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Reading Park Station
Caversham Road
Reading
RG1 8BA

Residential Development
Energy and Sustainability
Statement/Strategy

Issue 03

Client Name	Aviva Life and Pensions UK Limited
Client Address	Saint Helen's 1 Undershaft London EC3P 3DQ
Property:	Residential Development Reading Station Park, Caversham Road, Reading, RG1 8BA
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CONTENTS

EXECUTIVE SUMMARY

The energy strategy adopts a hierarchical approach using passive and low energy design technologies to reduce baseline energy demand and CO_2 emissions followed by the application of low and zero carbon technologies. This strategy is in line with the relevant Reading Policies and the related supplementary guidance. In accordance with the December 2019 issue of the SPG, a target carbon emission for this energy strategy is zero carbon homes and as a minimum on site 35% less than a Building Regulations Part L2A:2013 baseline.

The focus of this energy strategy is on CO_2 reduction by using a highly efficient building envelope with high efficiency mechanical and electrical services, along with air source heat pumps, photovoltaic panels serving the domestic hot water base load in conjunction with photovoltaic cell renewable technology. The result is a proposed development with predicted performance of:

- Block A achieves a 50.52% reduction in carbon, Block B achieves a 49.79% reduction in carbon, Block C achieves a 49.81% reduction in carbon and Block D achieves a 48.43% reduction in carbon when compared to a Building Regulation 2013 compliant building as required by the Reading Plan.
- Block A achieves a 8.58% improvement in fabric energy efficiency, Block B achieves a 9.13% improvement in fabric energy efficiency, Block C achieves a 3.38% improvement in fabric energy efficiency and Block D achieves a 9.06% improvement in fabric energy efficiency when compared to a Building Regulation 2013 compliant building as required by the Reading Plan.
- The residential development achieves a CO_2 emissions reduction of 49.64 % over the Building Regulations 2013 compliant baseline scheme.
- The energy strategy is predicted, using the Building Regulations calculation methodologies, to achieve an annual development carbon emission saving of 497.96 tonnes over the baseline scheme.

The carbon dioxide emission and savings values, for the development as a whole, are as follows:

	CO_2 Emissions (Tonnes per annum)	
	Regulated	**Unregulated**
Baseline Building Regulations 2013 Part L Compliant Development	1003.08	2033.74
After passive/low energy (energy demand) reduction	779.56	1810.21
After CHP or decentralised heating	774.52	1805.18
After renewable energy	505.12	1535.78

As stated above the developments carbon emission was significantly reduced compared to a Building Regulation 2013 complaint scheme. The below table set out the offset payment through Section 106 contribution as laid out within the Reading policies.

	Regulated CO_2 Savings	
	Tonnes per annum	**%**
Savings from passive/low energy (energy demand) reduction	223.53	22.28
Savings from CHP or decentralised heating	5.04	0.50
Savings from renewable energy	269.40	26.86
Total Cumulative Savings	**497.96**	**49.64**
Carbon Short Fall	**505.12**	

	Tonnes CO_2
Cumulative Saving for off-set payment	£15,153.61
Cash-in-lieu contribution	**£909,216.50**

1.00 INTRODUCTION

1.01 Purpose

This report has been prepared on behalf of Aviva Life and Pensions UK Limited for the proposed Reading Station Park development energy strategy.

The report contains the predicted energy and carbon emission assessment results and identifies savings from the proposed low and zero carbon technologies to be incorporated into the scheme.

The energy and carbon dioxide emission assessment also known as the SAP assessment (Standard Assessment Procedure) has been undertaken using Elmhurst Design SAP 2012 software. Based on the building design submitted with the planning application the modelling identifies the energy and carbon dioxide savings related to the building envelope design and efficient mechanical and electrical services systems followed by the improvement using the proposed low and zero carbon (renewable) technologies for the scheme.

1.02 Existing Building

The existing development comprise a number of low-level retail buildings arranged facing Vastern Road. This development will be demolished and the land repurposed.

1.03 Proposed Development

The proposed development is submitted in outline based on Development Parameters, which allow the mix of commercial and residential use to be determined at a later stage. Under all land use mix scenarios, the development would come forward on the four defined development plots within the application site. For the purposes of this report we have assumed the development will be residential led and is based on the illustrative scheme contained in the Design & Access Statement.

The proposed development consists of four new towers referred to as Block A, Block B, Block C and Block D. The site is located next to Reading railway station on the corner of Caversham Road and Vastern Road.

The four blocks will provide approximately 1000 apartments in various configurations. The ground level on all four blocks will consist of retail/commercial/community demises. The towers increase in height with Block D being the tallest tower within the proposed development.

1.04 Reservation

This report has been prepared solely for the use of the applicant and Watkins Payne Partnership accept no responsibility for its use by any third parties.

2.00 POLICY REVIEW

2.01 National Policy

The National Planning Policy Framework (NPPF) sets out the planning policies for England that are to be taken into account within local planning policies. The framework itself does not have specific policies but identifies the purpose of achieving sustainable development. The NPPF launched in February 2019 states;

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal changes. It should help to: shape places in ways that contribute to radical reduction in greenhouse gas emission, minimise vulnerability of existing buildings; and support renewable and low carbon energy and associate infrastructure".

2.02 Reading Sustainable Policies

Reading Borough Local Plan came into effect in November 2019. This document contains the policies for how Reading will develop up to 2036. The policies favours sustainable developments at the heart of its approach to planning and this is articulated in the National Planning Policy Framework, published in February 2019. The key policies associated with building design and energy strategy as noted below:

Sustainable Design and Construction

CC2: SUSTAINABLE DESIGN AND CONSTRUCTION

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- *All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible;*
- *All minor non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum;*
- *All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost effective.*

Adaptation to Climate Change

CC3: ADAPTATION TO CLIMATE CHANGE

All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- *Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;*
- *Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;*
- *Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and*
- *All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change*

Decentralised Energy

CC4: DECENTRALISED ENERGY

In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a decentralised energy source.

Any development of more than 20 dwellings and/ or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.

Where there is existing decentralised energy provision present within the vicinity of an application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.

Standards for New Housing

> ***H5: STANDARDS FOR NEW HOUSING***
>
> ***New build housing should be built to the following standards, unless it can be clearly demonstrated that this would render a development unviable:***
>
> ***a. All new build housing outside the Central Area as defined on the Proposals Map will comply with the nationally-described space standard.***
>
> ***b. All new build housing will be built to the higher water efficiency standard under Regulation 36(3) of the Building Regulations[79].***
>
> ***c. All major new-build residential development should be designed to achieve zero carbon homes.***
>
> ***d. All other new build housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations.***
>
> ***e. All new build housing will be accessible and adaptable in line with M4(2) of the Building Regulations, unless it is built in line with M4(3) (see below).***
>
> ***f. On developments of 20 or more new build dwellings, at least 5% of dwellings will be wheelchair user dwellings in line with M4(3) of the Building Regulations. Any market homes provided to meet this requirement will be 'wheelchair adaptable' as defined in part M, whilst homes where the Council is responsible for allocating or nominating an individual may be 'wheelchair accessible'.***

2.03 Reading Supplementary Planning Guidance

The further clarification to the Reading Local Plan 2019 is supported by supplementary planning guidance (SPG) that includes "Sustainable Design and Construction" dated December 2019 that relates specifically to sustainability issues.

The SPD is intended to guide developers and decision-makers on the implementation of key sustainability policies set out in the Reading Local Plan, namely CC2-CC5, EN18 and H5. Summary of these policies are below;

- CC2: Sustainable Design and Construction

  This policy seeks improved sustainability performance of buildings by setting out BREEAM requirements for non-residential developments conversions to residential. It also sets out the general principles of sustainability in new development that applies to both residential and non-residential uses. Requiring the specified BREEAM levels will significantly contribute to achieving Reading's emissions targets, as well as mitigating the effects of climate change.

- CC3: Adaptation to Climate Change

  This identifies measures including building orientation, shading, heating, ventilation, green or brown roofs and walls, planting and surface water run-off to deal with the effects of climate change. Where these measures are not appropriately incorporated, planners will consider whether or not this is a reason for refusal. This policy will ensure that development within the Borough is resilient in the face of climate change.

- CC4: Decentralised Energy

  This policy requires developers to consider inclusion of decentralised energy infrastructure, increasing the amount of decentralised energy provision in the Borough. This will help to achieve a shift to sustainable energy consumption and production and covers a wide range of technologies that reduce dependence on a centralised network or grid.

- CC5: Waste Minimisation and Storage

  This policy requires developers to identify measures to minimise the generation of waste and to handle waste appropriately during the lifetime of a development. It will help to achieve the aims of the Council's Waste Minimisation Strategy[9], as well as to comply with national policy, such as the Landfill Directive[10].

- EN18: Flooding and Sustainable Drainage Systems

  This policy directs development away from areas that are liable to flood. In areas of lower risk, development may move forward if it passes the exception test in the NPPF. It also requires major developments to incorporate Sustainable Drainage Systems (SuDS). This policy will help to protect people and property from flooding.

- H5: Standards for New Housing

  This policy outlines standards for new-build housing, including those for sustainable design and construction. All new-build housing must be built to the higher water efficiency standard under the Building Regulations. All major new-build residential should achieve zero carbon homes and all other new-build housing must achieve a minimum 19% improvement over the 2013 Building Regulations target. This policy will help to deliver high-quality new homes and achieve Reading's emissions targets, as well as mitigate the effects of climate change.

According to the SPD an energy statement would typically include the following information:
Energy efficiency of the building;

- Baseline annual predicted energy demand of the development (regulated and unregulated);
- Baseline annual predicted carbon emission of the development (regulated and unregulated), the Target Emission Rate (TER);
- The contribution of each proposed renewable energy technology;
- Cost information of technically feasible low zero carbon renewable technologies, including additional insulation, low carbon decentralised energy, heat pumps etc;
- Feasibility of district or community heating;
- Summary of the benefits of various energy technologies;
- The total estimated reduction in the development's baseline carbon and/or energy emissions.

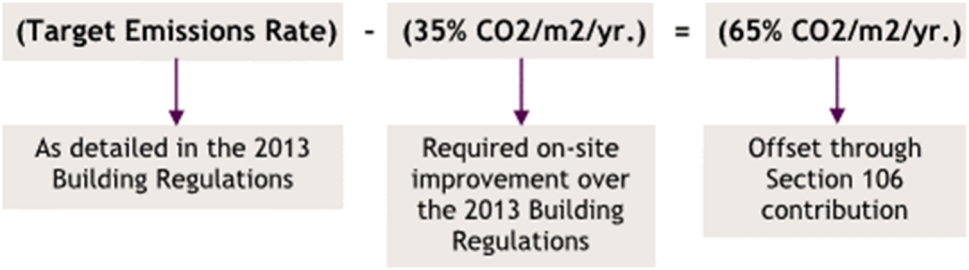
The relevant sections from the Sustainable Design and Construction SPG are as follows:

Table 3.1: Required level of sustainability standard

	Size of Development	Required Standard
New-build residential	**Minor** (fewer than 10 dwellings)	19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations
	Major (10 dwellings or more)	Zero Carbon (or if unachievable, a minimum 35% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations and planning contribution to offset remaining carbon emissions to zero)
Creation of new residential units through conversion from other uses and/or	**Minor** (fewer than 10 dwellings)	BREEAM 'Very Good'
	Major (10 dwellings or more)	BREEAM 'Excellent'
Non-residential development (including development for non-C3 residential)	**Minor** (less than 1,000 sq. m of floorspace)	BREEAM 'Very Good'
	Major (1,000 sq. m of floorspace or more)	BREEAM 'Excellent'
Non-residential refurbishment (including refurbishment for non-C3 residential)	**Minor** (less than 1,000 sq. m of floorspace)	BREEAM 'Very Good'
	Major (1,000 sq. m of floorspace or more)	BREEAM 'Excellent'

As stated above the requirement for major new residential developments is to achieve Zero Carbon Homes. The policy recognised that is not always achievable and such if not achievable, it must achieve a minimum of 35% improvement in regulated emissions over the Target Emissions Rate (TER) in the 2013 Building Regulations, plus a Section 106 contribution of £1,800 per remaining tonne towards carbon offsetting within the Borough calculated as £60/tonne over a 30 year period). £60 per tonne of carbon is nationally recognized price of carbon and reflects the amount established by the Zero Carbon Hub.

The following calculation should be used to determine contribution:



3.00 OUTLINE METHODOLOGY

3.01 Energy Strategy

The fundamental approach for the energy strategy is as follows:

- Establish the baseline energy demand in line with statutory requirements in terms of Building Regulations Part L1A:2013 compliance using SAP assessment methodology.
- Adopt passive and low energy design techniques in order to reduce the energy demand for the development beyond the baseline energy demand requirements.
- Assess the potential decentralised heating, cooling and power measures available to suit this development and establish potential energy/carbon dioxide reduction for viable solutions (clean scheme).
- Assess the potential low and zero carbon (renewable) technologies to suit the development and establish potential energy/carbon dioxide reduction for viable solutions.
- Establish the anticipated energy and carbon dioxide emission reductions for the residential areas.

This approach is in line with the principles detailed within the relevant policy statements and regulatory guidelines listed in section 2.00. The development consists of new build residential apartments. The above-mentioned methodologies shall be applied to the whole residential development.

3.02 Energy Strategy Targets

The target carbon emission savings for this energy strategy are 35% less than a Building Regulation Part L1A:2013 Baseline.

4.00 ENERGY DEMAND ASSESSMENT

4.01 General

4.01.01 Principles

The energy demand assessment work has been undertaken using the Standard Assessment Procedure (SAP) 2012 version 9.9.2 in line with Building Regulations Part L1A: 2013 requirements using Elmhurst Design SAP 2012 software version 4.12.

Within the energy demand assessment, the following fuel carbon dioxide emission intensity factors have been used in line with Part L1A:2013.

Fuel	kg CO_2 / kWhr
Natural gas	0.216
Grid supplied electricity	0.519
Grid displaced electricity	0.519

4.01.02 Regulated and Un-regulated Energy

The planning application energy strategy will be provided in a format that reflects the recommendations of the Reading SPA December 2019.

Therefore, this framework energy strategy shows how policy compliance for the "regulated" energy can be achieved at the development and makes reference to the estimated "un-regulated" energy usage by means of energy benchmarks.

For clarity "regulated" and "un-regulated" energy are summarised as follows:

- Regulated Energy — This is the energy covered by Approved Document L1A of the Building Regulations i.e. the energy used in heating, cooling, fans and pumps plus domestic hot water
- Un - regulated Energy — This is energy used within a building that is not covered by the Building Regulations i.e. the energy used for general small power loads, lifts, external lighting, catering electricity, etc.

The planning policy CO_2 reduction targets are based in "regulated" energy only. Hence the % CO_2 emission savings target is not adversely affected by the estimated "un-regulated" energy in a building.

The assessed un-regulated energy uses for the proposed development are as follows:

- Appliances
- Cooking

For Block A the area weighted un-regulated energy equates to 20.19 $kgCO_2/m^2$, Block B 19.25 $kgCO_2/m^2$, Block C 19.50 $kgCO_2/m^2$ and Block D 18.80 $kgCO_2/m^2$.

4.02 Baseline Scheme

The baseline demand is the Building Regulations Part L1A:2013 target emission rate (TER).

The Part L1A:2013 TER is derived from the thermal model based on the National Calculation Methodology (NCM). The review has been carried out utilising the Elmhurst Design SAP 2012 software version 4.12.

The baseline CO_2 emissions for residential development are modelled as follows:-

Block A

Type		**TER-CO_2 Emission Rate (kg CO_2/ m^2)**
Area weighted		**19.06**

The annual CO_2 emission resulting from the baseline demand equates to the following:

	CO_2 Emission (tonnes CO_2/year)
Without unregulated uses	209.91
With unregulated uses	432.24

Under the Building Regulations L1A: 2013 a fabric energy efficiency requirement was added to criterion 1, along with the carbon emission requirement which is mandatory requirement under the regulations.

This is referred to as the Target Fabric Energy Efficiency (TFEE) and expressed in kwh/m² per annum. The base line fabric energy efficiencies for the residential development are modelled as follows:

Type		**TFEE – Fabric Energy Efficiency (kwh/ m^2)**
Area Weighted		**44.77**

Block B

The baseline CO_2 emissions for Block B residential development are modelled as follows:-

Type	**Apartments**	**TER-CO_2 Emission Rate (kg CO_2/ m^2)**
Area weighted		**19.06**

The annual CO_2 emission resulting from the baseline demand equates to the following:

	CO_2 Emission (tonnes CO_2/year)
Without unregulated uses	252.28
With unregulated uses	507.13

Baseline fabric energy efficiency for the Block B apartment types is as follows:

Type	Apartments	TFEE – Fabric Energy Efficiency (kwh/ m^2)
Area weighted		**45.34**

Block C

The baseline CO_2 emissions for Block C residential development are modelled as follows:-

Type	Apartments	TER-CO_2 Emission Rate (kg CO_2/ m^2)
Area weighted		**18.79**

The annual CO_2 emission resulting from the baseline demand equates to the following:

	CO_2 Emission (tonnes CO_2/year)
Without unregulated uses	282.86
With unregulated uses	576.41

Baseline fabric energy efficiency for the Block C apartment types is as follows:

Type	Apartments	TFEE – Fabric Energy Efficiency (kwh/ m^2)
Area weighted		**45.81**

Block D

The baseline CO_2 emissions for Block D residential development are modelled as follows:-

Type	Apartments	TER-CO_2 Emission Rate (kg CO_2/ m^2)
Area weighted		**18.75**

The annual CO_2 emission resulting from the baseline demand equates to the following:

	CO_2 Emission (tonnes CO_2/year)
Without unregulated uses	257.48
With unregulated uses	515.68

Baseline fabric energy efficiency for the Block D apartment types is as follows:

Type	Apartments	TFEE – Fabric Energy Efficiency (kwh/ m^2)
Area weighted		**44.76**

4.03 Energy Efficiency Measures

4.03.01 General

The energy strategy prioritises the reduction in energy consumption and hence CO_2 emissions through the building envelope design together with the use of efficient mechanical and electrical services.

The passive and low energy design principles that have been adopted in the current design include:

- High performance glazing
- Enhanced thermal performance to the existing walls and roof by the introduction of thermal insulations. High degree of thermal insulations within the new walls and roof associated with the building (Fabric Efficiencies are listed within Appendix 1)
- Low building air leakage rate (3 $m^3/hr/m^2$ at 50 Pa which represents a 40 % improvement over the minimum 2013 Building Regulations requirements)
- Whole house mechanical supply and extract ventilation with integral heat recovery
- Community heating system serving all flats
- Low energy lighting (LED lamp sources)
- High efficiency gas fired boilers
- Variable speed pumps
- Building management system to provide sophisticated energy efficiency controls

4.03.02 Block A

The Building Regulations thermal model analysis identifies the following CO_2 emissions for Block A only:

		Part L1A:2013	
Type		**Baseline Scheme (kg CO_2/m^2/year)**	**Lean Scheme (kg CO_2/m^2/year)**
Part L1A :2013 Total		**19.06**	**14.77**
Unregulated Power		20.19	20.19
Total		**39.25**	**34.96**

The comparison of the energy efficient scheme (Lean) against the baseline scheme identifies that for the residential apartments there is a predicted 22.51 % (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 10.93 % (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	162.68
With unregulated uses	385.01

The Dwelling Fabric Energy Efficiency (DFEE) for the apartment types is as follows:

		Part L1A:2013	
Type		**Baseline Scheme (kWh/m²/year)**	**Lean Scheme (kWh/m²/year)**
Area weighted		**44.77**	**40.93**

Residential Block A shows a 8.58 % improvement over the targeted fabric energy efficiency (TFEE) when compared to the dwelling fabric energy efficiency (DFEE).

4.03.03 Block B

The Building Regulations thermal model analysis identifies the following CO_2 emissions for the Block B only:

		Part L1A:2013	
Type		**Baseline Scheme (kg CO_2/m²/year)**	**Lean Scheme (kg CO_2/m²/year)**
Part L1A :2013 Total		**19.06**	**14.68**
Unregulated Power		19.25	19.25
Total		**38.31**	**33.93**

The comparison of the energy efficient scheme (Lean) against the baseline scheme identifies that for the residential apartments there is a predicted 22.98 % (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 11.43 % (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	194.31
With unregulated uses	449.16

The Dwelling Fabric Energy Efficiency (DFEE) for the apartment types is as follows:

		Part L1A:2013	
Type	**Apartments**	**Baseline Scheme (kWh/m²/year)**	**Lean Scheme (kWh/m²/year)**
Area weighted		**45.34**	**41.20**

Residential Block B shows a 9.13 % improvement over the targeted fabric energy efficiency (TFEE) when compared to the dwelling fabric energy efficiency (DFEE).

4.03.04 Block C

The Building Regulations thermal model analysis identifies the following CO_2 emissions for Block C:

		Part L1A:2013	
Type	**Apartments**	**Baseline Scheme (kg CO_2/m^2/year)**	**Lean Scheme (kg CO_2/m^2/year)**
Part L1A :2013 Total		**18.79**	**14.95**
Unregulated Power		19.50	19.50
Total		**38.29**	**34.45**

The comparison of the energy efficient scheme (Lean) against the baseline scheme identifies that for the proposed Block C residential development there is a predicted 20.44 % (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 10.03 % (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	225.04
With unregulated uses	518.59

The Dwelling Fabric Energy Efficiency (DFEE) for the apartment types is as follows:

		Part L1A:2013	
Type		**Baseline Scheme (kWh/m^2/year)**	**Lean Scheme (kWh/m^2/year)**
Area weighted		**45.81**	**44.26**

Residential Block C shows a 3.38 % improvement over the targeted fabric energy efficiency (TFEE) when compared to the dwelling fabric energy efficiency (DFEE).

4.03.05 Block D

The Building Regulations thermal model analysis identifies the following CO_2 emissions for Block D:

		Part L1A:2013	
Type	**Apartments**	**Baseline Scheme (kg CO_2/m^2/year)**	**Lean Scheme (kg CO_2/m^2/year)**
Part L1A :2013 Total		**18.75**	**14.40**
Unregulated Power		18.80	18.80
Total		**37.55**	**33.20**

The comparison of the energy efficient scheme (Lean) against the baseline scheme identifies that for the proposed Block D residential development there is a predicted 23.20

% (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 11.58 % (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	197.75
With unregulated uses	455.95

The Dwelling Fabric Energy Efficiency (DFEE) for the apartment types is as follows:

		Part L1A:2013	
Type		**Baseline Scheme (kWh/m^2/year)**	**Lean Scheme (kWh/m^2/year)**
Area weighted		**44.76**	**40.71**

Residential Block C shows a 9.06 % improvement over the targeted fabric energy efficiency (TFEE) when compared to the dwelling fabric energy efficiency (DFEE).

5.00 DECENTRALISED HEATING, COOLING AND POWER ASSESSMENT

5.01 General

The potential use of decentralised heating, cooling and power for the building has been assessed in relation to the following:

- Decentralised heating
- Decentralised cooling
- Combined heat and power (CHP)
- Combined cooling heat and power (CCHP/trigeneration)

5.02 Decentralised Heating and Cooling

Decentralised heating and cooling relate to a central system that provides the necessary heating and cooling water to more than one use or part of a building or to more than one building. For example, a decentralised heating system can comprise central boiler plant that provides heat to separate dwellings and similarly a decentralised cooling system can comprise central refrigeration plant that provides cooling to individual retail units in a shopping centre.

Two types of decentralised heating and cooling schemes have been considered for the development.

1. Connection to a district energy network (DEN)
2. The provision of a development decentralised energy centre

District Energy Network

Investigations into existing or proposed district energy networks to provide decentralised heating and / or cooling to the development has established that there are proposals by Reading Borough Council to develop networks in some prominent areas in Reading. Heat map has been created by Element Energy which highlight four clusters which will be suitable for heat network schemes. The heat map is demonstrated on Appendix 2 within this report.

The site proposed for the Reading Station Park development discussed within this report will be located in an area where the development could connect to the district heating network in the future.

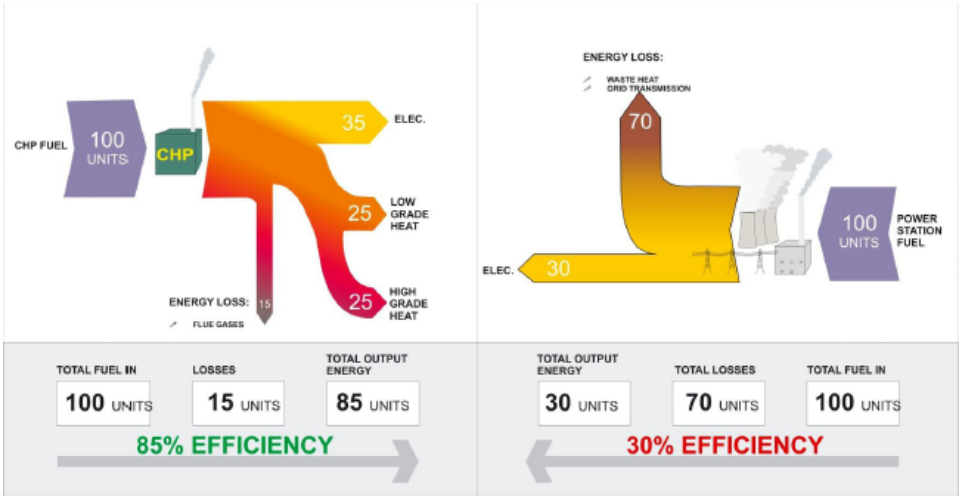
Therefore, the DES is not a viable option for the development site, however connections will be provided for future connectivity.

Decentralised Energy Centre

The development will be provided with central plant serving both the residential and retail uses. The condenser water system will incorporate heat exchangers that will be used by the retail tenants as their heat source when in heating mode and heat sink when in cooling mode from their fit-out systems. The tenants fit out guide will stipulate that the retail tenants will have to use the condenser water system for their primary heating and cooling.

5.03 Combined Heat and Power

Combined Heat and Power (CHP) generates electricity on site and recovers a proportion of the waste heat for use in heating and/or hot water generation for the building. This allows the overall efficiency to be significantly greater than the electricity generated via power stations feeding the National Grid. The CHP plant typically uses gas as the primary energy source and often incorporates a thermal store. Biomass fuelled CHP is possible however this is typically only for very large schemes due to operational difficulties with smaller capacity units.



CHP systems are typically considered only to be viable where they are able to run for at least 5000 hours per annum and have an appropriate year-round heating demand.

The domestic hot water service (HWS) requirement for a residential development is relatively high. As residents will require hot water throughout the day across the year the CHP will operate to its optimum efficiencies. The displaced electricity produced shall be utilised by the residence which offers a clean source of energy.

With the de-carbonisation of the grid using natural gas as a fuel source is no longer sustainable. CHP systems is also considered to contribute to air pollution and as such this system is not viable system for the development.

5.04 Combined Cooling, Heat and Power

Combined Cooling, Heat and Power (CCHP) that is often referred to as trigeneration uses the same principles as detailed above for a CHP system however the heat produced is also used to generate cooling via an absorption chiller. The CCHP plant can make use of heat generated by the CHP plant in buildings with a cooling demand.

Similar to CHP plant the CCHP system is typically considered only to be viable where they are able to run for at least 5,000 hours per year and have an appropriate year-round usage for the heat generated from the CCHP plant.

The absorption chiller incorporated within a CCHP scheme has a very low efficiency. Therefore, a CCHP plant is not considered suitable for the development.

5.05 Decentralised Heating, Cooling and Power Analysis

The SAP assessment has been repeated incorporating a CHP system to contribute to the domestic hot water load (Clean Scheme).

5.05.01 Block A

The Building Regulations thermal model analysis identifies the following CO_2 emissions for Block A only:

		Part L1A:2013		
Type		**Baseline Scheme (kg CO_2/m^2/year)**	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**
Area Weighted Part L1A :2013 Total		**19.06**	**14.77**	**14.75**
Unregulated Power		20.19	20.19	20.19
Total		**39.25**	**34.96**	**34.94**

The comparison of the clean energy efficient scheme against the baseline scheme identifies that for the residential apartments there is a predicted 22.61 % (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and

then a predicted improvement of 12.33 % (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the decentralised energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	162.44
With unregulated uses	384.77

5.05.02 Block B

The Building Regulations thermal model analysis identifies the following CO_2 emissions for the Block B only:

		Part L1A:2013		
Type	**Apartments**	**Baseline Scheme (kg CO_2/m^2/year)**	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**
Area Weighted Part L1A :2013 Total		**19.06**	**14.68**	**14.65**
Unregulated Power		19.25	19.25	19.25
Total		**38.31**	**33.93**	**33.90**

The comparison of the clean energy efficient scheme against the baseline scheme identifies that for the residential apartments there is a predicted 23.14 % (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 13.0% (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the decentralised energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	193.91
With unregulated uses	448.75

5.05.03 Block C

The Building Regulations thermal model analysis identifies the following CO_2 emissions for Block C:

		Part L1A:2013		
Type	**Apartments**	**Baseline Scheme (kg CO_2/m^2/year)**	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**
Area Weighted Part L1A :2013 Total		**18.79**	**14.95**	**14.66**
Unregulated Power		19.50	19.50	19.50
Total		**38.29**	**34.45**	**34.16**

The comparison of the clean energy efficient scheme against the baseline scheme identifies that for the proposed Block C residential development there is a predicted 21.98 % (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 11.99 % (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the decentralised energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	220.59
With unregulated uses	514.13

5.05.04 Block D

The Building Regulations thermal model analysis identifies the following CO_2 emissions for Block C:

		Part L1A:2013		
Type	**Apartments**	**Baseline Scheme (kg CO_2/m^2/year)**	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**
Area Weighted Part L1A :2013 Total		**18.75**	**14.40**	**14.36**
Unregulated Power		18.80	18.80	18.80
Total		**37.55**	**33.20**	**33.16**

The comparison of the clean energy efficient scheme against the baseline scheme identifies that for the proposed Block D residential development there is a predicted 23.41 % (Part L1A 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 13.22 % (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the decentralised energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L1A:2013
Without unregulated uses	197.19
With unregulated uses	455.39

6.00 RENEWABLE ENERGY ASSESSMENT

6.01 General

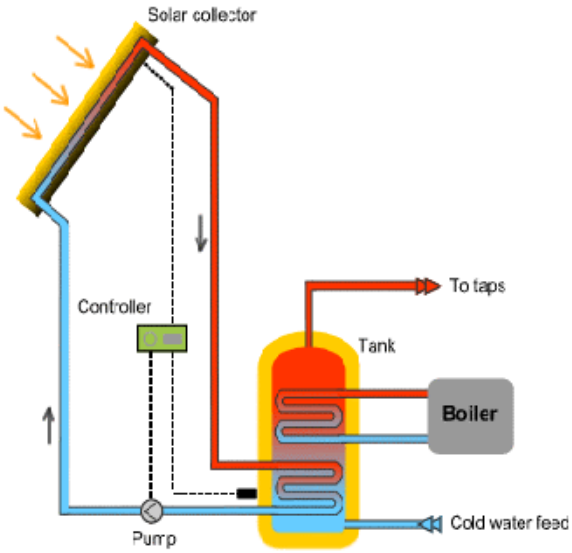
The potential use of renewable energy technology has been undertaken for the following:

- Solar water heating
- Wind turbines
- Photovoltaic cells
- Biomass
- Ground source heating and cooling
- Air source heating and cooling
- Fuel cell

6.02 Solar Water Heating

Solar thermal panels utilise the suns energy to generate hot water for use within the building. The panels are commonly provided in either flat plate or evacuated tube arrangements. The panels are ideally located facing south at an approximate 30° inclination angle in areas where they are not subjected to shade.

The development has the potential to use solar water heating to pre-heat the domestic hot water service, but as the development is provided with a heat pumps the benefit of having solar thermal panels is limited and as such not viable for the development.



6.03 Wind Turbines

Wind turbines generate electrical energy derived from kinetic energy provided by the local wind resource. The performance of wind turbines depends greatly on the wind speed and turbulence that in turn is influenced by the terrain and installation height.

In urban areas non-laminar wind flow occurs as a result of turbulence due primarily to adjacent buildings. There is growing evidence of urban wind turbines failing to perform in line with manufacturer's estimated outputs and as a result wind turbines are likely to produce only modest power outputs with corresponding low carbon dioxide emission reduction within urban sites.

For the reasons detailed above wind turbines are not considered viable for the development.

6.04 Photovoltaic Cells

Photovoltaic (PV) panels utilise the sun's energy to generate electricity. The optimum location for PV panels is south facing at an approximate 30° inclination angle in areas where they are not subjected to shade.

The development has unshaded roof areas that could be utilised for PV panels. Based on various site constrains only the roof of Block D has available space for a PV installation and an area of 30m² can be provided for the installation of PV panels. The contribution from the PV installation shall be put towards Block A, Block B, Block C and Block D.

6.05 Biomass

Biomass is considered to be a renewable fuel source as the CO_2 absorbed during the growth period is assessed as being approximately equal to the CO_2 emitted during combustion and hence deemed "carbon neutral". Biomass for boilers is typically wood either in chip or pellet form.

Biomass boilers require fuel storage together with associated transportation and delivery to the store location. Biomass boilers also increase the NOx emissions when compared to gas fired boilers.