar gain
- Air Permeability 5 m³/hm² @50 pa in new dwellings
- Thermal mass to ensure internal comfort and reduce overheating.

Table 4.c The SAP 2012 Part L 1A 2010 baseline outputs for the typical new build residential unit examples.

Apartments (mid floor)	
Floor Area Average (m ²)	60
Dwelling TER (kgCO ₂ /m ² /yr)	20.01
Fabric Energy Efficiency – FEE (kWh/m ² /yr)	44.8
Dwelling DER (kgCO ₂ /m ² /yr)	19.19
CO² reduction	4.1%

4.3.2 Alternative low and zero carbon energy options

This section offers an analysis of various renewable energy technologies for consideration on the new build development. The proposed development will achieve a 19% carbon saving below Building Regulations from low and zero carbon (i.e. renewable) energy across 50% of the new dwellings on site.

Table 4.d below considers the alternative low and zero carbon energy options .

Table 4.d Alternative low and zero carbon energy options

Technology	Image	Comments
Solar Thermal		Available in two main forms as flat plate and evacuated tube collectors. In general, the evacuated tube system is more efficient however it is less robust and more prone to breakage of the tubes. Flat Plate is favoured in areas where it is accessible and therefore is a more robust solution. Either system is in common usage mainly for hot water generation

Solar Photo Voltaic		There are a number of distinct types of solar Photo voltaic Cell. They are usually made from silicon, The silicon is treated or "doped" so that when light strikes it electrons are released, so generating an electric current. There are three basic types of solar cell. Monocrystalline cells are cut from a silicon ingot grown from a single large crystal of silicon whilst polycrystalline cells are cut from an ingot made up of many smaller crystals. The third type is the amorphous or thin-film solar cell which offers locational flexibility but low efficiencies.
Wind Generation		Small scale wind turbines may be suitable for a development of this size. They could be roof or mast mounted. The wind turbine is available in a number of types with both horizontal axis and vertical axis blades. Horizontal axis is generally more efficient but all wind turbines require a clear air path and minimal turbulence to achieve best results
Biomass		Biomass boilers can produce heat from a variety of fuels including wood pellet, wood chip, waste to energy (e.g. refuse incineration) sewerage off-gassing. The boilers can also take many forms from small single room space heaters to very large scale systems suitable for district heating schemes. Each will have a fuel source appropriate to the size of plant. For the development under consideration wood fuel would be considered further. This is the only technology other than solar PV which could achieve carbon compliance on its own. It would cost approximately £8,000 per home. Current information suggests there are no district heat mains in the proximity to the site.

Combined Heat and Power (Micro-Generation)		Combined heat and power uses a fossil fuel such as diesel or gas to run an engine to drive a generator which in turn produces electricity. The unit then recovers and uses the heat normally wasted by the internal combustion engine, gas turbine sterling engine or other motive power to produce hot water, space or process heating. These systems require a reasonably stable base heat load and long run times to be at their most efficient.
District Heating		These systems use a single point of heat generation or a number of heat generators serving a district heating ring to heat a number of buildings on a site without the need for dedicated plant in each building. There are economies of scale in such systems but there are also heat losses from the distribution pipe work to consider. Systems such as these are often favoured on sites such as military bases where multiple plant rooms feeding the circulation mains also offers a high degree of resilience to the heating within the buildings served.
Heat Pumps (Air, Water or Ground Sourced)		Among the most efficient energy sources currently available in the market and more affordable than many others. Heat pumps use electrical energy to "extract" heat energy from the air, water or ground. A Coefficient Of Performance of up to 4 means that for every one unit of electrical energy used, there is a potential output of 4 units worth of heat energy. These systems require careful design and integration with the heating systems and are better linked to heating systems that require a low grade heat such as under floor heating. It should be noted that the lower the output temperature from the heat pump, the higher the COP is likely to be.

4.3.3 Initial High Level Review

The following Technologies have been considered and rejected for this development as noted.

4.e Technologies rejected for the Development

Technology	Reason for Rejection as unsuitable
Combined Heat and Power (CHP) - biomass	Electricity and heating demand are too small to be feasible and there will be no use for generated heat in summer. There are potential noise issues requiring specialist acoustic treatment in a primarily suburban/rural area where it could be a disturbance to local residents.
Combined Heat and Power (CHP) - Natural gas	As for Biomass CHP
Combined Heat and Power (CHP) - sewerage gas and other biogas	As for Biomass CHP
Individual Biomass Room Heaters	Normally these would be rejected on a development of this type in favour of a central heating system due to cost and viability.
Biomass – community/district heating scheme	A small seasonal heating load is present which makes the selection and implementation of central plant impractical from both an efficiency and operational perspective, although even small plant may be able to export some heat to other areas when demand in the dwellings is low. As local heat demand is low this has been rejected. A district gas CHP system could achieve compliance and 10-15% energy contribution without the use of solar PV. However, its additional capital cost would be over £11,000 per unit and it would have a net whole life cost rather than benefit.
Wind Energy from Turbines	Believed to be impractical as likely to require 25m mast to achieve and maximise clear air flow. Maintenance area and space for drop down mast will be required in what is a congested site. Turbines are visually intrusive and planning permission likely to be required. Proximity to other buildings may be an issue as turbines can be perceived as a nuisance. Turbines produce noise and the suburban setting means this will increase the overall ambient background noise level. Strobing due to the rotating blades and vibration can also be experienced

	especially with building mounted solutions. It would however be possible to sell back excess energy generated via the Feed In Tariff.
Heat Pumps (Water Sourced)	No suitable nearby water source available such as a river or water course. Potential issues also with the Environment Agency for installations of this type where habitats of water borne wildlife can be adversely affected.
Solar Thermal (hot water)	Both types of installation of evacuated tubes or flat plate panels, situated on the roof are generally bulky and unsightly. Efficiency is a function of location, pitch and orientation. There are significant areas of South facing roof, between 30° and 45° from the horizon. There is little overshadowing. They cannot achieve required CO₂ reductions without the additional use of solar PV, compared to which it has a higher capital cost and poorer payback. Back up electric immersion will still be required for providing heat when solar energy is not available. Once installed, running costs are low and maintenance is minimal. Additional hot water storage would be necessary a- Condensing Combination boilers are planned for the development.

4.3.4 Potential Technologies for Further Analysis

Following the initial high level review and strip out of those technologies deemed unsuitable or not feasible, the remaining technologies have been analysed and are reviewed below:

The table 4.f offers potential methods of producing the required CO₂ reduction using low and zero carbon (LZC) technologies compared to the same development that is Building Regulations compliant, but does not use LZC technologies.

4.f Potential Methods of achieving 10% CO2 reduction using LZCs

System	Advantages & Disadvantages	Payback
Solar Photovoltaic	Solar Voltaic panels are a noiseless technology generating electricity to use in the home. In addition, it is possible to sell back excess power to the grid. Feed in Tariffs mean revenue can be collected for electricity used and exported to grid. Currently up to 14.9p per kWh generated is available and guaranteed for 20 years. Relatively high solar yields are possible in the Guildford area compared with much of the UK. Silicon mono Crystalline or polycrystalline panels are efficient and cost effective compared to less intrusive PV tiles which are approximately double the cost.	Payback not including maintenance and any items such as fall arrest systems to access the panels could be in the region of 7-10 years at current Feed in Tariff Levels with the system being "in profit" beyond this. In reality, inverters and other components will require replacement at or around 10 years which will reduce the benefit further. Capital cost is still relatively high and in the event that the Feed in Tariff were to be removed or suspended, the export rate to grid falls to approximately 3p/kWh. This would increase the payback to >20years.
Heat Pumps (Ground Sourced)	The requirement for electricity to power the pump is a disadvantage however efficiencies are good at around 4:1 especially in well insulated new build dwellings as the proposed development although can fall to 2.5:1. Lack of available land for many of the proposed plots precludes horizontal ground loops for most, although may prove an good alternative for detached homes on the site. Further investigations into ground conditions would be required to decide on suitability.	The Energy Saving Trust estimates that an average performing ground source heat pump could save: between £650 and £1,035 a year to replace oil-fired heating between £1,265 and £2,000 a year to replace electric heating it could provide an additional £2,325 to £3,690 a year through the Renewable Heat Incentive.. Payback is dependent on efficiencies and therefore difficult to predict.

4.3.5 Summary and Recommendations for Renewable technologies

With due consideration of all of the renewable energy sources discussed in this statement, it is clear that photovoltaic cells would be the most suited to the site location, dwelling design, layout and orientation. The location, when compared to the UK average, demonstrates there are significantly more sunlight hours available. In addition, the site layout offers areas of southern, south eastern, or south western facing roof elevations appropriate for this technology.

As Table 4.g demonstrates, by targeting high fabric energy efficiency in the design, this significantly reduces the energy requirement and therefore the need for alternative energy sources. An estimated 0.5kWp would be required by an average new build apartment unit on site, equivalent to 7-9m² of panels (appendix B).

Table 4.g The SAP 2012 Part L 2010 outputs for the sample residential units with PV/MVHR.

	Apartments with PV
Capacity (kWp)	0.5
Dwelling TER (kgCO ₂ /m ² /yr)	20.01
Fabric Energy Efficiency – FEE (kWh/m ² /yr)	44.8
Dwelling DER (kgCO ₂ /m ² /yr)	15.57
CO₂ Reduction (%)	22.2%

Given the above evaluation of low and zero carbon energy technologies and assuming that the PV requirement may be spread across the dwellings determined by the orientation and available roof space, in order to reduce the energy demand of the development by 19% across 50% of the new dwellings, the following approach is currently being considered for the development at the land at 1-3 Castle Crescent. However, the use of alternative technologies has not been ruled out:

- Efforts will be made to provide PV on 50% home with a roof facing between south-west and south-east which can mount the required area of PV to achieve 19% reduction in CO₂ emissions over Building Regulations Part L 1A in the new build apartments
- Alternatively, a PV array may be split among the total planned new build units to achieve the target level of 19% CO₂ reduction requirement.
- PV tiles will be considered for all PV arrays across the development to ensure there is no visual intrusion from both within or from outside the development.

The proposed development at 1-3 Castle Crescent, Reading will build in the required basic infrastructure to enable easier installation of roof mounted renewable technologies such as solar PV where required by the property owner. Features will include:-

- Roof construction will be upgraded to ensure they are structurally capable of accommodating significant arrays of solar renewable technologies.
- The supply of energy meters on all properties will be explored to allow for renewable energy micro- generation equipment.

5.0 Sustainability Statement

5.1 Introduction

The developer is keen to demonstrate a commitment to current and future sustainability requirements and goals through this section of the report and will adhere closely to Local Development Framework Core Strategy policies and associated Supplementary Planning Documents and accepting there have been changes to the Code for Sustainable Homes prior to planning approval,

This Sustainability Statement follows closely on from the Renewable Energy Assessment and will discuss the types of measures which will be employed over and above those discussed in the previous sections and in line with the relevant policies in the adopted Reading Core Strategy, as covered in the introduction.

5.2 Internal and External Water Consumption

Measures will be taken to minimise water use, with a target 105 litres per day per person for all residential units. This can be achieved through the use of low flow taps, showers and aerators, dual flush toilets and low volume baths, where applicable. However, the specification of baths within residential units will be minimised. Appendix A offers an example calculation for the Apartments to achieve the water usage target of 105l per person per day.

5.3 Sustainable Drainage (SuDS)

Sustainable Drainage Systems (SuDS) are an approach to drainage which seeks to decrease the amount of surface water runoff and/or divert it for other purposes, thereby reducing the contribution it makes to sewer discharge and flooding. SuDS can also improve the quality of runoff, preventing pollutants from entering the drainage system and provide landscape, amenity and biodiversity benefits.

In addition to SuDS, water conservation measures considered across the site will include:

- The use of water butts within the residential and leisure areas
- The use of water efficient technologies where possible in residential bathrooms and kitchens including spray taps, water saving shower heads, flow controls, dual flush toilets and water efficient appliances including washing machines and dishwashers.

5.4 Materials and Waste

In line with the Supplementary Planning Document "Sustainable Design and Construction (2011) revised 2015 and the Waste Hierarchy, materials and systems will be selected that include an environmental assessment using the BRE Green Guide to Specification for Buildings. Wherever possible 'A or A+ Rated' materials will be used. These selections will include evaluations of cost and performance as well as environmental considerations. Preference will be given to the use of local materials and suppliers, where viable, to reduce the transport distances and to support the local economy. Supply chains could be developed locally for timber products where timber frame buildings are specified and many other products such as stairways and panelling.

5.4.1 Site Waste Management

During development, a Site Waste Management plan will be employed on the site to monitor and report waste generated in defined waste groups. The plan will include the setting of targets

to promote resource efficiency and will include procedures and commitments to sort and divert waste from landfill.

5.4.2 Storage of Waste

Provision will be made for the internal and external storage of non-recyclable waste and recyclable waste. Internal recycling bins will be located in a dedicated non-obstructive position such as a cupboard in a kitchen or utility room. External space should be located on level hard standing and accessed by an inclusive route from the closest external door to the dwelling/apartments. The Castle Crescent area benefits from Local Authority Waste and recycling services.

5.4.3 Composting

Composting facilities will be supplied for each dwelling to accommodate recycling of green and garden waste. Furthermore, facilities will be made available for the commercial development on site where appropriate.

5.5 Health and Wellbeing

5.5.1 Ecology and Green Infrastructure

The proposed development will be designed to maximise the ecological value of the site. Ecological enhancements, recommended by the site ecologist, will be adopted where appropriate.

The site's existing and proposed landscaping will provide green corridors linking to the existing green infrastructure links around the site and further afield.

In addition, the proposed development will incorporate high levels of sympathetic green infrastructure. Native species will be retained and/or planted across the development.

5.5.2 Buildings for Life and Adaptable Buildings.

The proposal acknowledges the need to incorporate design features that will create a flexible blueprint for accessible and adaptable homes and neighbourhoods on the proposed development. The residential development will therefore be designed to adhere to Buildings for Life to achieve a "Good" standard and comply with Local Plan Policy G1, the Sustainable Design and Construction Supplementary Planning Document (SPD) March 2011.

5.5.3 Pollution

The proposal at 1-3 castle Crescent will include a strategy to ensure all space heating and hot water systems minimise the risks associated with pollutants such as the Nitrogen Oxide group of highly reactive gasses. At this stage in the design process it is assumed that high efficiency combination condensing boilers will be required for primary space and water heating. Such modern equipment can deliver low NOx emissions.

Building products such as insulants which have high Global Warming Potential (GWP), will be restricted.

5.6 Alternative modes of Transport

The land at 1-3 Castle Crescent development lies in close proximity to the urban area of Reading, linked from Coley Avenue by the main arterial Bath Road, which offers direct access to the urban centre by foot, cycle and public transport, with regular and frequent daily bus services currently operating.

5.6.1 Walking and cycling

Encouraging residents out of cars and onto the existing cycle and footpath networks to make those small but rewarding journeys by foot or cycle, experiencing the natural environment and in turn reducing car journeys and enticing residents and workers to walk or cycle is a significant consideration for the proposed development at 1-3 Castle Crescent.

The site location is within walking and cycling distance of Reading (approximately 1.0 km as the crow flies) as a major employment, retail, leisure and education centre. The proposed development at 1-3 Castle Crescent will design in foot and cycle paths to link with the existing infrastructure as well as public transport links and other alternative modes of transport.

5.6.2 Public Transport

Travel accounts for between 15-25% of the overall carbon emissions of residents in the UK, therefore an important aspect in the provision of new developments is to provide suitable and sustainable travel networks for residents to use to go about their every day journeys.

Specifically, there are frequent and regular local bus services on Coley Avenue and Bath Road to and from Reading town centre.

5.7 Security

The proposed development will be designed to ensure that residents feel safe and secure, where crime and disorder, or the fear of crime, does not undermine quality of life or community cohesion.

5.8 Sustainable Management

Home User Guides will be distributed to all residential and commercial buildings across the development on completion and handover.

5.9 Considerate Constructors

Considerate Constructors Scheme Certification will be sought for the scheme and will aim to commit to achieve Best Practice.

5.10 Minimising Construction site Impacts

The development will adopt best practice in monitoring, reporting and setting targets for Air (dust), noise, water pollution and consumption across the site.

6.0 Summary

This document illustrates the sustainable approach taken by the proposed development at the Land at 1-3 Castle Crescent, Reading. It has taken full consideration of local, sub-regional and broader policies in its approach. It will deliver both sustainable living and working accommodation in an ecologically diverse environment.

The development plans to offer highly energy efficient accommodation and renewable technologies across the new build element to reduce reliance on the National Gas and Electricity Grids. It will include and further support highly sustainable transport links, both locally by foot or cycle and more widely by bus or train.

The proposal offers a sustainable solution to surface water runoff and will increase the opportunity for flora and fauna to flourish within the site.

Appendix A

1-3 Castle Crescent, Reading

You are within your target maximum consumption of potable water (105 litres per person per day).

Total water consumption from your calculation

101.92

litres per person per day

This calculator is intended to inform design choices by demonstrating the likely impact of specification changes on total water consumption. Results can only be used to demonstrate compliance with the Code for Sustainable Homes when the calculations have been verified by a suitably qualified Code for Sustainable Homes assessor.

Calculation summary

Installation type	Unit of measure	Capacity / flow rate	Use factor	Fixed use	Litres / person / day
WCs (single flush)	Flush volume (litres)		4.42	0	20.6
WCs (dual flush)	Average effective flushing volume (litres)	4.66			
Taps (excl. kitchen/utility room)	Flow rate (litres / minute)	7.05	1.58	1.58	12.72
Bath (shower also present)	Capacity to overflow (litres)	140	0.11	0	15.4
Shower (bath also present)	Flow rate (litres / minute)	6.7	4.37	0	29.28
Kitchen/utility room sink taps	Flow rate (litres / minute)	4.5	0.44	10.36	12.34
Washing machine	Litres / kg dry load	8.17	2.1	0	17.16
Dishwasher	Litres / place setting	1.25	3.6	0	4.5
Waste disposal unit	Litres / use	☐	3.08	0	
Water softener	Litres / person / day	☐	1	0	
Contribution from Grey Water					undefined
Contribution from Rain Water					undefined
Normalisation factor					$\Sigma \times 0.91$

Appendix B

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.1.25

Printed on 18 September 2015 at 14:00:52

Project Information:

Assessed By: () Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 60m²

Site Reference : 1-3 Castle Crescent Reading

Plot Reference: apt 60m2

Address : H Carter and Son, Aldershot Road, Guildford, GU3 3HF

Client Details:

Name: Barton Willmore

Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 20.01 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.57 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 44.8 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.22 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 382, product index 017310):	
	Boiler systems with radiators or underfloor heating - mains gas	
	Brand name: Worcester	
	Model: 533 Compact NG	
	Model qualifier:	
	(Combi)	
	Efficiency 89.8 % SEDBUK2009	
	Minimum 88.0 %	OK

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls: TTZC by plumbing and electrical services **OK**
 Hot water controls: No cylinder
 Boiler interlock: Yes **OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100.0%
 Minimum: 75.0% **OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (South West England): Not significant **OK**

Based on:

Overshading: Very Little
 Windows facing: South West 5.1m²
 Ventilation rate: 4.00
 Blinds/curtains: Light-coloured curtain or roller blind
 Closed 100% of daylight hours

10 Key features

Doors U-value: 1 W/m²K
 Photovoltaic array

DRAFT