

Energy Strategy

816 Oxford Road

On behalf of John Filbee Properties Limited

Revision 01

Date: 18th March 2022



REVISION HISTORY

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EXECUTIVE SUMMARY.

The Energy Strategy has been produced by Energist UK on behalf of John Filbee Properties Limited ('the applicant'). It supports a planning application for 816 Oxford Road, Reading ('the development'). This is being submitted to Reading Borough Council.

Development proposals consist of a mix of houses and flats, summarised as follows.

Table 1. Development overview.

	Quantity	GIA (sqm)
Domestic Areas		
Flats	21	1,585
Houses	3	400.5
Total		

By adopting principles of sustainable design, and through the incorporation of efficient, Low- or Zero-Carbon (LZC) technologies, the applicant successfully delivers Reading Borough Council planning policies (2019):

- *Reading Borough Council Sustainable Design and Construction SPD, Policy H5.*
- *Reading Borough Council Local Plan, Policies CC1-CC4.*

The Energy Strategy is written in accordance with Chapter 3 of the Sustainable Design and Construction SPD (2019) – Submission Requirements.

The applicant is committed to a design approach that aligns with the principles of the energy hierarchy. The development will achieve a total reduction in regulated CO₂ emissions of 76% over the Target Emission Rate (TER) Approved Document Part L (AD L) 2013 through BE LEAN, BE CLEAN and BE GREEN measures and successfully delivers the target 35% minimum on-site reduction in regulated CO₂ emissions over AD L 2013 for domestic schemes.

SAP10 emission factors are adopted within the Energy Strategy in order to estimate, more accurately, the predicted energy performance and actual carbon emissions associated with the development scheme post-construction. This is in accordance with the requirements of Clause 3.34 of the sustainable Design and Construction SPD (2019). This converts to a 88% reduction in CO₂ emissions over ADL 2013 once SAP10 emission factors are applied.

BE LEAN: Passive design measures have been included and lead to a reduction in regulated CO₂ emissions over the AD L 2013 TER and Target Fabric Energy Efficiency (TFEE) standard. A combination of BE LEAN measures including: energy-efficient building fabric; insulation to all heat loss floors, walls and roofs; triple-glazed windows; low-energy lighting; and efficient heating and ventilation systems all contribute to an enhancement in energy performance equal to a 16% reduction in regulated CO₂ emissions over AD L 2013 or 20% once SAP 10 emission factors have been applied.

BE CLEAN: The feasibility of supplying decentralised energy to the development has been assessed in accordance with the heating hierarchy. Two separate communal heating systems, powered ASHPs, will serve the flats and provide a source of decentralised energy to future occupants within the development. Individual ASHPs will be provided to the houses.

Be GREEN: Opportunities to maximise renewable energy have been assessed and all options reviewed for their practical, financial and technical viability in relation to the development scheme. ASHPs form a central component of the heat network and have been described under the BE CLEAN stage of the energy hierarchy. However, their impact on the energy assessment as a LZC technology is accounted for under BE GREEN measures. Solar PV has been selected by the applicant as the preferred strategy for renewables. In combination, ASHPs and Solar PV will deliver a further 60% reduction in regulated CO₂ emissions over AD L 2013, or 67% once SAP 10 emission factors are applied.

The development achieves the zero-carbon homes standard in full through a carbon-offset payment which offsets the shortfall in regulated CO₂ emissions reduction for the new dwellings. The total CO₂ emissions to offset for 816 Oxford Road, Reading have been calculated as: 103 t.CO₂ over a 30 year period. Based on SAP 10 emission factors and a carbon price of £60/t.CO₂, this is equivalent to a cash-in-lieu contribution of: £6,208.

The results of the energy assessment based on SAP10 emission factors, and the impact of BE LEAN, BE CLEAN and BE GREEN measures in terms of how the applicant delivers their commitment to the energy hierarchy, is illustrated in Figure 1, Figure 2, Table 2, 3, 4 and Table 5 overleaf.

Figure 1. Domestic energy hierarchy ADL 2013.

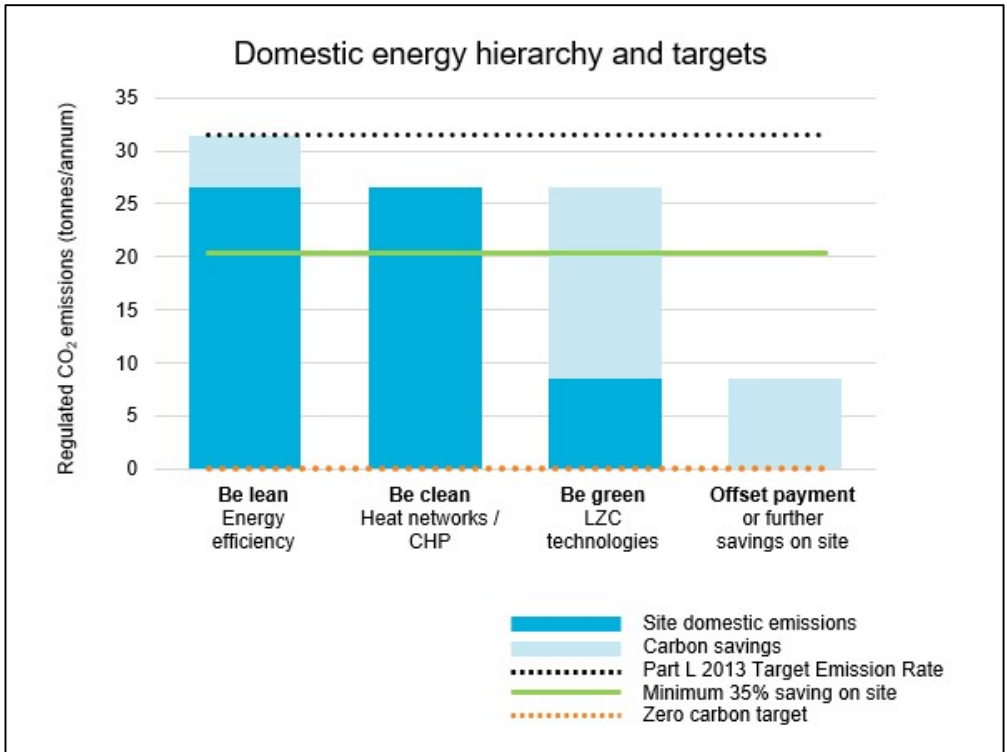


Figure 2. Domestic energy hierarchy (SAP 10)

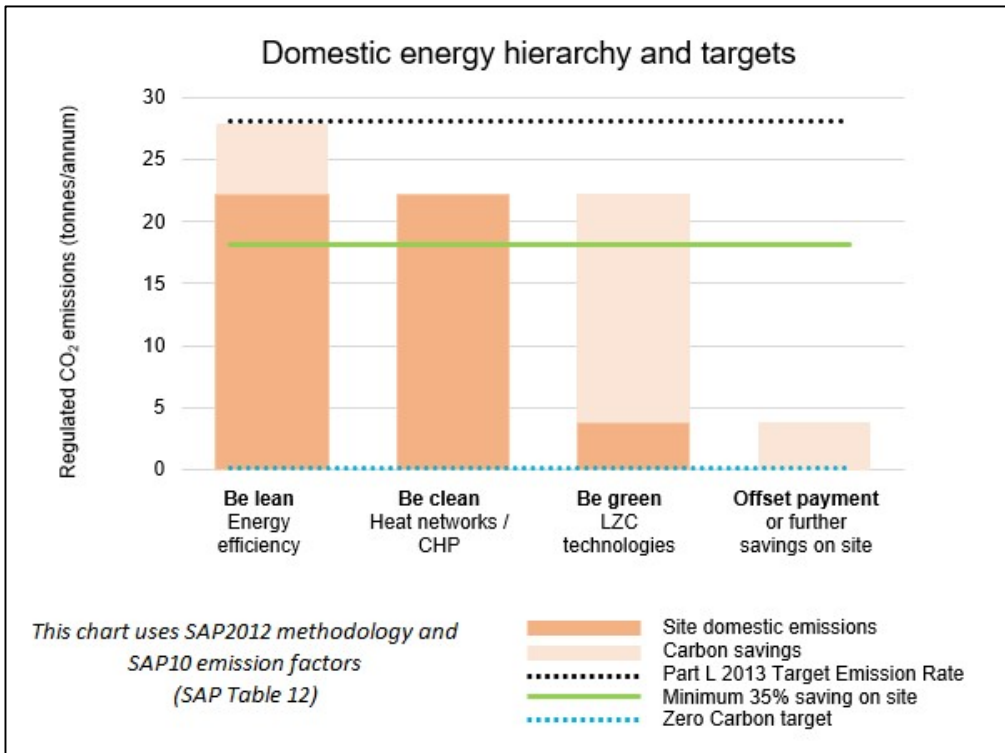


Table 2. Domestic carbon emission savings ADL 2013.

Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings		
	Regulated domestic carbon dioxide savings	
	Tonnes CO ₂ per annum	% reduction
Savings from energy demand reduction	5.00	16.00%
Savings from heat network / CHP	0.00	0.00%
Savings from renewable energy	19.00	60.00%
Cumulative on site savings	24.00	76.00%
Carbon shortfall	8.00	-
Cumulative savings for offset payment	230.00	tonnes CO₂
Cash-in-lieu contributions	£ 13,828.00	

Table 3. Domestic carbon emission savings. (SAP 10)

Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings		
	Regulated domestic carbon dioxide savings	
	Tonnes CO ₂ per annum	% reduction
Savings from energy demand reduction	6.00	20.00%
Savings from heat network / CHP	0.00	0.00%
Savings from renewable energy	19.00	67.00%
Cumulative on site savings	24.00	88.00%
Carbon shortfall	3.00	-
Cumulative savings for offset payment	103.00	tonnes CO₂
Cash-in-lieu contributions	£ 6,208.00	

Table 4: Carbon Emissions at each Stage of the Energy Hierarchy, ADL 2013.

Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings		
	Carbon dioxide emissions for domestic buildings Tonnes CO ₂ per annum	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	32.00	9.43
After energy demand reduction	26.00	9.43
After heat network / CHP	26.00	9.43
After renewable energy	8.00	9.43

Table 5: Carbon Emissions at each Stage of the Energy Hierarchy, SAP 10.

Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings		
	Carbon dioxide emissions for domestic buildings Tonnes CO ₂ per annum	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	28.00	6.67
After energy demand reduction	22.00	6.67
After heat network / CHP	22.00	6.67
After renewable energy	3.00	6.67

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1. INTRODUCTION.

This Energy Strategy has been produced by Energist UK on behalf of John Filbee Properties Limited ('the applicant').

It will set out the climate change mitigation measures incorporated by the applicant as part of the development scheme: 816 Oxford Road, Reading ('the development'), written in support of the planning application being submitted to Reading Borough Council.

By adopting principles of sustainable design, and through the incorporation of efficient, Low- or Zero-Carbon (LZC) technologies, the applicant successfully delivers Reading Borough Council planning policies (2019):

- *Reading Borough Council Sustainable Design and Construction SPD, Policy H5.*
- *Reading Borough Council Local Plan, Policies CC1-CC4.*

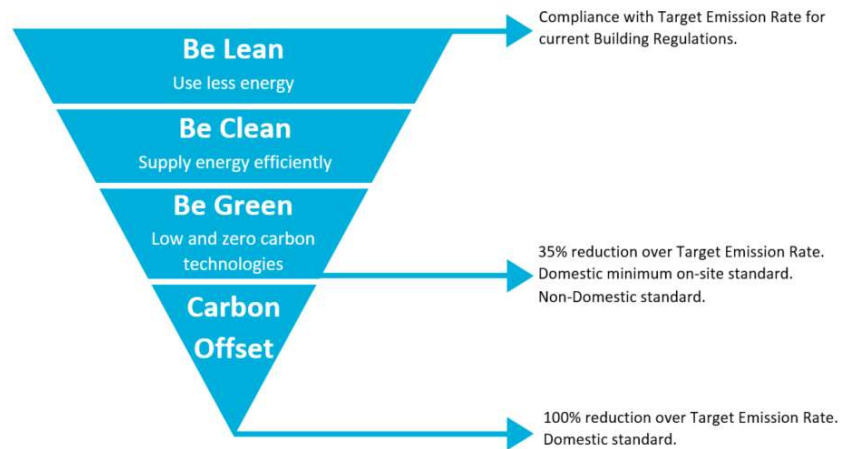
It will demonstrate the energy-strategy approach adopted by the applicant to comply with:

- i) National Planning Policy Framework.
- ii) Reading Borough Council Sustainable Design and Construction SPD, Policy H5 to:
 - Achieve a minimum 35% on-site reduction in CO₂ emissions over Approved Document Part L (AD L) 2013, based on SAP10 emission factors, for all major domestic development by implementing principles of the energy hierarchy.
 - Achieve the zero carbon homes standard in full and, where this cannot be achieved on site, a commitment to offset the shortfall in CO₂ emissions through a carbon offset payment.
 - Evaluate the viability of heat networks in accordance with the following hierarchy:
 - 1) *Connection to an area wide heat network.*
 - 2) *Communal heating system:*
 - *Site-wide heat network*
 - *Building-level heating system*
 - 3) *Individual heating system.*
 - Reduce the potential for overheating through the incorporation of passive design measures in accordance with the cooling hierarchy.
 - Maximise opportunities for the installation of renewable energy technologies.

The Energy Strategy is written in accordance with Chapter 3 of the Sustainable Design and Construction SPD (2019) – Submission Requirements.

The Energy Strategy describes demand-reduction measures, energy-efficiency measures and Low- and Zero-Carbon (LZC) technologies in relation to how the applicant meets the objectives of the energy hierarchy: BE LEAN, BE CLEAN and BE GREEN.

Figure 3. The energy hierarchy



2. DEVELOPMENT OVERVIEW.

Figure 4. 816 Oxford Road, Reading, Site Plan.



Source: Weston + Co Architects, Proposed Site Plan, Drawing No. 19014-PL-03, dated 28/02/2022

This Energy Strategy has been produced for the proposed development at 816 Oxford Road, located in Reading.

An outline planning application is being submitted to Reading Borough Council for a residential scheme consisting of three houses, and twenty one apartments, built over two blocks.

Development proposals are summarised below in Table 6.

Table 6. Development overview.

	Quantity	GIA (sqm)
Domestic Areas		
Flats	21	1,585
Houses	3	400.5
Total		

3. METHODOLOGY.

The purpose of the Energy Strategy is to demonstrate the applicant's commitment to delivering the principles of the energy hierarchy. The Strategy is assessed against, and presented, to align with the following steps:

The Baseline: The development's baseline emissions, the Target Emission Rate (TER), will be calculated to establish the minimum on-site standard for compliance with AD L 2013, and will then be converted based on SAP10 emission factors. The baseline is calculated using a mains gas heating system.

BE LEAN: The development's Dwelling Emission Rate (DER) will be calculated to explain how the applicant's design specification has led to a reduced energy demand and an improved fabric-energy efficiency. The better the design of the building fabric in terms of, for example, insulation, air tightness and orientation to maximise solar gain, the less energy required to heat the dwelling and so the better the fabric energy efficiency.

BE CLEAN: The potential to provide energy to the development in an efficient way, by either connecting to a District Heat Network (DHN) or installing a site-wide, low-carbon energy supply, will be assessed and viability concluded.

BE GREEN: Low- and Zero-Carbon (LZC) technologies will be assessed for their suitability and viability in relation to the development. Solutions will be put forward for the development and the resulting regulated CO₂ emission savings presented.

Carbon Offset: Where it is demonstrated that the energy target for the development cannot be met onsite then any shortfall in regulated CO₂ emissions reduction will be offset through a cash-in-lieu payment and mechanism agreed in consultation with the Local Planning Authority.

3.1 ASSESSMENT METHODS

At each stage of the energy hierarchy, the estimated energy performance of the development has been calculated using the following assessment methodologies.

3.1.1 Domestic

SAP 2012 methodology has been used to calculate energy demand for 4no sample dwellings representing a cross-section of all proposed properties included in the development proposals. This sample size is considered appropriate for the purposes of extrapolation.

SAP calculates the regulated energy demands associated with hot water, space heating and fixed electrical items. Part L1A is used for the purposes of the new build energy assessment.

The cumulative floor areas for representative, sample dwellings have been used to estimate the TER and DER for new dwellings within the development proposals.

The energy assessment data from SAP 2012 are extrapolated to reflect more accurately the expected regulated CO₂ emission rates and energy demand for all new build domestic elements included in the development proposals.

3.1.3 SAP10 emission factors

In order to more accurately reflect the carbon emissions associated with the expected operation of the proposed development, and to demonstrate the way in which the applicant will meet planning policy targets, outputs from the energy assessment in SAP 2012 have been manually converted using SAP10 emission factors.

4. THE DEVELOPMENT BASELINE.

In order to measure the effectiveness of BE LEAN, demand-reduction measures, it is first necessary to calculate the baseline energy demand for the development and this has been completed using SAP 2012 and is based on SAP10 emission factors. This is also referred to as the Target Emission Rate (TER.)

The resulting AD L 2013 TER for 816 Oxford Road, Reading has been calculated using Part L model designs which have been applied to the applicant's development details. The TER, or baseline energy demand, represents the maximum regulated CO₂ emissions that are permitted for the development in order to comply with AD L 2013.

The resulting TER under ADL 2013 has been calculated as 32 t.CO₂/yr. To ensure compliance with AD L 2013, regulated CO₂ emissions should not exceed this figure. When manually converted using SAP 10 emission factors, the TER has been calculated as 28 t.CO₂/yr.

Refer to Appendix 4 for sample TER and DER worksheets.

5. BE LEAN: REDUCED ENERGY DEMAND.

The domestic development scheme at 816 Oxford Road achieves a high quality, sustainable design by integrating the following passive and active design measures to reduce energy demand:

- Energy-efficient building fabric and insulation to all heat loss floors, walls and roofs.
- High-efficiency triple-glazed windows throughout.
- Quality of build will be confirmed by achieving good air-tightness results throughout.
- Efficient-building services including high-efficiency heating systems.
- Low-energy lighting throughout the building.

Throughout the design process, the applicant has developed a fabric specification that takes into account multiple issues and environmental considerations. These include: building form and massing and its impact on energy efficiency; noise impact; air quality; and the internal overheating of dwellings. The Energy Strategy represents a design approach that achieves a balance and takes into account each of these objectives.

Refer to the BE LEAN design specification in detail in Table 7 overleaf.

Table 7. BE LEAN design specification.

Element	BE LEAN Design Specification
Ground Floor U-Value (W/m ² .K)	0.1
External Wall U-Value (W/m ² .K)	0.15
Corridor Wall U-Value (W/m ² .K)	0.15
Party Wall U-Value (W/m ² .K)	0 (fully filled and sealed)
Roof (Slope) U-Value (W/m ² .K)	0.1
Roof (Flat) U-Value (W/m ² .K)	0.1
Thermal Mass	Calculated
Glazing U-Value (W/m ² .K)	1.1 (triple-glazed units)
Glazed Area (from inside looking out)	22% (Glazed area divided by façade area multiplied by 100)
Glazing G-Value	0.63
Door U-Value (W/m ² .K)	1
Space Heating	Community Gas Boilers, 91.5% efficiency
Heating Controls	Charging system linked to use, at least two thermostats and a programmer.

Domestic Hot Water	From Main Heating System
Ventilation	Openable windows will allow for the natural ventilation of dwellings should the occupant require it. All dwellings will also be fitted with energy-efficient ventilation systems. System 4 MVHR is specified to allow for purge ventilation where there are noise concerns.
Design Air Permeability	3
Cooling	No cooling requirement.
Low Energy Lighting	100% Low-e
Thermal Bridging	ACDs/Bespoke Psi Values

5.1 BE LEAN CARBON EMISSIONS REDUCTION

The applicant's design specification and intended demand-reduction measures for the development have been modelled using the same methodology as before. This allows us to assess the effectiveness of BE LEAN measures as a percentage reduction in CO₂ emissions over the baseline for both domestic and non-domestic elements of the development separately.

Refer to Appendix 3 for an energy assessment summary and SAP10 spreadsheet and Appendix 4 for sample TER and DER worksheets.

By incorporating sustainable design, the applicant will reduce regulated CO₂ emissions over AD L 2013. These reductions are illustrated in Table 8 below.

Table 8. BE LEAN regulated CO₂ emissions ADL 2013.

	Total regulated emissions (Tonnes CO ₂ /yr)	Regulated CO ₂ emissions savings (Tonnes.CO ₂ /yr)	Percentage saving (%)
AD L 2013 baseline	32	-	-
BE LEAN: DER	26	6	16
Total		6	16

Table 9. BE LEAN regulated CO₂ emissions, SAP 10.

	Total regulated emissions (Tonnes CO ₂ /yr)	Regulated CO ₂ emissions savings (Tonnes.CO ₂ /yr)	Percentage saving (%)
AD L 2013 baseline	28	-	-
BE LEAN: DER	22	6	20
Total		6	20

5.2 TOTAL ENERGY DEMAND

The total Part L Fabric Energy Efficiency Standard (FEES) is provided for the development as a whole and set out in Table 10 below.

Table 10: Total energy demand for domestic units.

Fabric Energy	Target Fabric Energy Efficiency (TFEE)	Dwelling Fabric Energy Efficiency (DFEE)	Improvement
	kWh/m ²	kWh/m ²	%
Development total	44.68	34.43	22.9%

5.3 LIMITING THE RISK OF OVERHEATING

In accordance with the cooling hierarchy, the applicant has considered overheating risk with a focus on passive design solutions.

Table 11. Cooling hierarchy for 816 Oxford Road, Reading.

Cooling hierarchy	Measures to reduce demand for cooling
Minimising internal heat generation through energy-efficient design.	Heat losses have been minimised by providing adequate insulation to circulation pipework and risers. Energy-efficient appliances and mechanical systems have been specified.
Thermal mass and ceiling heights absorbing excess heat	Ceiling heights have been maximised to absorb excess heat.
Passive ventilation	Primary means of passive ventilation is through openable windows which have been included on the majority of facades.
Mechanical ventilation	Mechanical ventilation and heat recovery systems have been modelled to minimise overheating risk.

Overheating risk is calculated within the FSAP software for Part P requirements, this analysis has highlighted a slight-medium overheating risk within the dwellings. This is perfectly acceptable and indicates a pass for this element of the assessment.

6. BE CLEAN: HEATING INFRASTRUCTURE.

Steps have been taken by the applicant to reduce the energy demand of the development through BE LEAN measures.

The next step in the energy hierarchy is to consider how the remaining energy demand can be met and whether there is the potential for this to be done through the mechanism of establishing and/or linking up with existing or planned District Heat Network (DHN).

To ensure compliance with the energy hierarchy, the potential to supply energy efficiently to the development and further reduce regulated CO₂ emissions through BE CLEAN measures, has been evaluated. This has been done with attention to the following hierarchy for selecting an energy system:

1. *Connection to an area wide heat network.*
2. *Communal heating system:*
 - *Site-wide heat network*
 - *Building-level heating system*
3. *Individual heating system.*

6.1 AREA-WIDE HEAT NETWORK

The development does not lie within the vicinity of an existing DHN. The closest live DHN is the Lisson Grove Network which is approximately 55 kilometres to the East.

The closest proposed DHN is the Hillingdon DHN which is approximately 32km to the East of the proposed development.

The development does lie within an area of Decentralised Energy Potential so the applicant incorporates a communal heating system.

6.2 SITE-WIDE HEAT NETWORK

A site-wide heat network, served by a single energy centre is not viable due to the space requirements and constraints of the infill nature of the site. Therefore the applicant has opted for a building wide community heating system to serve each of the blocks of flats, and individual heating systems to the houses. The systems proposed will be ASHPs, a low-carbon generation heat source, and will form the central component of the energy strategy at 816 Oxford Road, Reading.

Table 12. Energy centre design.

Heating Infrastructure	Detail
Heat Demand Met: Air Source Heat Pump (ASHP)	100%
Make and Model (if known): ASHP Efficiency	Default selected at this stage. 280%
Heat Losses	20% in line with CIBSE CP1.

All energy generating equipment will be located on the roofs of the flats for the communal heating systems, or to the rear of the houses for the individual systems.

The ASHP solution will be sized according to the development's predicted monthly heat demand once detailed design calculations are undertaken.

Whilst ASHPs form a central component of the site-wide heat network, their impact on the energy assessment as a LZC technology is accounted for in Section 7 of the energy strategy.

To align with the upcoming changes to the building regulations and the future homes standard, this strategy moves away from on-site combustion and towards highly efficient all-electric systems, therefore the air quality impacts of the proposed development will be negligible.

The building-wide heat network will be designed in accordance with the District Heating Manual for London and CIBSE CP1: the focus being to ensure that common design and key principles are adopted in the specification in the early stages. Steps will be taken to:

- Reduce network losses by keeping the length of pipework to a minimum; and
- Insulating pipework to ensure heat loss is minimised with CP1 Best Practice Target of <20% being achieved.

The construction of the communal heating systems be on a block by block basis, and will take place in the early stages of development, they will therefore be operational from the beginning.

6.3 BE CLEAN CARBON EMISSIONS REDUCTION

As the connection to an area-wide heat network is not a possibility and as there are no firm plans for an area-wide heat network within the vicinity of the development, the applicant adopts a strategic and sustainable, building-wide heating solution for the flats, and individual systems for the houses.

The ASHP is accounted for under the Be Green calculation described in Section 7 of the energy strategy.

7. BE GREEN: LOW- AND ZERO-CARBON TECHNOLOGIES.

In line with *Reading Borough Council Sustainable Design and Construction SPD, Policy H5*, the applicant seeks to maximise opportunities for incorporating Low- and Zero-Carbon (LZC) technologies as part of their energy strategy for the development.

In accordance with the energy hierarchy, the applicant has adopted BE LEAN and BE CLEAN measures as a priority for the scheme and demonstrates a 16% reduction in regulated CO₂ emissions over the AD L 2013 baseline, once converted to SAP10 emission factors, this has been calculated as 20% over the baseline.

LZC technologies have been assessed for their viability as a component of a complementary heating strategy for the development. A detailed review of LZC technologies is provided in Appendix 4.

The applicant's adopted strategy for LZC technologies are compatible with the engineered solution for the development scheme's building-wide DHN.

7.1 SOLAR PHOTOVOLTAICS

Heating Infrastructure	Detail
Size of Array	34.65 kWp
Approximate size Number of panels	280m ² 105 330W panels.
Orientation, shading and pitch	Southerly orientation with little or no overshading, installed at a 30 degree pitch.

7.2 AIR SOURCE HEAT PUMPS

Heating Infrastructure	Detail
Heat Demand Met: Air Source Heat Pump (ASHP)	100%
Make and Model (if known): ASHP Efficiency	Default selected at this stage. 280%
Heat Losses	20% in line with CIBSE CP1.

7.3 BE GREEN CARBON EMISSIONS REDUCTION

The cumulative impact of Be Green measures is illustrated in Tables 13 and 14 below.

Table 13. BE GREEN regulated CO₂ emissions, ADL 2013.

	Total regulated emissions (Tonnes CO ₂ /yr)	Regulated CO ₂ emissions savings (Tonnes.CO ₂ /yr)	Percentage saving (%)
AD L 2013 baseline	32	-	-
BE LEAN: domestic	26	5	16
BE CLEAN: domestic	26	0	0
BE GREEN: domestic	8	19	60
SITE TOTALS	8	24	76

Table 14. BE GREEN regulated CO₂ emissions, SAP10.

	Total regulated emissions (Tonnes CO ₂ /yr)	Regulated CO ₂ emissions savings (Tonnes.CO ₂ /yr)	Percentage saving (%)
AD L 2013 baseline	28	-	-
BE LEAN: domestic	22	6	20
BE CLEAN: domestic	22	0	0
BE GREEN: domestic	3	19	67
SITE TOTALS	3	24	88%

8. SITE-WIDE RESULTS.

By adopting principles of sustainable design, and through the incorporation of efficient, LZC technologies, the applicant demonstrates their commitment to Sustainable design and meeting policies CC1-CC4 of the Reading Borough Council Local Plan, and Policy H5 of the Sustainable Design and Construction SPD.

The applicant is committed to a design approach that aligns with the principles of the energy hierarchy and will achieve a total reduction in regulated CO₂ emissions of 86.5% over the Target Emission Rate (TER) Approved Document Part L (AD L) 2013 through BE LEAN, BE CLEAN and BE GREEN measures, through the adoption of SAP10 emission factors, or 73.06% under current ADL 2013 and successfully delivers the target 35% minimum on-site reduction in regulated CO₂ emissions over AD L 2013.

The way in which the applicant achieves the CO₂ emissions reduction for the development, at each stage of the energy hierarchy, is summarised here. Results are provided for both SAP10 emission factors and SAP 2012 emission factors for comparison purposes.

Figure 5. Domestic energy hierarchy ADL 2013.

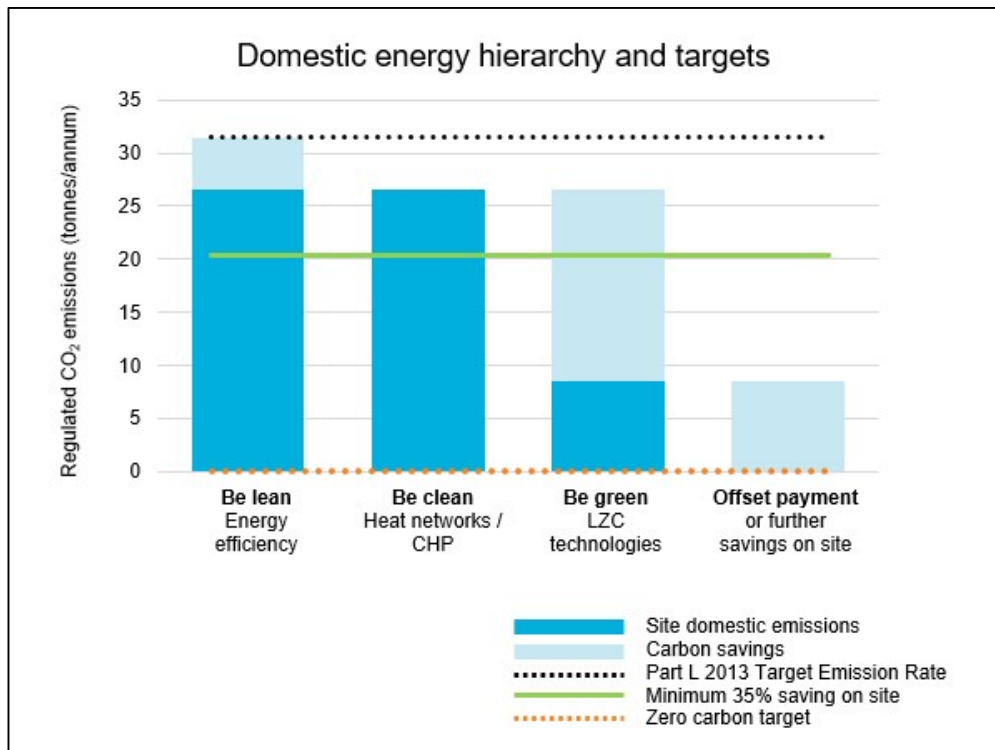


Figure 6. Domestic energy hierarchy (SAP 10)

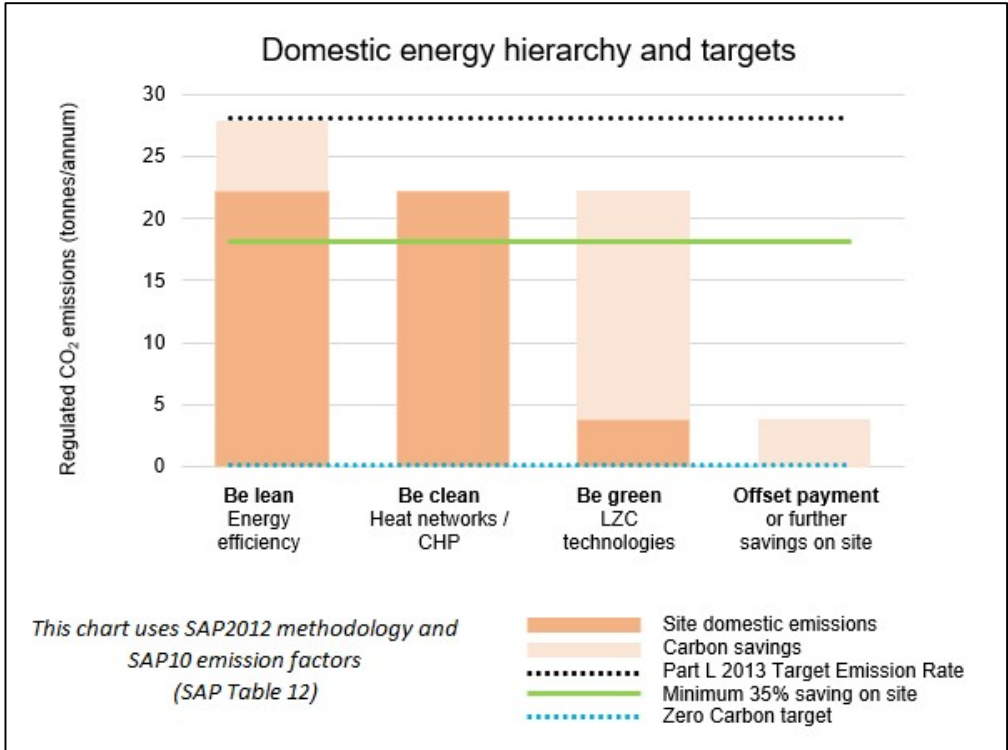


Table 15. Domestic carbon emission savings ADL 2013.

Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings		
	Regulated domestic carbon dioxide savings	
	Tonnes CO ₂ per annum	% reduction
Savings from energy demand reduction	5.00	16.00%
Savings from heat network / CHP	0.00	0.00%
Savings from renewable energy	19.00	60.00%
Cumulative on site savings	24.00	76.00%
Carbon shortfall	8.00	-
Cumulative savings for offset payment	230.00	tonnes CO₂
Cash-in-lieu contributions	£ 13,828.00	

Table 16. Domestic carbon emission savings. (SAP 10)

Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings		
	Regulated domestic carbon dioxide savings	
	Tonnes CO ₂ per annum	% reduction
Savings from energy demand reduction	6.00	20.00%
Savings from heat network / CHP	0.00	0.00%
Savings from renewable energy	19.00	67.00%
Cumulative on site savings	24.00	88.00%
Carbon shortfall	3.00	-
Cumulative savings for offset payment	103.00	tonnes CO₂
Cash-in-lieu contributions	£ 6,208.00	

Table 17: Carbon Emissions at each Stage of the Energy Hierarchy, ADL 2013.

Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings		
	Carbon dioxide emissions for domestic buildings Tonnes CO ₂ per annum	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	32.00	9.43
After energy demand reduction	26.00	9.43
After heat network / CHP	26.00	9.43
After renewable energy	8.00	9.43

Table 18: Carbon Emissions at each Stage of the Energy Hierarchy, SAP 10.

Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings		
	Carbon dioxide emissions for domestic buildings Tonnes CO ₂ per annum	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	28.00	6.67
After energy demand reduction	22.00	6.67
After heat network / CHP	22.00	6.67
After renewable energy	3.00	6.67

The development achieves the zero-carbon homes standard in full through a carbon-offset payment which offsets the shortfall in regulated CO₂ emissions reduction for the new dwellings. The total CO₂ emissions to offset for 816 Oxford Road, Reading have been calculated as: 103 t.CO₂ over a 30 year period. Based on SAP 10 emission factors and a carbon price of £60/t.CO₂, this is equivalent to a cash-in-lieu contribution of: £6,208.

10. CONCLUSIONS AND RECOMMENDATIONS.

The applicant demonstrates commitment to delivering climate change mitigation measures at 816 Oxford Road.

By adopting principles of sustainable design, and through the incorporation of efficient, Low- or Zero-Carbon (LZC) technologies, the applicant successfully delivers Reading Borough Council planning policies (2019):

- *Reading Borough Council Sustainable Design and Construction SPD, Policy H5.*
- *Reading Borough Council Local Plan, Policies CC1-CC4.*

The Energy Strategy is written in accordance with Chapter 3 of the Sustainable Design and Construction SPD (2019) – Submission Requirements.

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SAP10 emission factors are adopted within the Energy Strategy in order to estimate, more accurately, the predicted energy performance and actual carbon emissions associated with the development scheme post-construction. This is in accordance with the requirements of Clause 3.34 of the sustainable Design and Construction SPD (2019). This converts to a 88% reduction in CO₂ emissions over ADL 2013 once SAP10 emission factors are applied.

BE LEAN: Passive design measures have been included and lead to a reduction in regulated CO₂ emissions over the AD L 2013 TER and Target Fabric Energy Efficiency (TFEE) standard. A combination of BE LEAN measures including: energy-efficient building fabric; insulation to all heat loss floors, walls and roofs; triple-glazed windows; low-energy lighting; and efficient heating and ventilation systems all contribute to an enhancement in energy performance equal to a 16% reduction in regulated CO₂ emissions over AD L 2013 or 20% once SAP 10 emission factors have been applied.

BE CLEAN: The feasibility of supplying decentralised energy to the development has been assessed in accordance with the heating hierarchy. Two separate communal heating

systems, powered ASHPs, will serve the flats and provide a source of decentralised energy to future occupants within the development. Individual ASHPs will be provided to the houses.

Be GREEN: Opportunities to maximise renewable energy have been assessed and all options reviewed for their practical, financial and technical viability in relation to the development scheme. ASHPs form a central component of the heat network and have been described under the BE CLEAN stage of the energy hierarchy. However, their impact on the energy assessment as a LZC technology is accounted for under BE GREEN measures. Solar PV has been selected by the applicant as the preferred strategy for renewables. In combination, ASHPs and Solar PV will deliver a further 60% reduction in regulated CO₂ emissions over AD L 2013, or 67% once SAP 10 emission factors are applied.

The development achieves the zero-carbon homes standard in full through a carbon-offset payment which offsets the shortfall in regulated CO₂ emissions reduction for the new dwellings. The total CO₂ emissions to offset for 816 Oxford Road, Reading have been calculated as: 103 t.CO₂ over a 30 year period. Based on SAP 10 emission factors and a carbon price of £60/t.CO₂, this is equivalent to a cash-in-lieu contribution of: £6,208.

11. APPENDICES

APPENDIX 1: LIST OF ABBREVIATIONS.

AD L 2013	Approved Document Part L of Buildings Regulations 2013
ASHP	Air Source Heat Pump
CHP	Combined Heat & Power
DER	Dwelling Emission Rate
DHN	District Heat Network
DHW	Domestic Hot Water
ESCO	Energy Services Company
FEES	Fabric Energy Efficiency Standard
GSHP	Ground Source Heat Pump
LPA	Local Planning Authority
PV	Photovoltaics
SAP	Standard Assessment Procedure
TER	Target Emission Rate

APPENDIX 2. PLANNING POLICY AND DESIGN GUIDANCE.

The Climate Change Act (2008)

Passed in November 2008, the Climate Change Act mandated that the UK would reduce emissions of six key greenhouse gases, including Carbon Dioxide, by 80% by 2050.

As a consequence, the reduction of carbon dioxide emissions is at the forefront of National, Regional and Local Planning Policy, along with continuing step changes in performance introduced by the Building Regulations Approved Document L (2013).

Approved Document L (2013)

This development is subject to the requirements of Approved Document L (2013). AD L 2013 represented an approximate reduction of 6% in the Target Emission Rate (Kg/CO₂/sqm per annum) over the requirements of Approved Document L (2010) for residential development and an aggregate 9% reduction for non-residential development. AD L (2013) also sees the introduction of a Fabric Energy Efficiency Target, a measure of heating demand (kW hrs/sqm per annum) to ensure new-build dwellings with low-carbon heating systems still meet satisfactory energy-efficiency standards.

National Planning Policy

The National Planning Policy Framework encourages Local Planning Authorities to ‘support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change’ (NPPF paragraph 152), ‘whilst taking a proactive approach to mitigating and adapting to climate change, taking into account the long-term implication for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of over shading from rising temperatures’. (NPPF Paragraph 153).

Paragraph 155, upholds the requirement for Local Plans to: ‘To help increase the use and supply of renewable and low carbon energy and heat, plans should: a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts); b) consider identifying suitable areas of renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.’

In paragraph 157, NPPF stipulates that local planning authorities should take account of the benefits of decentralised energy and passive design measures as a means of energy efficiency in new development: ‘In determining planning applications, local planning

authorities should expect new development to: a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.'

Reading Borough Council Local Plan (2019)

The following policies from the adopted Local Plan (2019) are applicable to this Development:

Policy CC1: Presumption in Favour of Sustainable Development

CC1: PRESUMPTION IN FAVOUR OF SUSTAINABLE DEVELOPMENT

A positive approach to considering development proposals will be taken that reflects the presumption in favour of sustainable development contained in the National Planning Policy Framework (NPPF). Where appropriate, the Council will work proactively with applicants jointly to find solutions which mean that proposals can be approved wherever possible.

Planning law requires that applications for planning permission must be determined in accordance with the development plan unless material considerations indicate otherwise. Planning applications that accord with the policies in the development plan (including, where relevant, with policies in neighbourhood plans) will be approved without delay, unless material considerations indicate otherwise. Proposed development that conflicts with the development plan will be refused, unless other material considerations indicate otherwise.

Where there are no policies relevant to the application or the policies which are most important to determining the application are out of date at the time of making the decision then permission will be granted unless material considerations indicate otherwise - taking into account whether:

- The application of policies in the NPPF that protect areas or assets of particular importance provides a clear reason for refusing the development proposed; or*
- Any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in the NPPF taken as a whole.*

Policy CC2: 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.

Policy CC3: 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*

Policy CC4: 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.

Reading Borough Council Sustainable Design and Construction SPG (2019)

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 Regulations³².*
- 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'.*

APPENDIX 3: ENERGY ASSESSMENT RESULTS.

TER and DER workseets for each stage of the energy hierarchy to be provided separately.

APPENDIX 4: ASSESSMENT OF LOW- AND ZERO-CARBON TECHNOLOGIES.

Wind	<i>The ability to generate electricity via a turbine or similar device which harnesses natural wind energy. This could be considered as an onsite solution to reducing carbon emissions (turbines included within the development), or offsite (investing financially into a nearby wind farm).</i>
Installation considerations	▪ Wind turbines come in a variety of sizes and shapes. Turbines of 1 Kw can be installed to single house and large-scale turbines of 1-2 MW can be installed on a development to generate electricity to multiple dwellings and other buildings. In both instances the electricity generated can be used on site or exported to the grid. Vertical- or horizontal-axis turbines are available. ▪ A roof-mounted 1 kW micro wind system costs up to £3,000. A 2.5 kW pole-mounted system costs between £9,900 and £19,000. A 6 kW pole-mounted system costs between £21,000 and £30,000 (taken from the Energy Saving Trust, TBC by supplier) ▪ Local average wind speed is a determining factor. A minimum average wind speed of 6 m/s is required. ▪ Noise considerations can be an issue dependent on density and build-up of the surrounding area. ▪ Buildings in the immediate area can disrupt wind speed and reduce performance of the system. ▪ Planning permission will be required along with suitable space to site the turbine, whether ground installed or roof mounted.
Advantages	▪ Generation of clean electricity which can be exported to the grid or used onsite.

	▪ Can benefit from the Feed in Tariff, reducing payback costs.
Disadvantages	▪ Planning restrictions and local climate often limit installation opportunities. ▪ Annual maintenance required. ▪ High initial capital cost. It is usual for an investor to consider a series of turbines to make the investment financially sound.
Development feasibility	▪ Installing a large turbine in an area such as this is not considered to be appropriate due to its appearance and physical impact on the built-up environment. Residents' and neighbours' concerns may include the look of the turbine, the hum of the generator and the possibility of stroboscopic shadowing from the blades on homes. ▪ Wind speed has been checked for the development scheme using the NOABL wind map: http://www.rensmart.com/Weather/BERR. The wind speed at ten metres for the development scheme is 4.8 metres per second (m/s) which is below the minimum of 5 m/s and threshold for technical viability. ▪ Typical payback times for a single turbine are expected to be greater than 15 years which means that the cost of installing and maintaining a single wind turbine is not considered a commercially-viable option.

Solar PV
Solar Thermal

The ability to generate energy (either electricity, hot water or a combination of the two) through harnessing natural solar energy. This could include the use of solar thermal panels, photovoltaic (PV) panels, or a combined solution. PV panels, similarly to turbines, can be considered both on and offsite.

Solar Photovoltaics convert solar radiation into electricity which can be used on site or exported to the national grid.

Solar Thermal generates domestic hot water from the sun's radiation. Glycol circulates within either flat plate or evacuated tube panels, absorbing heat from the sun, and transferring this energy to a water cylinder. A well designed solar thermal system will account for 50-60% of a dwelling's annual hot water demand. Sizing the system to meet a higher demand will lead to excess heat generation in the summer months, and overheating of the system.

**Installation
considerations**

- Operate most efficiently on a south-facing sloping roof (between 30 and 45-degree pitch.)
- Shading must be minimal (one shaded panel can impact the output of the rest of the array.)
- Panels must not be laid horizontally on a flat roof as they will not self-clean. Panels will therefore need to be installed at an angle and with appropriate space between them, to avoid over-shading.
- Large arrays may require upgrades to substations if exporting electricity to the grid.
- Local planning requirements may restrict installation of panels on certain elevations.
- Installation must take into account pitch and fall of the roof, along with any additional plant on the roof to ensure there is sufficient room.

	▪ The average domestic solar PV system is 4kWp and costs £5,000 - £8,000 (including VAT at 5 per cent) - (taken from the Energy Saving Trust, TBC by supplier.)
Advantages	▪ Relatively straightforward installation, connection to landlord's supply and metering. ▪ Linear improvement in performance as more panels are installed. ▪ Maintenance free. ▪ Installation costs are continually reducing. ▪ Can benefit from the Feed in Tariff to improve financial payback.
Disadvantages	▪ Not appropriate for high-rise developments, due to lack of roof space in relation to total floor area. ▪ With Solar Thermal, performance is limited by the hot water demand of the building – system oversizing will lead to overheating.
Development feasibility	▪ The suitability of Solar panels has been considered for this Development and are concluded as a technically-viable option. ▪ There are potential areas of roof space suitable for the positioning of unshaded Solar PV arrays. ▪ The Development is not on land which is protected or listed, so it is considered that Solar panels would not have a negative impact on the local historical environment or the aesthetics of the area.

Aerothermal

The transfer of latent heat in the atmosphere to a compressed refrigerant gas to warm the water in a heating system. This includes air to water heat pumps and air conditioning systems.

Air Source Heat Pumps (ASHPs) extract heat from the external air and condense this energy to heat a smaller space within a dwelling or non-domestic building. A pump circulates a refrigerant through a coil to absorb energy from the air. This refrigerant is then compressed to raise its temperature which can then be used for space heating and domestic hot water.

They can feed either low-temperature radiators or underfloor heating and often have electric immersion heater back-up for the winter months.

Installation considerations

- ASHPs operate effectively in buildings with a low energy demand, as they emit low levels of energy suitable for maintaining rather than dramatically increasing internal temperatures. It is therefore vital that the dwelling has a low heating demand to ensure the system can provide appropriate space-heating capability.
- Underfloor heating will give the best performance but oversized radiators can also be used.
- Immersion heater back-up required to ensure appropriate Domestic Hot Water (DHW) temperature in winter months.
- Noise from the external unit can limit areas for installation.
- £7,000-£11,000 per dwelling (taken from the Energy Saving Trust, TBC by supplier.)

Advantages

- Air source systems are a good alternative solution to providing heating and hot water to well-insulated, low heat loss dwellings.
- They require additional space when compared to a gas boiler. Space for an external unit is needed, as is space for the hot water cylinder and internal pump.
- Heat pumps are generally quiet to run.
- Running costs between heat pumps and modern gas boilers are comparable.

Disadvantages

- Residents need to be made aware of the most efficient way of using a heat pump; as the low flow rates used by such a system means that room temperature cannot be changed as reactively as a conventional gas or oil boiler system.
- Will not perform well in homes that are left unoccupied and unheated for a long period of time.
- Back-up immersion heating can drastically increase running costs.
- Noise and aesthetic considerations limit installation opportunities.

Development feasibility

- ASHPs are considered a technically-viable option for this development scheme.
- Installing an ASHP is aligned with the future homes standard and the drive away from on-site combustion so is a good way to future proof the development.

Geothermal

The transfer of latent heat from the ground to a compressed refrigerant gas to warm the water in a heating system. This includes ground source heat pumps. Heat can be collected through the use of either horizontally laid or vertically installed coils.

Ground Source Heat Pumps (GSHPs) operate on the same principle as an Air Source Heat Pump (ASHP) in that they extract heat from a source (in this instance the ground) and compress this energy to increase temperature for space heating and hot water. Pipework is installed into the ground, either through coils or in bore holes and piles, circulating a mix of water and antifreeze to extract energy from the ground, where the year-round temperature is relatively consistent (approx. 10 °C at 4 metres depth). This leads to a reliable source of heat for the building.

Again, an electrically powered pump circulates the liquid and powers the compressor, however annual efficiencies for GSHPs tend to be higher than those of ASHPs.

Installation considerations

- Require appropriate ground conditions to sink piles/bore holes or excavate for coils (which also require a large area of land.)
- Decision between coils or piles can lead to significant extra cost.
- Need to consider whether low temperature output is fed through underfloor heating (most efficient) or oversized radiators.
- Similar to ASHPs, perform best in well-insulated buildings with a low heating demand.
- Electric immersion heater required for winter use.

	▪ £11,000-£15,000 per dwelling dependent on the size of the system (taken from the Energy Saving Trust, TBC by supplier.)
Advantages	▪ Perform well in well-insulated buildings, with limited heating demand. ▪ More efficient than ASHPs.
Disadvantages	▪ The coils can be damaged by natural earthworks and by intensive gardening practices – occupants would need to be aware of the location of the coils for this system, and how to operate the system efficiently. Coils may also be damaged within the dwelling where the circuit is connected to the internal unit. ▪ Will not perform well in buildings that are left unoccupied and unheated for a long period of time. ▪ Back up immersion heating can drastically increase running costs. ▪ Large area of ground needed for coil installation.
Development feasibility	▪ GSHPs are not considered a technically-viable option for this development scheme due to the physical constraints in terms of ground conditions and area available for installation. ▪ The capital installation cost would be high which leads us to the conclusion that GSHPs would not be a commercially-viable option for this development scheme.

Biomass	<i>Providing a heating system fuelled by plant based materials such as wood, crops or food waste.</i> Biomass boilers generate heat for space heating and domestic hot water through the combustion of biofuels, such as woodchip, wood pellets or potentially biofuel or bio diesel. Biomass is considered to be virtually zero carbon. They can be used on an individual scale or for multiple dwellings as part of a district-heating network. A back-up heat source should be provided as consistent delivery of fuel is necessary for continued operation.
Installation considerations	▪ Biomass boilers are larger than conventional gas-fired boilers and also require what can be significant storage space for the fuel source. This needs to be considered at planning stage to ensure an appropriate plant room can be provided. ▪ Flue required to expel exhaust gases – design needs to be in line with the requirements of the Building Regulations. ▪ Need to consider whether fuel deliveries will be reliable and consistent to the location of the site (especially relevant in rural areas) and whether the plant room can be easily accessed by the delivery vehicle. ▪ £9,000-£21,000 per dwelling dependent on size (taken from Energy Saving Trust, TBC by Supplier).
Advantages	▪ Considerable reduction in CO₂ emissions.
Disadvantages	▪ Limited reduction in running costs compared to A-rated gas boilers, but at a substantially higher up-front cost. ▪ Plant room space required for boiler and storage. ▪ Dependent on consistent delivery of fuel.

**Development
feasibility**

- Ongoing maintenance costs (need to be cleaned regularly to remove ash.)
- Biomass is not considered a technically-viable option for the development scheme. The primary reason for this is down to the negative environmental impact of high levels of NOx gases that are emitted from biomass boilers and the subsequent impact on local air quality. This is contrary to planning policies for air quality.
- There are concerns regarding a sustainable supply of biomass to the site.
- The capital installation cost would be high which leads us to the conclusion that biomass would not be a commercially-viable option for this development scheme.