Energy and Sustainability Statement

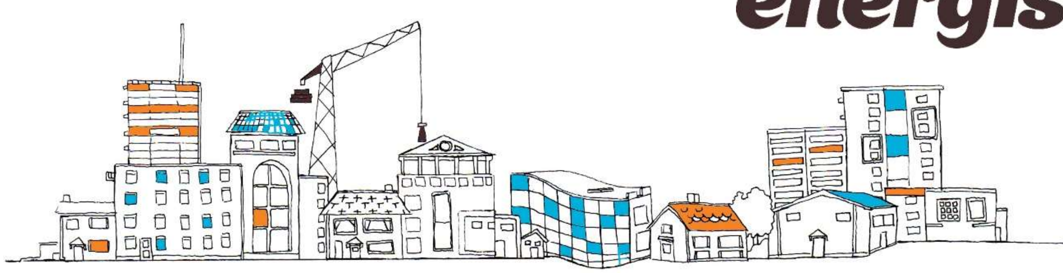
Campus Park East, Welwyn Garden City

On behalf of Bellway Homes Limited (North London)

Revision 02

BeCWAL8

Date: November 22



REVISION HISTORY

Revision	Issue Date	Description	Issued By	Checked By
R00	30/09/2022	First Issue	RP	MA
R01	06/10/2022	Sustainability chapter added	RP	TW
R02	01/11/2022	Updated scheme	RP	TW

Calculations contained within this report have been produced based on information supplied by the Client and the design team. Any alterations to the technical specification on which this report is based will invalidate its findings.

All advice provided by Energist UK Ltd regarding the performance of materials is limited solely to the purposes of demonstrating compliance of the Energy Strategy. The performance of materials under other criteria, including but not limited to fire, structural, acoustics are not considered in our advice. It is the responsibility of the client to ensure the wider suitability of materials specified in our assessments.

College Farm
Tetbury Road
Cirencester
GL7 6PX

Tel: 08458 386 387

info@energistuk.co.uk
www.energistuk.co.uk

CONTENTS

EXECUTIVE SUMMARY

This Energy Statement has been produced by Energist UK on behalf of Bellway Homes Limited (North London) ('the Applicant').

It will set out the measures planned by the Applicant to achieve carbon reductions at the proposed Development Site: Campus East Car Park, College Way, Welwyn Garden City AL8 ('the Development') demonstrating compliance with:

i) National Planning Policy Framework.
ii) Approved Document Part L of the Building Regulations 2021.
iii) The local planning Policy requirements for Welwyn Hatfield Borough Council to meet Policies SP 1, SP 10 and SADM 13 of the Draft Local Plan which state:

- Policy SP1 – Delivering Sustainable Development
  - That adaptation and mitigation principles relating to climate change are incorporated into the design and construction of new development which include energy and water efficiency measures, the use of low carbon and renewable energy, the provision of green infrastructure and sustainable drainage systems (SUDs).

- Policy SP10 – Sustainable Design and Construction
  - Layout and design of the site and building(s) reflect the energy hierarchy to maximise opportunities to reduce carbon emissions.
  - The use of renewable and low carbon energy infrastructure is used where it is appropriate and consistent with other policies.
  - Proposals are responsive to how the climate will change over their lifetime and minimise their contribution to the urban heat island effect.
  - Water sensitive design principles and practices are integrated into development proposals to sustainably address water supply, consumption and quality, extreme rainfall, drainage and flood risk in a holistic way that supports other design aims and objectives

- Policy SADM 13 – Sustainability Requirements
  - All major development proposals must demonstrate that they have sought to maximise opportunities for renewable and low carbon

sources of energy supply where consistent with other Local Plan policies.

- All newly constructed dwellings will be required to achieve an estimated water consumption of no more than 110 litres/person/day, with water reuse and recycling and rainwater harvesting incorporated wherever feasible to reduce demand on mains water supply.

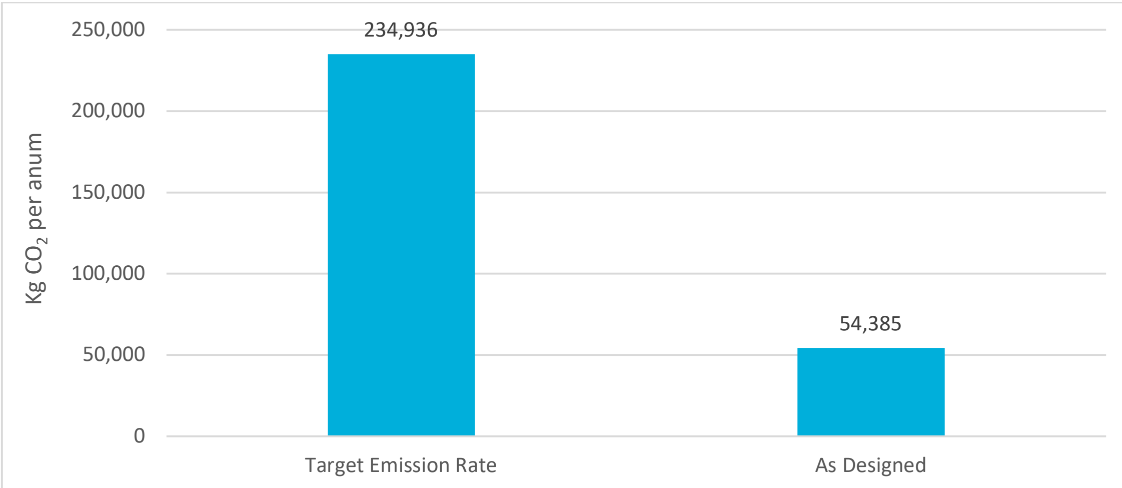
The Energy Statement concludes that the following combination of measures, summarised below, will be incorporated into the Development demonstrating how the energy standard will be delivered by the Applicant.

Table 1 - Measures incorporated to deliver the energy standard.

Fabric first: Demand-reduction measures	▪ Energy-efficient building fabric and insulation to all heat loss floors, walls and roofs. ▪ High-efficiency double-glazed windows throughout. ▪ Quality of build will be confirmed by achieving good air-tightness results throughout. ▪ Efficient-building services. ▪ Low-energy lighting throughout the building.
Renewable and low-carbon energy technologies	▪ Nilan Compact P to serve the heating, hot water and ventilation requirement for each dwelling. ▪ 185kWp of PV to be installed across the development, at a horizontal pitch, to a southerly orientation with little or no overshading.

The impact of these design measures in terms of how the Applicant delivers the energy standard is illustrated in the figure overleaf.

Figure 1 - How the Development meets the energy standard



The calculated reduction in carbon emissions and the percentage reduction in CO_2 over the ADL 2021 Baseline is demonstrated in the Table below.

Table 2 - CO2 emissions and percentage reduction over ADL 2021

	CO_2 emissions	
	kg/CO_2 per annum	% reduction
Target Emission Rate: Compliant with ADL 2021	234,936	-
Dwelling Emission Rate: Proposed design	54,385	76.85%
Total savings	**180,551**	76.85%

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1. INTRODUCTION

This Energy Statement has been prepared for the residential Development at Campus Park East. This falls under the jurisdiction of Welwyn Hatfield Borough Council (WHBC).

Development consists of demolition of all existing buildings and structures followed by the erection of five buildings to provide 313 residential units (Use Class C3) including 30% affordable housing, resident's car parking, cycle storage, refuse storage, hard and soft landscaping, external lighting, drainage, infrastructure and all associated works.

The development proposals are outlined below:

Table 3. Development overview.

	Quantity	% Mix
Scheme Dwelling Mix – All Tenures		
Studio	1	0.3
1 bed	115	36.7
2 bed	183	58.5
3 bed	14	4.5
Total	**313**	**100%**

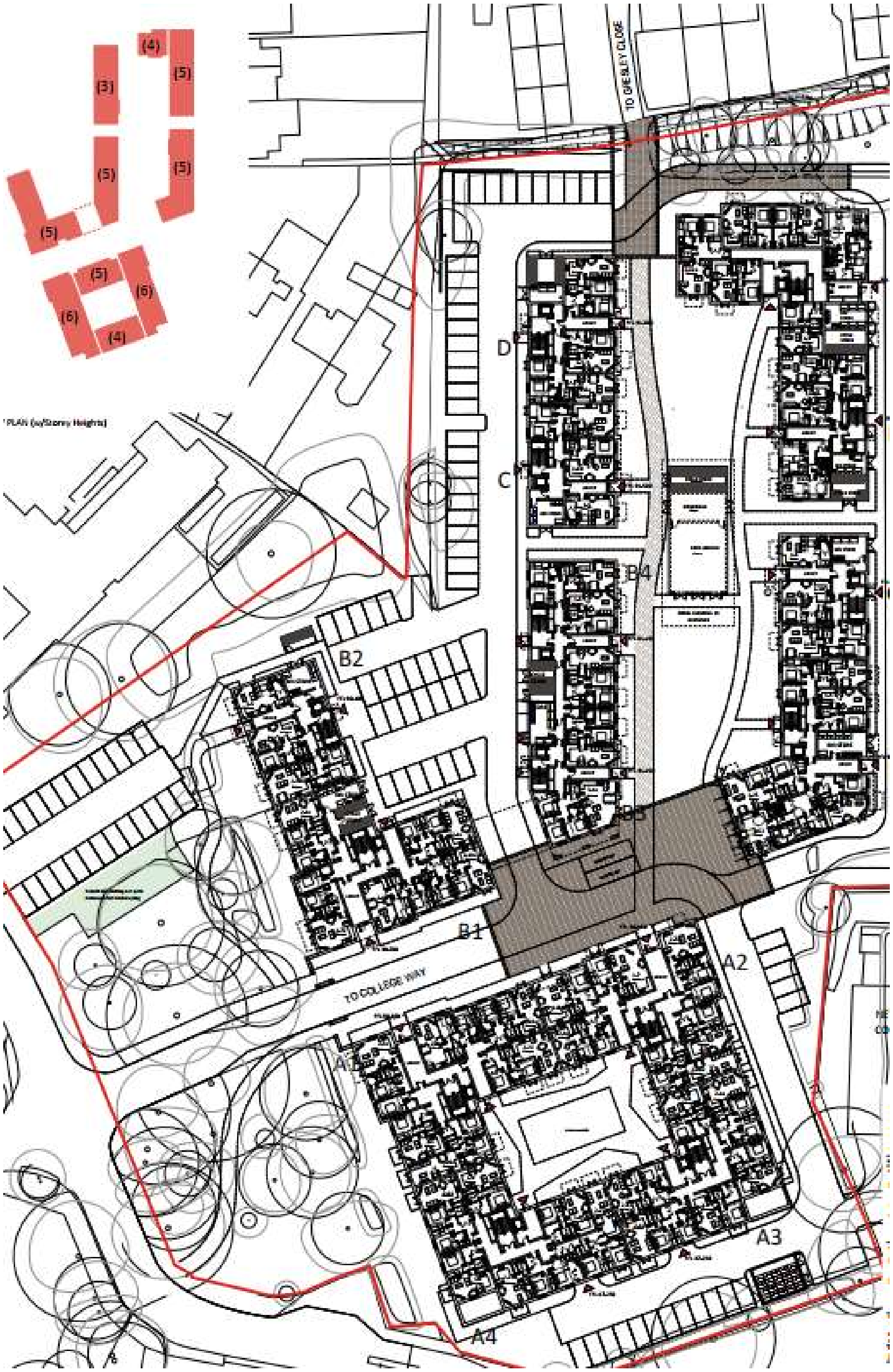

Figure 2- Proposed Site Layout, Saunders Architecture and Urban Design, Drawing number 8375/SK111, Rev P, dated September 2021.

This Statement sets out how the Applicant intends to meet:

i) National Planning Policy Framework.
ii) Approved Document Part L of the Building Regulations 2021.
iv) The local planning Policy requirements for Welwyn Hatfield Borough Council to meet Policies SP 1, SP 10 and SADM 13 of the Draft Local Plan which state:

- Policy SP1 – Delivering Sustainable Development
  - That adaptation and mitigation principles relating to climate change are incorporated into the design and construction of new development which include energy and water efficiency measures, the use of low carbon and renewable energy, the provision of green infrastructure and sustainable drainage systems (SUDs).

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  - Water sensitive design principles and practices are integrated into development proposals to sustainably address water supply, consumption and quality, extreme rainfall, drainage and flood risk in a holistic way that supports other design aims and objectives

- Policy SADM 13 – Sustainability Requirements
  - All major development proposals must demonstrate that they have sought to maximise opportunities for renewable and low carbon sources of energy supply where consistent with other Local Plan policies.
  - All newly constructed dwellings will be required to achieve an estimated water consumption of no more than 110 litres/person/day, with water reuse and recycling and rainwater harvesting incorporated wherever feasible to reduce demand on mains water supply.

For a detailed overview of the planning policy requirements specific to this development, refer to Appendix 2.

The way in which the Applicant meets the energy standard at Campus Park East, Welwyn Garden City will be set out in this Statement as follows:

- **Baseline energy demand**: The Development's Target Emission Rate (TER) will be calculated to establish the minimum on-site standard for compliance with ADL 2021.
- **Reduced energy demand & low-carbon and renewable energy:** The Development's Dwelling Emission Rate (DER) will be calculated to explain how the Applicant's design specification will lead 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. Low-carbon and renewable energy 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 energy savings presented.

Energist UK has used SAP 10.2 methodology to calculate energy demand for twenty-three dwellings. The data have been extrapolated to reflect more accurately the expected energy demand for all proposed dwellings included in the Development proposals.

2. BASELINE ENERGY DEMAND

In order to measure the effectiveness of demand-reduction measures, it is first necessary to calculate the baseline energy demand, and this has been done using SAP 10.2 methodology.

The resulting ADL 2021 Baseline for the proposed Development 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 CO_2 emissions that are permitted for the proposed Development in order to comply with ADL 2021.

The resulting TER has been calculated as 234,936 kg/CO_2 per annum. To ensure compliance with ADL 2021, CO_2 emissions should not exceed this figure.

Table 4 - Baseline design specification.

Element	Proposed Design Specification
Ground Floor U-Value (W/m^2.K)	0.13
External Wall U-Value (W/m^2.K)	0.18
Party Wall U-Value (W/m^2.K)	0 (fully filled and sealed)
Roof – insulated at joists U-Value (W/m^2.K)	0.13
Glazing U-Value – including Frame (W/m^2.K)	1.4
Door U-Value (W/m^2.K)	1.4
Design Air Permeability	5
Space Heating	Electric
Heating Controls	Standard heating system controls.
Domestic Hot Water	From main heating source.
Ventilation	Natural ventilation with intermittent extract fans
Low Energy Lighting	100%
Thermal Bridging	Appendix R values

3. REDUCED ENERGY DEMAND

Many Local Planning Authorities are now recognising the benefits of a fabric-first approach, where the lifetime energy consumption of a building takes precedence over the use of bolt-on renewable energy technologies. It is clear that the fabric-first approach can create buildings with a very comfortable living and working environment. The internal temperature is consistent and fuel bills are kept to a minimum. One key advantage of a fabric-first approach is that it does not require changes to the behavioural patterns of the occupants and, as such, a building designed using a fabric-first approach will often perform more effectively once completed than a building that incorporates a low-carbon or renewable-energy technology that requires behavioural change (e.g., solar thermal). This becomes an increasingly important consideration as energy costs rise and the issue of fuel poverty becomes commonplace.

Energist UK has considered a fabric-first approach as the priority solution for this proposed Development.

The Applicant will integrate the following design measures to reduce energy demand:

- Energy-efficient building fabric and insulation to all heat loss floors, walls and roofs.
- High-efficiency double-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.

The Applicant adopts a fabric-first approach as the priority solution for this Development and steps have been taken to reduce energy demand through high-quality sustainable design. The low-carbon and renewable energy solutions applicable to this development scheme are assessed and potentially viable solutions recorded (refer to Appendix 4 for assessment).

The following low-carbon and renewable energy technologies, summarised below, are considered potentially viable options for the proposed Development.

Table 5 - Summary of feasible technologies

✓	Solar thermal Solar PV Aerothermal
✗	Wind Geothermal Biomass

It should be noted that ADL 2021 represents a 31% uplift in performance over ADL 2013.

The applicant has opted to install the Nilan Compact P air source heat pump (ASHP) within the development proposal as the most viable option for meeting ADL 2021 energy standard as well as meeting the new ADO standard for overheating. In addition to this, all available roof space has been maximised for PV installation with a 185kWp PV array to be installed at a horizontal pitch, a southerly orientation with little or no overshading. This introduction, along with the fabric improvements, lead to a reduction in Site carbon emissions by 76.85% over the ADL 2021 baseline.

The total calculated CO_2 emissions for the proposed design after energy reduction measures and low-carbon and renewable technologies have been considered is **54,385** kg/CO_2 per annum, which is a reduction of **76.85** % or **180,551** kg/CO_2 per annum over the ADL 2021 baseline TER emissions. This is illustrated in the Table below (Refer to Appendix 3 for SAP results).

Table 6 - CO2 emissions and percentage reduction over ADL 2021

	CO_2 emissions	
	kg/CO_2 per annum	% reduction
Target Emission Rate: Compliant with ADL 2021	234,936	-
Dwelling Emission Rate: Proposed design	54,385	76.85%
Total savings	**180,551**	76.85%

Table 7 - Proposed design specification

Element	Proposed Design Specification
Ground Floor U-Value (W/m^2.K)	0.12
External Wall U-Value (W/m^2.K)	0.18
Corridor Wall U-Value (W/m^2.K)	0.2
Party Wall U-Value (W/m^2.K)	0 (fully filled and sealed)
Roof – insulated at joists U-Value (W/m^2.K)	0.13
Glazing U-Value – including Frame (W/m^2.K)	1.3
Door U-Value (W/m^2.K)	1.6
Design Air Permeability	3
Space Heating	Nilan compact P ASHP.
Heating Controls	Time & Temperature Zone Control
Domestic Hot Water	From main heating system
Ventilation	From the Nilan Compact P
Low Energy Lighting	5W at 80 lm/W efficacy.
Thermal Bridging	Constructive Details

4. MAINS-WATER CONSUMPTION

The water consumption of a dwelling has a significant impact on not only direct operational running costs (i.e., water consumption charges), but also indirectly through additional energy usage and the heating of water for domestic use. This is, in part, reflected in the SAP 10.2 methodology which assumes reduced energy consumption should a dwelling be compliant with Approved Document Part G 2013.

The standard of 110 litres of water per person per day can be met using the following specification. A water-efficiency calculation, demonstrating how the Applicant can achieve compliance with the target for water efficiency, can be referred to in Appendix 4.

Table 8 - Water calculations for new dwellings

Element	Performance
Kitchen Taps flow rate	6 Litres per minute
Other basin Taps flow rate	5 Litres per minute
WCs Flush Volume	4/2.7 Litres
Shower Flow rate	9 Litres per minute
Bath Volume	160 Litres
Dishwasher water consumption	1.25 Litres per place setting
Washing-machine water consumption	8.17 Litres per kg

5. SUSTAINABILITY

The Applicant is committed to all aspects of sustainability on the scheme at Campus Park East. The Welwyn Hatfield District Plan Supplementary Design Guidance (2005) requires that development considers a full spectrum of sustainability issues, and as such, the sustainability measures undertaken by the applicant have been outlined below.

Building Materials with high thermal efficiencies

As outlined in the chapters above, the scheme has been designed with reducing energy demand as the core objective prior to renewable energy being added in. All U-values are a significant improvement over the ADL minimum standards, with a particular emphasis on reducing thermal bridging through the incorporation of highly efficient psi values.

Orientation of the scheme has also been a consideration to maximise solar gain without risking overheating, as such, dwellings with a direct southerly orientation are limited, and the number of dual aspect dwellings has been maximised.

Sustainable Transport

A residential travel plan has been undertaken which will be live and enable future occupants to find out about the most sustainable methods of transport in the local area including bus, train and cycle routes.

Active electric vehicle charging points will be provided to all parking spaces, 184 in total in accordance with approved document S. In addition to this, initial correspondence has been made with Enterprise Car Club to provide one electric car club bay, and subject to demand could be increased.

In addition to this, 310 cycle spaces will be provided to the scheme, a ratio of more than one cycle space per unit in accordance with the Welwyn Hatfield Supplementary Planning Guidance (2004). The cycle spaces will be sheltered from the weather and secure, allowing both the wheel and frame to be locked securely.

Ecology

A preliminary Ecology Assessment (PEA) has been undertaken by Aspect Ecology confirming that the site is not of ecological importance and that no statutory or non-statutory nature conservations are present within or adjacent to the scheme. The development retains features of greatest relative value, such as hedgerows and trees, whilst small losses are compensated for through new landscape planting and habitat creation. These include new areas of planting; wildflower grassland; bat boxes; hedgehog nest domes; invertebrate habitat piles; and bee bricks in order to provide biodiversity net gains across the scheme.

Affordable Housing

Proposals seek to build on the aspirations of the established WGC 2120 strategic planning framework to deliver a high-quality development that comprises 307 new residential properties, across, 14 independently accessible blocks of between 3 and 5 storeys, comprising 1-, 2- and 3-bedroom flats. The scheme will deliver 30% affordable dwellings for WHBC. In addition, the scheme will seek to enhance the public realm with high quality landscaping proposals.
The project team has worked closely to develop a scheme that positively contributes to the Welwyn Garden City environment

Play Space Provision

Proposals include 1980m^2 of play space, providing provision for under 5's, 5-11 year olds and older children in the 12+ age bracket to ensure that more than 100% of the space requirement on site for all age groups is provided. The walking distance to each provision, both new and existing, has been calculated from the development, accounting for barriers and has been calculated as the following:

Under 5's – 100m

5-11 – 400m

12+ - 800m

A woodland walk/play area has been provided on the development as well as a central lawn and play space to the centre of the scheme with a focus on natural and incidental play in a circuit.

Recycling and Waste

The Applicant will develop a Pre-Demolition Audit and Sustainable Waste Management Plan to consider, as part of the design and construction process, waste reduction, maximising reuse and recycling, and treating remaining waste as a resource, in line with the waste hierarchy.

The Applicant has committed to diverting 70% volume of non-hazardous waste from landfill. This will be managed through the effective implementation of an on-site plan that will focus on steps in the waste hierarchy:

1) Prevention
2) Minimisation
3) Reuse
4) Recycling
5) Energy recovery
6) Disposal

This approach will ensure that waste from the site is minimised and environmental impact reduced. It will also serve to identify dedicated spaces for the segregation and storage of operational waste.

Each dwelling will be provided with fixed internal bins for the segregation of recycling, with a home user guide provided at the point of occupation to highlight the importance of resource efficiency and recycling to future occupants of the scheme.

6. CONCLUSIONS AND RECOMMENDATIONS

The Applicant demonstrates commitment to delivering the energy standard at Campus Park East as follows:

- The Development has been designed to generate a total reduction in CO_2 emissions of **76.85**% over the TER ADL 2021
- This energy standard is delivered through fabric-first approach to design, energy efficiency measures and LZC technology.
- Water consumption shall be no more than 110 litres/person/day.
- Sustainability has been considered as a core principle in the design of the scheme with many aspects of sustainability as outlined within the supplementary planning guidance being met and exceeded across the scheme through the incorporation of considered and intelligent design in all areas.

A combination of demand-reduction measures, energy-efficiency measures and low-carbon and renewable energy will deliver the Applicant's target for on-site reduction in carbon emissions.

The following measures are incorporated in the development proposals.

Table 9 - Measures incorporated to deliver the energy standard.

Fabric first: Demand-reduction measures	▪ Energy-efficient building fabric and insulation to all heat loss floors, walls and roofs. ▪ High-efficiency double-glazed windows throughout. ▪ Quality of build will be confirmed by achieving good air-tightness results throughout. ▪ Efficient-building services. ▪ Low-energy lighting throughout the building.
Renewable and low-carbon energy technologies	▪ Nilan Compact P to serve the heating, hot water and ventilation requirement for each dwelling.

	▪ 185kWp of PV to be installed across the development, at a horizontal pitch, to a southerly orientation with little or no overshading.

The way in which these design measures deliver the Applicant's commitment to the energy standards is illustrated as follows:

Figure 3 - How the Development meets the energy standard.- CO_2

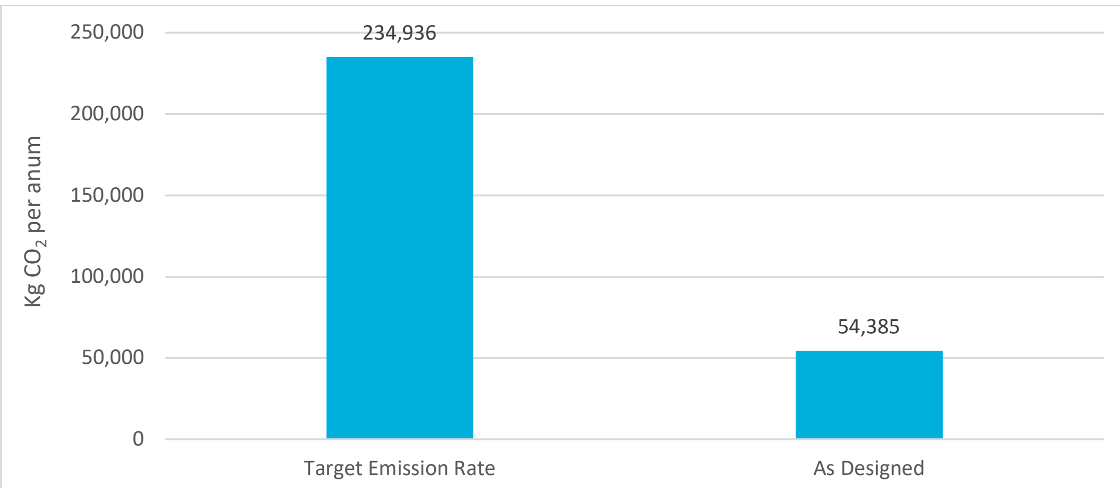

Table 10 - Summary of CO2 emissions and percentage reduction for the proposed Development

	CO_2 emissions	
	kg/CO_2 per annum	% reduction
Target Emission Rate: Compliant with ADL 2021	234,936	-
Dwelling Emission Rate: Proposed design	54,385	76.85%
Total savings	**180,551**	76.85%

7. APPENDICES

APPENDIX 1: LIST OF ABBREVIATIONS

ADL 2021	Approved Document Part L of Buildings Regulations 2021
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
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 (2021)

This development is subject to the requirements of Approved Document L (2021). ADL 2013 represented an approximate reduction of 6% in the Target Emission Rate (Kg/CO_2/sqm per annum) over the requirements of Approved Document L (2010) for residential development and an aggregate 9% reduction for non-residential development. ADL (2021) has seen a further 31% improvement over these targets. It also sees the introduction of a Primary Energy 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 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 costal change' (*NPPF paragraph 152), *'whilst taking a proactive approach to mitigating and adapting to client change, taking into account the long-term implication for flood risk, costal change, water supply, biodiversity and landscapes, and the risk of over shading from rising temperatures'.* (NPFF 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.'
Welwyn Hatfield Borough Council Draft Local Plan (2016)
<u>Policy SP 1 - Delivering Sustainable Development (Relevant Items)</u> ▪ That adaptation and mitigation principles relating to climate change are incorporated into the design and construction of new development which include energy and water efficiency measures, the use of low carbon and renewable energy, the provision of green infrastructure and sustainable drainage systems (SUDs). <u>Policy SP 10 - Sustainable design and construction (Relevant Items)</u> ▪ Layout and design of the site and building(s) reflect the energy hierarchy to maximise opportunities to reduce carbon emissions. ▪ The use of renewable and low carbon energy infrastructure is used where it is appropriate and consistent with other policies. ▪ Proposals are responsive to how the climate will change over their lifetime and minimise their contribution to the urban heat island effect. ▪ Water sensitive design principles and practices are integrated into development proposals to sustainably address water supply, consumption and quality, extreme rainfall, drainage and flood risk in a holistic way that supports other design aims and objectives <u>Policy SADM 13 - Sustainability requirements (Relevant Items)</u> ▪ All major development proposals must demonstrate that they have sought to maximise opportunities for renewable and low carbon sources of energy supply where consistent with other Local Plan policies. ▪ All newly constructed dwellings will be required to achieve an estimated water consumption of no more than 110 litres/person/day, with water reuse and recycling and rainwater harvesting incorporated wherever feasible to reduce demand on mains water supply.

APPENDIX 3: SAP RESULTS

Dwelling Type	TER/DER		TFEE/DFEE		TPER/DPER		Compliance achieved
Dwelling type 1.5	21.09	3.95	44.8	40.8	60.28	33.05	Yes
Dwelling type 1.10	16.01	3.21	35.5	32.7	86.09	36.39	Yes
Dwelling type 1.1 mid	13.25	2.89	20.9	20.8	71.26	33.3	Yes
Dwelling type 1.1 TF	15.2	3.36	30.1	33.2	81.74	38.13	Yes – on block compliance
Dwelling type 1.2 mid	13.14	2.93	21.8	22.1	70.61	33.57	Yes – on block compliance
Dwelling type 1.2 top	15.85	3.38	34.5	35.5	85.19	38.14	Yes – on block compliance
Dwelling type 1.3 mid	15.33	3.23	27.9	28.2	82.54	37.19	Yes – on block compliance
Dwelling type 1.3 top	18.59	3.77	43.1	42.3	100.06	42.73	Yes
Dwelling type 1.9 over UH	16.24	3.41	38	38.2	88.1	38.03	Yes – on block compliance
Dwelling type 1.1 over UH	17.06	3.52	39.6	39.5	91.75	39.7	Yes
Dwelling type 1.4 mid	13.56	2.76	22.4	22.3	72.79	32.51	Yes
Dwelling type 2.6e mid	12.03	2.72	22.8	22.7	64.78	30.61	Yes
Dwelling type 2.6e top	14.91	3.25	36.3	36.1	80.29	35.96	Yes
Dwelling type 2.1e mid	11.57	2.65	19.3	19.1	62.26	30	Yes
Dwelling type 2.1e top	13.93	2.97	30.5	29.9	74.97	33.2	Yes
Dwelling type 2.10	11.33	2.67	21.8	21.6	60.5	29.96	Yes
Dwelling Type 2.15	11.36	2.64	21.6	21.1	60.66	29.68	Yes
Dwelling type 2.20e	11.28	2.65	21.8	21.1	60.23	29.69	Yes
Dwelling type 2.21e	11.17	2.61	19.2	18.1	59.54	29.64	Yes
Dwelling type 2.25	11.85	3.09	25.4	24.4	63.4	33.77	Yes
Dwelling type 2.11e	10.8	2.95	26.8	25.3	57.34	32.2	Yes
Dwelling type 3.3e	11.27	3.04	25.2	24.2	60.28	33.05	Yes
Dwelling Type 3.2e	10.94	2.98	25.9	24.6	58.52	32.45	Yes

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

5.2 Wind	*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 energy (turbines included within the development), or offsite (investing financially into a nearby wind farm).*
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 4.7 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.

5.3 Solar PV and 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.

- If PV panels were to be used, the occupants may be entitled to claim the Feed-In-Tariff for any energy which is generated. If solar thermal panels were to be used, the occupants would see a reduction in hot water bills.

5.4 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 such as these.
- Heat pumps are generally quiet to run.
- Running costs between heat pumps and modern gas boilers are comparable.

	▪ Heat pump technology is aligned with ADL 2021 and the future homes standard which favours high efficiency all-electric heating systems and seeks to move away from fossil fuels and on-site combustion.
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. ▪ ASHP's are aligned with ADL 2021 and provide a pass easily within the new regulations.

5.5 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℃ 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. ▪ Aligned with ADL 2021 which favours high-efficiency all-electric heating systems.
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 as there are physical constraints in terms of ground conditions and area available for installation. ▪ The capital installation cost would also be high which leads us to the conclusion that GSHPs would not be a commercially viable option for this development scheme.

5.6 Biomass	*Providing a heating system fuelled by plant-based materials such as wood, crops or food waste.* 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 carbon.
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.

	▪ Ongoing maintenance costs (need to be cleaned regularly to remove ash.) ▪ On site combustion can exacerbate localised air quality issues.
Development Feasibility ✗	▪ Biomass is considered not a technically viable option for this development scheme as there are physical constraints on site in terms of installing biomass boilers and storing a sufficient supply. ▪ There are also concerns regarding a sustainable supply of biomass to the site. ▪ The capital installation cost would, however, be high which leads us to the conclusion that biomass would not be a commercially viable option for this development scheme.

APPENDIX 5: PART G WATER CALCULATION

This calculation complies with the methodology used under 'Part G (2015) Enhanced' for use in England.

Table A1: The water efficiency calculator

Installation type	Unit of measure	Capacity / Flow rate	Use factor	Fixed use litres/person/day	Litres per person per day
WC (single flush)	Flush volume (litres)	0.0	4.42	0	0.00
WC (dual flush)	Full flush volume (litres)	4.0	1.46	0	5.84
	Part flush volume (litres)	2.7	2.96	0	7.99
WCs (multiple fittings)	Average effective flushing volume (litres)	0.0	4.42	0	0.00
Taps (excluding kitchen / utility room taps)	Flow rate (litres per minute)	5.0	1.58	1.58	9.48
Bath (where shower also present)	Capacity to overflow (litres)	160.0	0.11	0	17.60
Shower (where bath also present)	Flow rate (litres per minute)	9.0	4.37	0	39.33
Bath only	Capacity to overflow (litres)	0.0	0.50	0	0.00
Shower only	Flow rate (litres per minute)	0.0	5.60	0	0.00
Kitchen / utility room sink taps	Flow rate (litres per minute)	6.0	0.44	10.36	13.00
Washing machine	Litres/kg of dry load	8.2	2.10	0	17.16
Dishwasher	Litres/place setting	1.3	3.60	0	4.50
Waste disposal unit	Litres/use	0.0	3.08	0	0.00
Water softener	Litres/person/day	0.0	1.00	0	0.00
				Total calculated use	114.90
		Contribution from greywater (litres/person/day) from Table 4.6			0.00
		Contribution from rainwater (litres/person/day) from Table 5.5			0.00
		Normalisation factor			0.91
		Total water consumption			104.56
		External water use			5.00
		Total water consumption (litres/person/day)			109.56
		Target			110.00

Assessed by James Alexander in the Energist Technical Team on 11/8/2022.
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