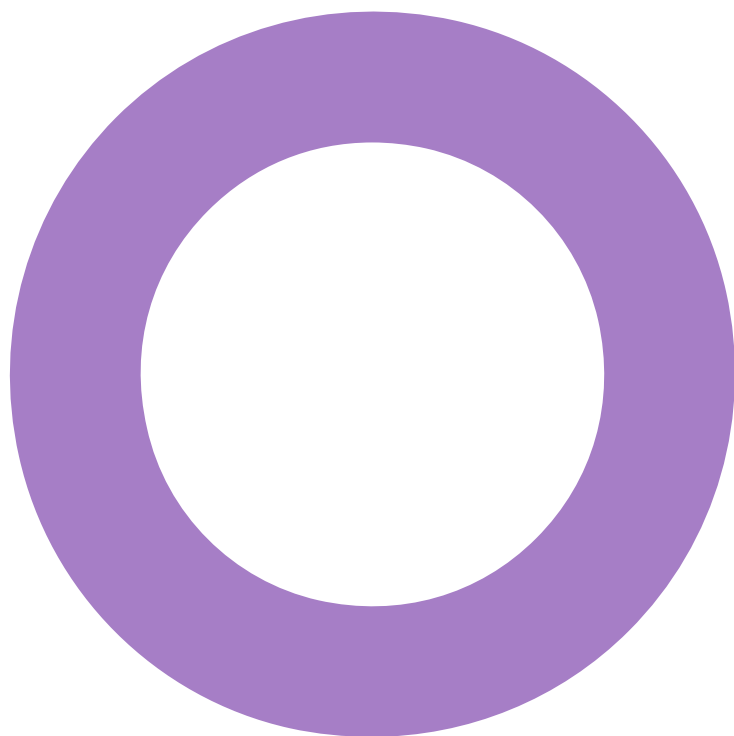


**71-73 Caversham Rd.
Reading.
S2 Estates.**

SUSTAINABILITY
ENERGY STRATEGY

REVISION B – 17.10.2019



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
A	06.09.2019	Draft issue for comment	J.T.	R.G.	K.C.
B	17.10.2019	Update	J.T.	R.G.	K.C.

This document has been prepared for S2 Estates only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

Project number: 23/20615
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Executive Summary.

The following provides a summary of the Energy Strategy for the proposed Caversham Rd development located in Reading.

The proposed development

The proposed development of a ground floor commercial unit and 44 apartments. The commercial unit will be developed as a ‘shell only’ assessment.

Targets

A policy review has been undertaken and the details are outlined in Section 2 of this document. Reading Borough Council is currently in the process of updating the Reading Borough Local Plan to reflect their emerging strategy. To this end, this Energy Strategy has been developed to meet the requirements of the emerging plan. The Proposed Development is targeting:

- Zero Carbon Homes for the residential section.
- Maximisation of energy efficient features and the integration of renewable and low carbon energy.
- Compliance with Part L2A of the building regulations for the commercial unit.

The draft Sustainable Design and Construction SPD states that where it is not possible to achieve Zero Carbon on site, an S106 contribution can be made towards the remaining tonnes of CO₂ produced on site.

Energy strategy summary: Residential

The strategy has been developed using the ‘Be Lean, Clean, and Green’ energy hierarchy which utilises a fabric first approach to maximise the reduction in energy through passive design measures.

The following table provides a summary of the energy strategy for the Proposed Development:

No L2C	12.3% betterment achieved against a Part L baseline. High energy efficient building fabric and building services have been utilised to reduce carbon emissions and energy demand through good practice passive and energy efficiency measures.
With ASHP	A further 73.4% betterment is achieved through the use of ASHP. Air source heat pumps are proposed to be installed to provide space heating as well as domestic hot water.
With PV	An 9.4% betterment is achieved through Solar PV. Renewable energy from the proposed PV’s is to be implemented in the scheme. It has been estimated that a 100 m ² of PV would provide 16,300 kWh/year, depending on the efficiency of the PV panel.

Table 1: Energy strategy summary – Residential.

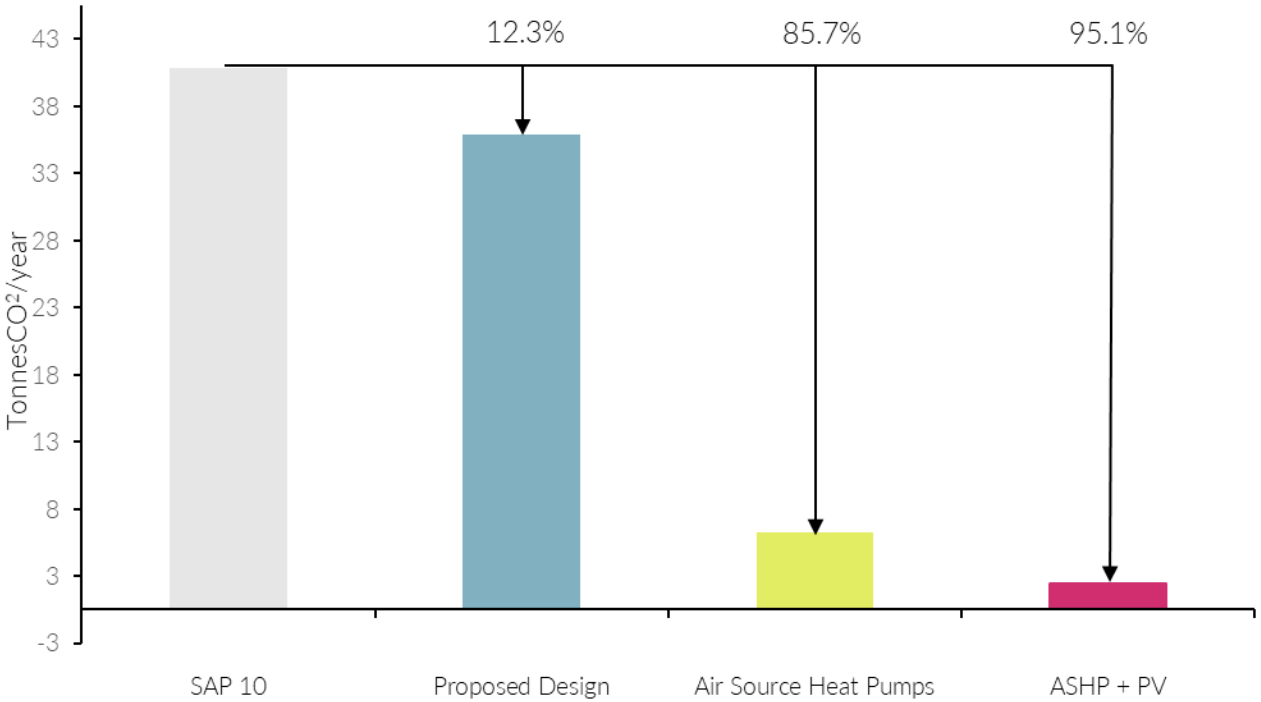


Figure 1: Summary of the estimated carbon reduction by the Proposed Development - Residential:

Results: Residential

Through the measures outlined in the energy strategy, it is anticipated that a 95.1% reduction in CO₂ emissions can be achieved in comparison to a Building Regulations Part L compliant baseline. In line with the Sustainable Design and Construction SPD, an S106 contribution will be provided to offset the remaining tonnes of CO₂ – this is estimated to be £3,510.

Energy strategy summary: Commercial

The commercial unit will be completed as a ‘shell only’ assessment in lieu of the fit-out details for these areas. Initial simulations based on the inputs provided in Appendix B show that the commercial unit could achieve a Building Emission Rate (BER) of 29.5 kgCO₂/m² compare to the Notional Building’s Target Emission Rate (TER) of 31.6 kgCO₂/m², leading to a 6% decrease in carbon emissions when compared to a Part L baseline.

1. Introduction.

This strategy has been prepared on behalf S2 Estates in support of the proposed Caversham Rd development located in Reading. This strategy summarises the relevant regulatory and planning policies applicable to the proposed development and sets out how the proposed development will address and achieve the relevant policy targets.

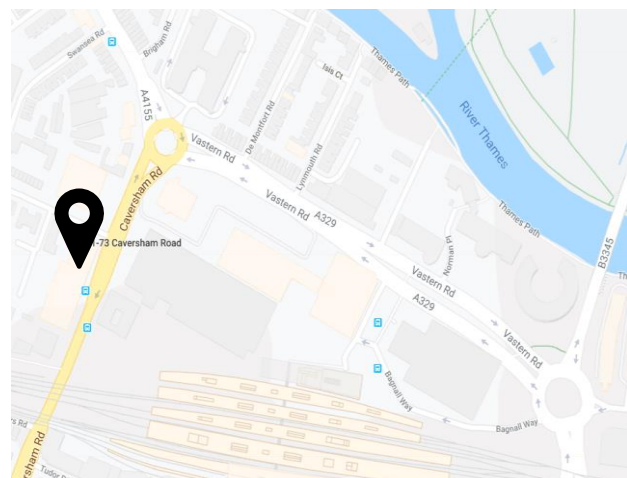


Figure 2 Proposed Development Location – JTP early renders

The Caversham Rd development consists of a mixture of residential and commercial units. The commercial unit is located on the ground floor with 6 stories of residential apartments and two levels of exterior amenity space.

The residential development consists of 44 apartments located above a commercial unit, associated services and stores.

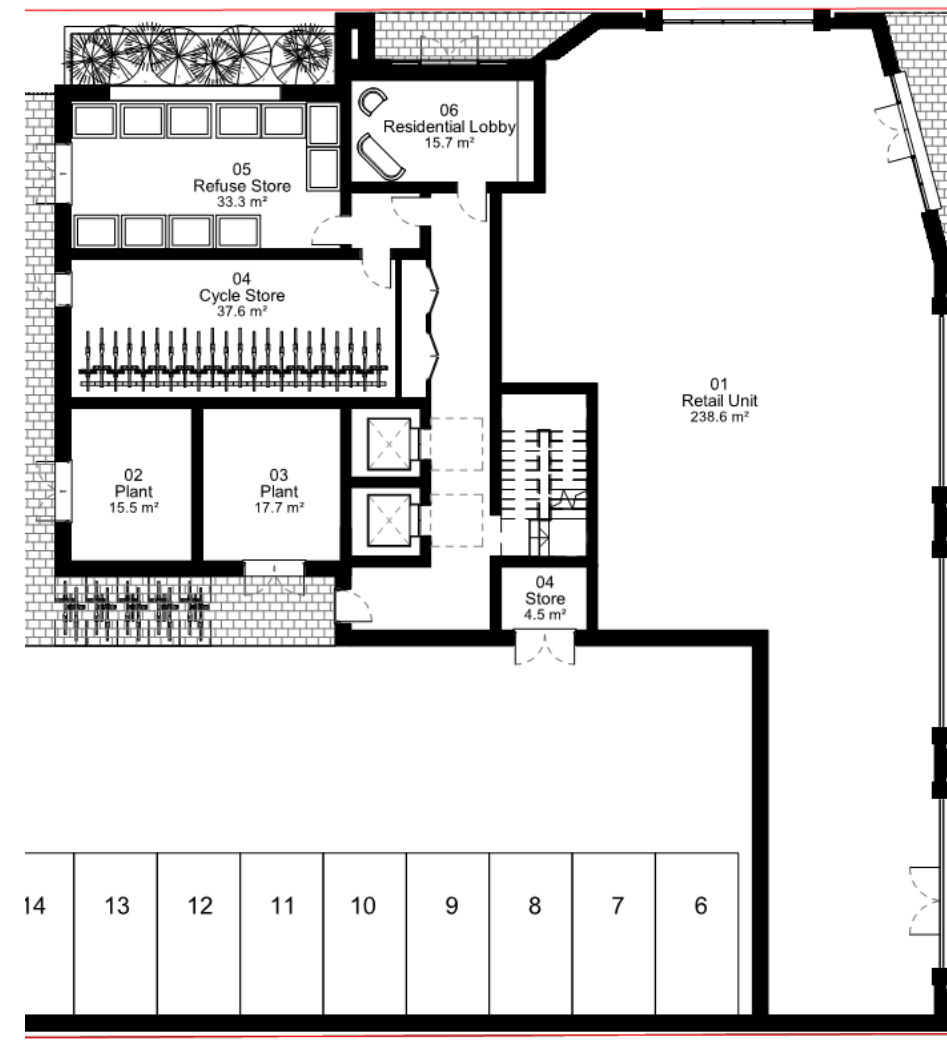


Figure 3: Proposed Ground floor commercial space

The commercial unit will be developed as “shell only”.

2. Policy and Drivers

The following section outlines the national and local policies and drivers.

2.1 Building Regulations Part L (2013)

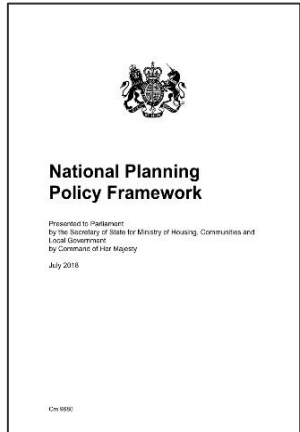


Part L of the Building Regulations is the mechanism by which UK central government is driving reductions in the regulated CO₂ emissions from new buildings. It consists of 5 criteria (listed below) It is split into 2 documents for domestic and non-domestic developments. Each document addresses the same first three criteria, which are applicable in the design stage of a project

- Criterion 1 – Achieving the Target CO₂ Emission Rate (TER) & Fabric Efficiency targets (TFEE)
 - Criterion 2 – Limits on design flexibility
 - Criterion 3 – Limiting the effects of solar gain in summer
 - Criterion 4 – Building performance consistent with BER
 - Criterion 5 – Providing information
- Design Stage
- Post Construction Stage

Part L1A is concerned with domestic buildings while Part L2A covers all non-domestic buildings.

2.2 National Planning Policy Framework



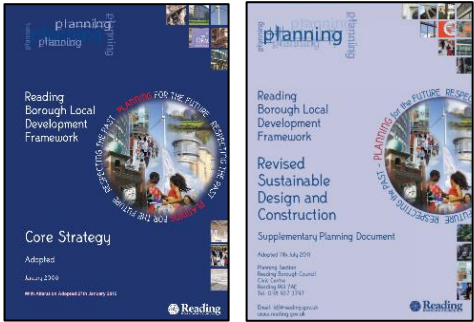
The National Planning Policy Framework (NPPF) was published in July 2018 and superseded all Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) documents. The National Planning Policy Framework sets out the Government's economic, environmental and social planning policies for England. In combination, these policies articulate the Government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations.

It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities. The NPPF states that: "Planning law requires that applications for permission be determined in accordance with the development plan [local plans], unless material considerations indicate otherwise".

2.3 Local Planning Policy and Supplementary Planning Documents

The policies of Reading Borough Council (RBC) are contained within the Local Plan documents:

Those applicable to the Development are:



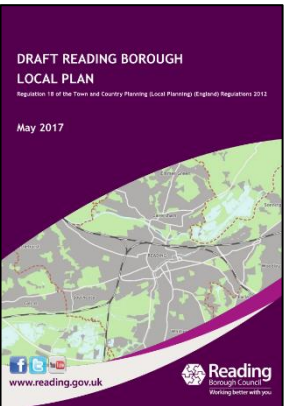
- Reading Borough Council Core Strategy (Alteration adopted January 2015)
- The Supplementary Planning Documents (SPD):

An updated version of the Sustainable Design and Construction SPD (July 2011) states the following:

'Recent changes to the Building Regulations mean that the requirement in policy CS1 to 'off-set at least 20% of predicted carbon dioxide emissions' has now been superseded for both residential and non-residential developments.

All other parts of policy CS1 are still relevant. For this reason, the requirement to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development in adopted policy CS1 is not mentioned further in this SPD'.

2.4 Submission Draft Reading Borough Local Plan and Updated SPD



The future planning policy identified by the Submission Draft version identifies that all major residential new housing is built to a zero carbon homes standard. Major developments consist of developments greater than 10 dwellings or over 1000 sqm of non-residential floorspace. Under this definition the site is considered to be a Major development.

Whilst there are carbon emission targets for residential development there are no specific targets for non-domestic development and therefore, as above, the targets are achieved through compliance with Building Regulations Part L2A.

Emerging Policy CC4 requires that assessment of decentralised heating energy technologies are to be considered. These technologies are identified to include a variety of technologies, including Low and Zero Carbon (LZC) technologies such as

heat pumps.

The draft Sustainable Design and Construction SPD (2019) further details the target for major developments to achieve zero carbon and states that should a development fail to reach Zero Carbon on site, the remaining tonnes of CO₂ can be offset via Section 106 contributions.

3. Energy Modelling -Approach and Methodology.

3.1 Energy Hierarchy

This strategy outlines how the proposed development will have a reduced impact on climate change by reducing CO₂ emissions associated with energy use in buildings.

Figure 4 below outlines the route followed by the proposed development when reducing CO₂ emissions and defines the structure of this statement.

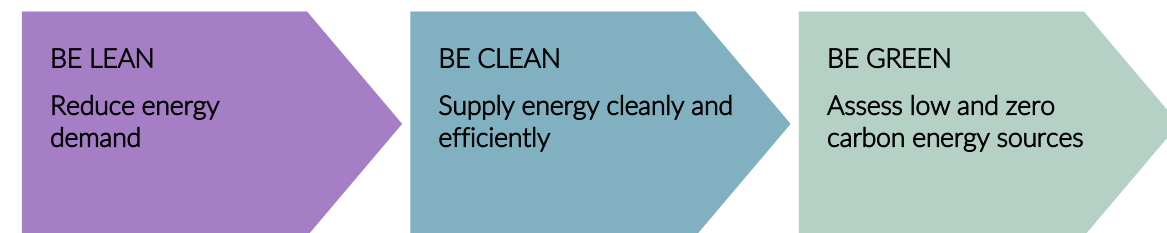


Figure 4: Energy Hierarchy

The strategic approach to the design of the proposed scheme has been to reduce demand for energy prior to the consideration of integrating Low or Zero Carbon (LZC) technologies, since controlling demand is the most effective way of reducing energy requirements and CO₂ emissions.

Further reductions are ensured through the specification of high-efficiency building services and controls to limit losses in energy supply, storage and distribution.

After the inclusion of passive design and energy efficiency measures, various options have been investigated to reduce CO₂ emissions associated with energy supply. The feasibility of LZC technologies has been investigated in line with the policy aspirations and as part of the Energy Strategy submitted in support of the application.

3.2 Methodology & Limitations

Assessments of the energy requirements and associated CO₂ emissions for the proposed development have been carried out using 'Standard Assessment Procedure' (SAP) calculations for a number of sample dwellings within the Proposed Development.

It is assumed that the commercial unit will achieve compliance with Part L2A of the Building Regulations. Initial calculations using Part L2A complaint modelling software have been conducted to demonstrate that compliance can be achieved through passive and active design measures.

The appraisals within this strategy should not be understood as a predictive assessment of likely future energy requirements or otherwise.

Occupants may operate their systems differently, and / or the weather may be different from the assumptions made by Part L approved calculation methods, leading to differing energy requirements.

3.3 Fabric First Approach

A 'fabric first' approach has been taken in order to reduce the energy demand and CO₂ emissions from the Proposed Development. The overriding objective for the façade design of the building will be to achieve the optimum balance between providing natural daylighting benefits to reduce the use of artificial lighting and limiting summertime solar gains to reduce space cooling demands.

Part L1A 2013 of the Building Regulations introduced criteria referred to as the 'FEE'. The Fabric Energy Efficiency (FEE) is influenced by factors such as glazing proportion, solar energy, air leakage and thermal bridges.

The FEE accounts for the dwelling's combined annual heating and cooling load. For reference the 'Notional' dwelling uses a glazing ratio of 25% (of the floor area). It should be noted that for FEE compliance, each dwelling does not need to comply on an individual basis, as the assessment can be aggregated over the whole building on an area weighted (average) basis.

Similarly, Part L2A details minimum fabric performance targets for non-domestic developments.

Appendix B details the target fabric and system performance parameters.

3.4 Grid Decarbonisation and Decentralised Energy

Recent progress in the energy sector has seen emissions associated with electricity consumption reduce drastically, however this is not reflected in the current Building Regulations which was last updated in 2013. National policy is expected to be updated in late 2020, further increasing the gulf between compliance and reality in new projects.

The carbon factor for grid-supplied electricity in current Building Regulations (2013) is 0.519kgCO₂/kWh; as can be seen in the graph below, this is a fair reflection of the performance of the grid at that time. However, in response to legally-binding targets established in line with the Paris Agreement, significant progress has been made in decarbonising the electricity grid over the past six years.

At the end of 2017, the Department for Business, Energy, and Industrial Strategy (BEIS) reported the carbon factor of electricity as having fallen to 0.177kgCO₂/kWh; a 65% reduction compared to that in Part L, 2013. The consequence of this is a discrepancy between emissions calculated using current building regulations methodology from electrical plant and any technologies which offset grid electricity (such as solar PV) compared to the reality of their performance. In a compliance-led world, buildings are being specified with technologies with the objective of reducing CO₂ emissions which, in fact, may not offer any real benefit at all.

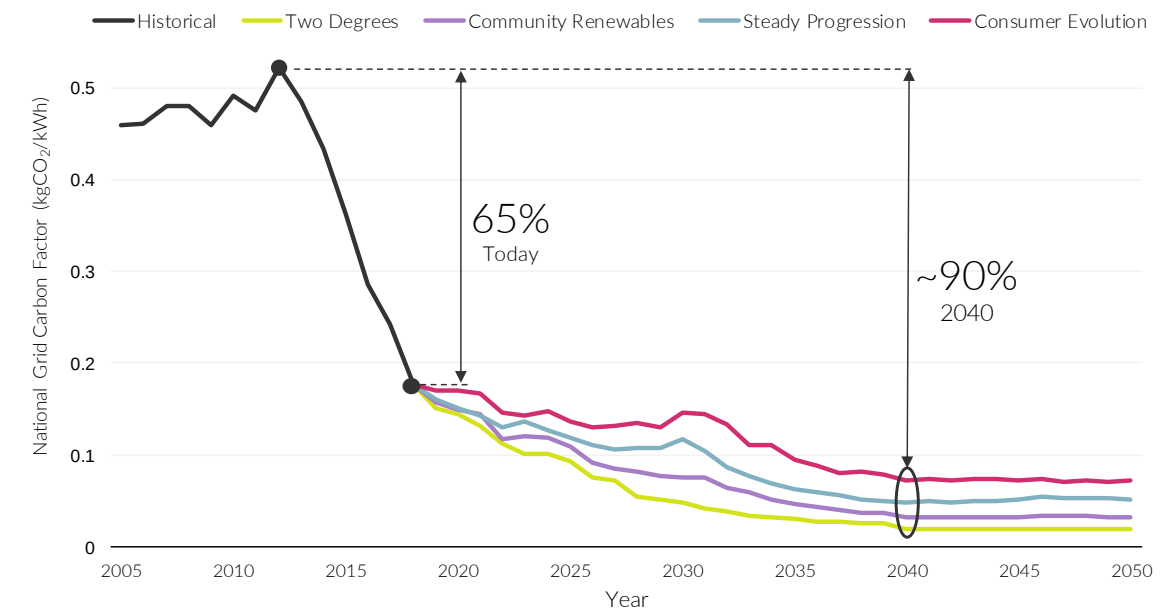


Figure 5 - Historic and future projected carbon factor for the National Grid (8% transmission and distribution losses are included).

In July of 2018, the BRE released an update to the Standard Assessment Procedure (SAP) – used to assess dwellings' compliance with Building Regulations – for consultation. This SAP 10 update incorporated amended carbon emission factors to reflect the decarbonisation of the grid and other national infrastructure changes. Table 2 below shows the changes in carbon factor from Part L 2013 to SAP 10.

It is likely that the next update to Building Regulations Part L will specify a completed update to the SAP methodology alongside the carbon factors associated with natural gas and electricity.

Fuel	Part L 2013 Carbon Factor (kgCO ₂ /kWh)	SAP 10 Carbon Factor (kgCO ₂ /kWh)
Main Gas	0.216	0.210
Electricity	0.519	0.233

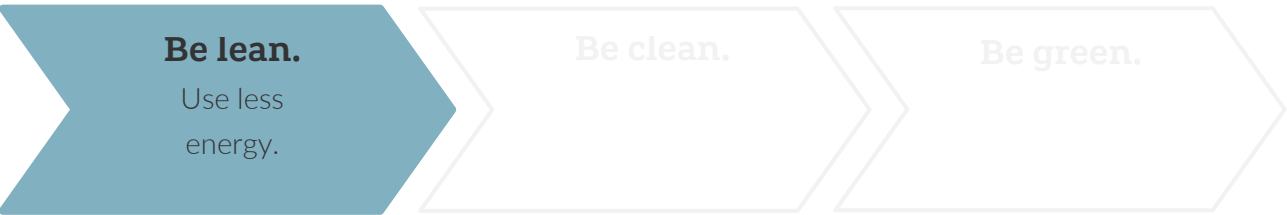
Table 2: Current (Part L 2018) and proposed (SAP10) carbon factors for natural gas and grid-supplied electricity

Due to the significant decrease in the carbon emission factor of electricity, the use of Combined Heat and Power (CHP) is likely to offer a ‘negative benefit’ within the next five years and therefore has not been explored as part of the energy strategy.

For the purpose of this energy strategy, the updated SAP 10 carbon factors have been used in order to quantify the carbon emission targets. As previously discussed, these carbon factors are a closer representation of the current carbon intensity of the electricity grid and therefore would be more appropriate than the Part L 2013 carbon factors for estimating potential carbon emission savings

4. Be Lean.

Passive design and energy efficiency measures form the basis for the reduction in overall energy demand and carbon emissions for the proposed development. This energy strategy aims to reduce the energy demand initially by optimising the envelope and building services within the development.



4.1 Passive Design and energy efficiency

Passive Design measures are those which reduce the demand for energy within buildings, without consuming energy in the process.

These are the most robust and effective measures for reducing CO₂ emissions as the performance of the solutions, such as wall insulation, is unlikely to deteriorate significantly with time, or be subject to change by future property owners. In this sense, it is possible to have confidence that the benefits provided by these measures will continue at a similar level for the duration of their installation.

	Thermal Insulation The Proposed Development will benefit from an efficient thermal envelope. Heat losses and gains will be controlled by the optimisation of the fabric of each building, i.e. ensuring appropriate levels of glazing to control winter heat loss and summer heat gain. Reducing the thermal transmittance of the building envelope where appropriate will help to reduce both heating and cooling requirement and result in lower energy requirements.
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	Ventilation Both the residential and commercial areas will utilise mechanical ventilation to provide fresh air to the occupied spaces. In order to reduce the energy consumption associated with the ventilation, the following measures are proposed: - High efficiency ventilation units with low SFPs. - High efficiency heat recovery systems.
	Lighting Lighting loads are also expected to be significant. Therefore, it is anticipated that the Proposed Development will be supplied with efficient electric lighting fittings such as ‘Light Emitting Diodes’ (LED) and will incorporate automatic lighting controls including presence or absence detection and daylight dimming. High efficiency display lighting will be required for the commercial space.

Table 3: Be lean measures

Appendix B contains the targets for fabric and system performance.

Energy breakdown

The anticipated domestic overall energy demand from each consumption element are compared in the charts below. This shows that the most dominant source of energy consumption is associated with hot water, followed by heating, then auxiliary (Pumps and fans) and lighting.

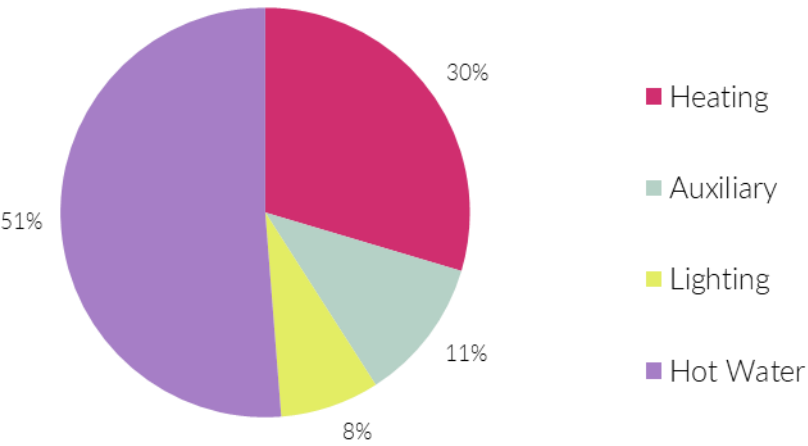
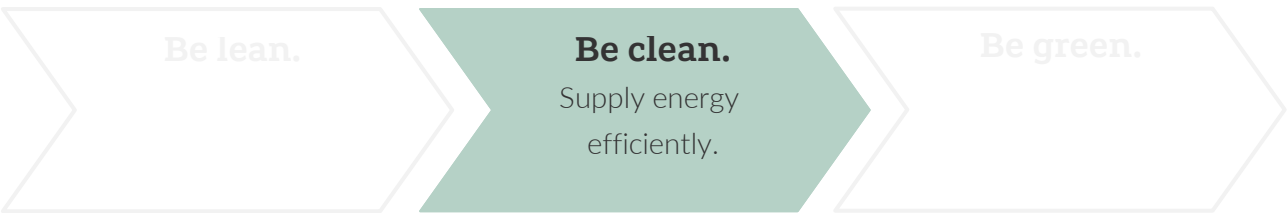


Figure 6: Residential energy breakdown

5. Be Clean.

This stage of the energy hierarchy refers to the use of heat networks or on-site Combined Heat and Power (CHP) in order to provide energy and reduce consumption from the national grid and gas networks, through the generation of electricity, heating and cooling on-site.



5.1 Development Demand

The proposed domestic development's approximated thermal demand has been initially calculated to be approximately 80% compared to 20% for non-thermal demand.

5.2 Be Clean: Network and technologies

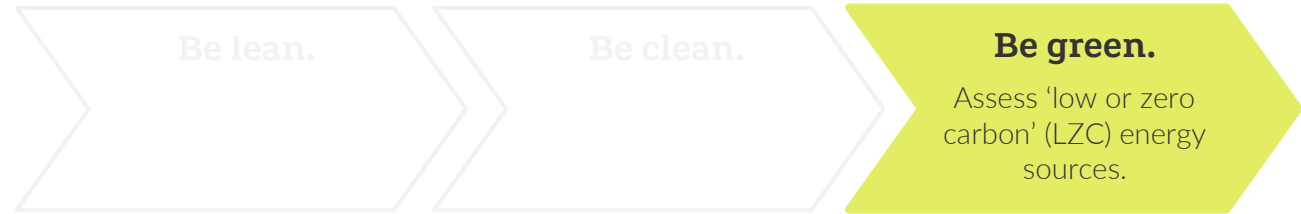
Due the proposed changes to the carbon emission factors in future revisions of Part L – the use of Combined Heat and Power (CHP) is likely to offer a 'negative benefit' within the next five years and therefore has not been explored as part of the energy strategy.

	District heat networks No suitable district heat networks have been identified for this site.
	Combined heat and power (CHP) The rapid decarbonisation of the electricity grid, as explained in Section 3.4, has greatly reduced the carbon emission saving potential of CHP, as it relies on burning fossil fuel to generate electricity. Using the SAP10 carbon emission factors, which are a closer representation of the current carbon intensity of the electricity grid than those in Part L 2013, the use of CHP would result in an increase in the carbon emissions when compared to a traditional arrangement of gas boilers and grid electricity. As the carbon intensity of the grid electricity decreases, the use of CHP will become less favourable. Therefore, a CHP is not proposed for be installed in the development.

Table 4: Be Clean measures

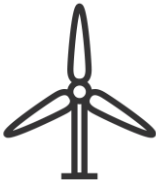
6. Be Green.

The final step of the energy hierarchy explores the feasibility of Low and Zero Carbon (LZC) technologies to allow for the production of renewable energy onsite in order to offer a further reduction in carbon emissions.



6.1 Be Green: Low and Zero Carbon Technologies

	Photovoltaics Photovoltaic panels harness energy from daylight and convert this into useful energy in the form of electricity. A PV system requires viable roof space in order for the system array to be installed and function effectively. Suitability to proposed development: Due to the primary demand of the domestic development being thermal, PVs are not suited to be the primary LZC technology on site. However, in combination with a system directly targeting the thermal demand, PVs can be used to further reduce the carbon demand for the site.
	Solar thermal Solar water heating systems use heat from the sun to heat domestic hot water. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders. Suitability to proposed development: Solar thermal technology would have a peak output in summer when less heat is needed, while the output would be significantly reduced in the winter months when the demand is higher, which would affect the carbon saving potential of the system. Additionally, the available roof area would be better utilised for the installation of PV panels.
	Air source heat pump Air Source Heat Pumps (ASHP) use a refrigeration cycle to extract heat from the air. The efficiency of the system is therefore dependent on outside air temperature. Suitability to proposed development: Air source heat pumps (ASHP) are an efficient way of providing both space heating and domestic hot water. Given the primary thermal demand of the site a community ASHP system with heat exchange units would be one of the most effective ways to provide a significant reduction in the domestic carbon emissions. However, external plant would be required and noise from the external units would also require consideration.

	Ground source heat pump Ground source heat pumps utilise either water extracted from an aquifer (open loop) or a fluid circulated within underground pipework (closed loop) as the heat source in a refrigeration process enabling them to produce hot water, typically at around 45°C, that can be used as a heating medium in buildings. Due to the relatively constant temperature of the ground at depth (typically 10-14°C in the UK) this produces heat more efficiently in winter than an air source heat pump, and usually with lower carbon emissions than a gas-fired boiler. Open loop systems require the water extracted to be re-injected into the aquifer at another borehole on another part of the site. A licence from the Environment Agency (EA) is required for both abstraction and discharge although these licences cannot be obtained until a test borehole has been constructed and the appropriate EA tests undertaken. Suitability to proposed development: While GSHP typically offer better efficiencies than ASHP, the capacity will be limited by the number and depth of the boreholes. Additionally, an annual balance between heating and cooling demand is generally recommended in order to ‘recharge’ the ground in the summer by pumping heat back to the ground when the heat pumps are running in cooling mode. Installation of a ground energy system would require a high capital cost and would have an impact on the construction programme. The lack of a cooling demand to provide adequate recharge serves as an additional barrier to the implementation of GSHP on this scheme. For these reasons, this technology has not been proposed for the scheme.
	Wind turbine Wind turbines use the wind's lift forces to turn aerodynamic blades that turn a rotor thus generating electricity. There are three basic types to consider: horizontal axis (propeller type), vertical access (helical type) and building integrated (where the building design is adapted to suit the wind turbine). For efficient operation and to yield high energy output, wind turbines require a smooth laminar flow of air. Suitability to proposed development: The installation of wind turbines will have a considerable visual impact on the site. Moreover, mounting wind turbines on the roofs of the Proposed Development could result in unacceptable vibration and resonance being felt within the occupied spaces. The turbines are also likely to generate noise which may be a nuisance to neighbouring properties. This scenario could result in the turbines being switched off. Even if a suitable location could be found, the output of a wind turbine and the consequential carbon dioxide savings are likely to be very limited when compared to the emissions of the whole development. Considering the impacts described above, the use of wind turbines is not proposed for the proposed development.
	Biomass A biomass boiler uses a natural fuel such as wood chips or wood pellets for combustion. Since it uses a natural resource that can be replanted it is considered as a renewable energy source subject to the distance the fuel is transported. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a carbon neutral process. Suitability to proposed development: Large fuel storage volumes are required to maintain continuous operation during the winter months. As such, area take for such plant is high. Fuel deliveries and security of fuel supply are

	also important considerations. Additionally, exhaust gases would require significant treatment to avoid degrading local air quality. Biomass boilers are therefore not proposed for the development.
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Table 5: Be Green measures

6.2 Proposed Technologies

When addressing the third tier of the Energy Hierarchy, the aim is to integrate low and zero carbon technologies that are appropriate to the design of the buildings at the development. Furthermore, the integration of renewables must not compromise or detract from the adoption of energy efficiency measures and decentralised energy infrastructure.

The 2035 emerging plan was addressed when evaluating the suitable LZC for site. As the site is considered a “major” development under the emerging Reading plan, a Zero Carbon strategy must be targeted for site. A community ASHP system for heating and DHW generation has been selected as the most suitable LZC technology for site. It is important to note that some roof space will be required for the deployment of ASHPs.

Furthermore, PV has been determined to be a suitable technology to support the ASHP system in achieving a Zero Carbon strategy.

7. Results

7.1 Criterion 1a: Achieving the Carbon Emissions Target

The SAP calculations undertaken as part of this energy strategy indicates that the evaluated development meets the targets defined within the Building Regulations Part L1A.

Through the uses of fabric first measures and high efficiency systems the proposed domestic development has been shown to achieve a 12.3% reduction in regulated carbon emissions when compared to a SAP 10 baseline building.

ASHPs have been identified as the most suitable technology for the scheme. Based on initial design estimates (detailed in Appendix B) it has been shown that ASHPs would achieve a further 73.4% reduction in regulated carbon emissions, bringing the total building regulated carbon reduction to an 85.7% improvement.

Site		BER (kgCO ₂ /m ²)	Total CO ₂ (kgCO ₂ /year)	Percentage improvement (%)
SAP 10	(Part L Compliant)	13.52	40,307	0
Be Lean	(Proposed)	11.86	34,353	12.3
Be Clean	(N/A)	11.86	34,353	0
Be Green	(Air Source Heat Pumps)	1.93	5,755	85.7

Table 6: Reduction in carbon emissions.

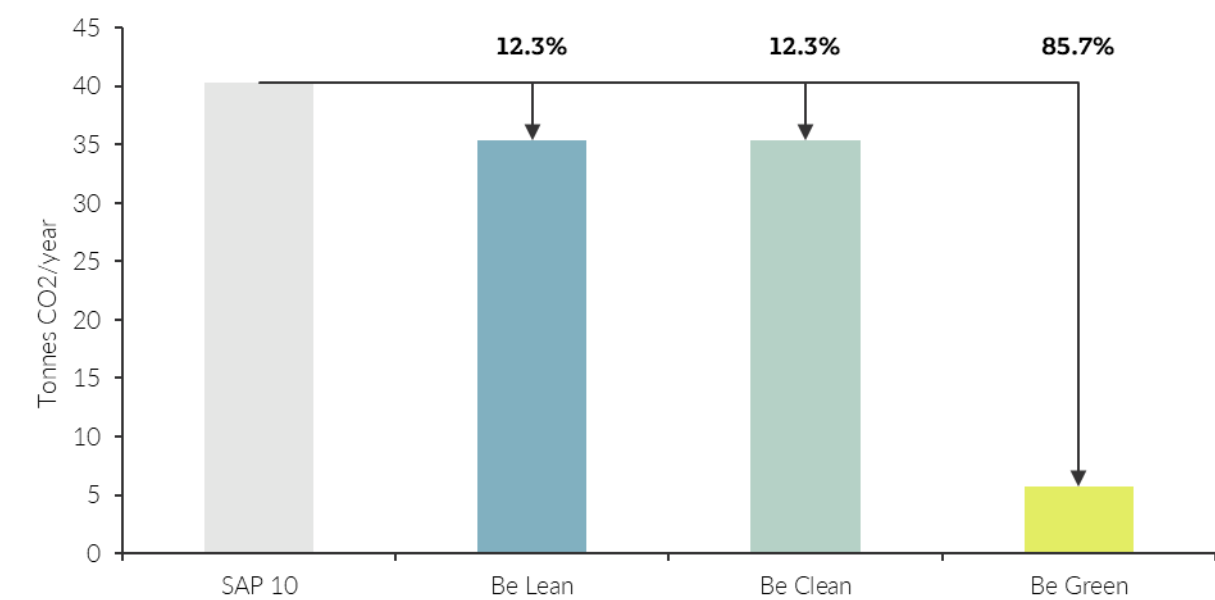


Figure 7: Be lean, Be Clean, Be Green

It has been estimated that approximately 100m² is available for PV panel deployment on the roof of the proposed development. A PV array of this size could generate 20 to 22.5 kWp depending on the efficiency of the installed panel. With an assumed solar irradiance of 966 kWh/m²/year and panel efficiency of 0.27 kWp/panel it is estimated that the proposed PV array could generate 16,300 kWh/year.

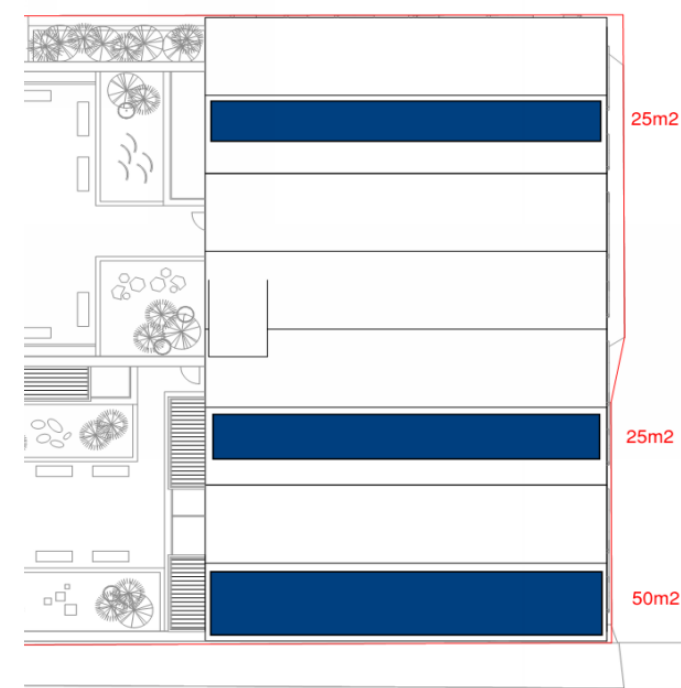


Figure 8: Proposed area for PV installation.

The effects of the PV have been demonstrated below showing that with the use of a roof mounted PV array in conjunction with the proposed ASHP the onsite carbon emission could be reduced by 95.1% when compared to a Part L compliance baseline.

Site		BER (kgCO ₂ /m ²)	Total CO ₂ (kgCO ₂ /year)	Percentage improvement (%)
SAP 10	(Part L Compliant)	13.95	40,307	0
Be Green	(Air Source Heat Pumps)	1.99	5,755	85.7
Be Green	(ASHP+Roof PV)	0.68	1,957	95.1

Table 7: PV Reduction

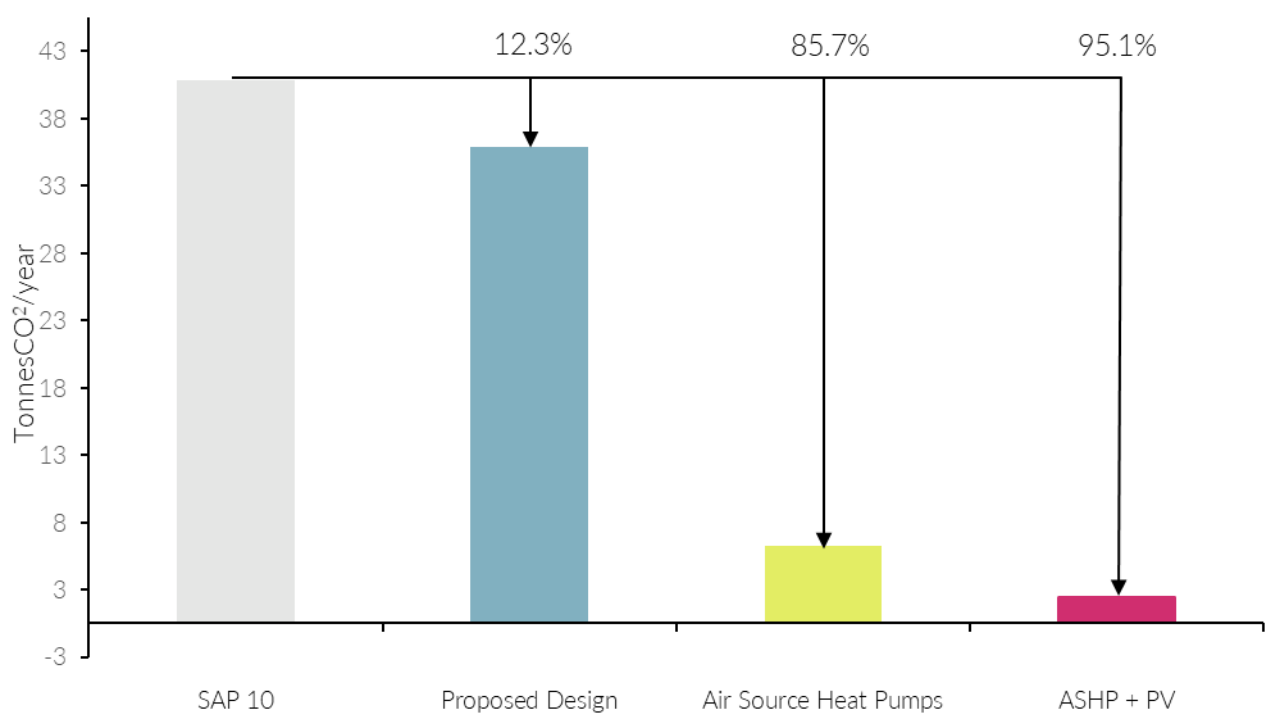


Figure 9: Summary of the estimated total carbon reduction achieved by the Proposed Development – Residential

The Draft Sustainable Construction Supplementary Planning Document for the Reading Borough confirms that if achieving Zero Carbon is not possible on site, a Section 106 contribution can be provided. The rate of this S106 contribution is £1,800 per remaining tonne of carbon emissions.

The proposed development achieves a 95.1% improvement over a Part L compliant baseline emission of 40.307 TonnesCO₂/year. The remaining 4.9% (1.95 tonnesCO₂/year) could be offset via a S106 contribution approximately equal to £3,510.

If a more efficient PV panel were to be used the amount of carbon offset on site would increase and the S106 contribution required would be reduced accordingly. Inversely, if a less efficient panel was to be used the S106 contribution may increase.

As discussed in Section 3.2 the commercial areas of the Proposed Development have been assessed as 'shell only'. Initial simulations based on the inputs provided in Appendix B show that the commercial unit could achieve a Building Emission Rate (BER) of 29.5 kgCO₂/m² when compare to the Notional Building's Target Emission Rate (TER) of 31.6 kgCO₂/m², leading to a 6% decrease in carbon emissions when compared to a Part L baseline.

7.2 Criterion 2: Limits on Design Flexibility

Criterion 2 sets minimum efficiency targets for building fabric and building services efficiencies. Generally, achieving the Fabric Energy Efficiency (FEE) results in the building fabric performance going beyond the minimum targets defined in Part L.

The Fabric Energy Efficiency (FEE) is approximately 11.47% better than the Target Fabric Energy Efficiency (TFEE).

7.3 Criterion 3; Limiting the Effects of Heat Gain in Summer

The Standard Assessment Procedure (SAP) calculations undertakes a simple assessment of summertime temperatures – using averaged data over the summer months. Criterion 3 of the Building Regulations is not to be taken as a summertime overheating risk assessment. A separated overheating risk assessment should be conducted to evaluate the proposed design.

The SAP calculations undertaken as part of this Energy Strategy indicates that all apartments achieve compliance with Criterion 3 through the use of light coloured roller blinds and openable windows.

8. Conclusion.

This strategy summarises the relevant regulatory and planning policies applicable to the proposed development and sets out how the proposed development will address and achieve the relevant policy targets. The strategy responds to the UK planning and regulatory framework, and specifically to the Reading Core Strategy policy documentation.

8.1 Planning Policy

The emerging policy states that applications for residential development should achieve the following targets:

Policy	Requirement
Policy H5	All major new-build residential developments should be designed to achieve zero carbon homes

Table 8: Domestic CO₂ Emission Reduction Targets, Reading Core Strategy

The Reading Borough Council; Draft Sustainable Design and Construction Supplementary Planning Document (SPD) confirms that Zero Carbon should be targeted for the residential development.

There are no specific targets for non-domestic development and therefore, as above, the targets are achieved through compliance with Building Regulations Part L2A.

8.2 Approach

This report evaluates the proposed development against the energy hierarchy; Be lean, Be clean and Be green. The building fabric performance was informed by the Part L1A 2013 Target Fabric Energy Efficiency (TFEE) criteria. In the latest edition to the Building Regulations, dwellings must demonstrate that the fabric efficiency is equal to or better than the ‘notional’ building.

The commercial unit of the proposed development has been assessed as a ‘shell only’ assessment in lieu of the fit-out details for these areas. An initial simulation has been evaluated using standard fabric and system performance values.

Combining passive design and energy efficiency measures with ASHPs and PV, the Proposed Development demonstrates that the annual regulated carbon dioxide emissions are 95.1% less than the Part L 2013 Target Emission Rate (TER) and the Fabric Energy Efficiency (FEE) is approximately 11.47% better than the Target Fabric Energy Efficiency (TFEE).

Furthermore, an S106 contribution is required to satisfy the draft SPD (2019). This has been estimated to be £3,510.

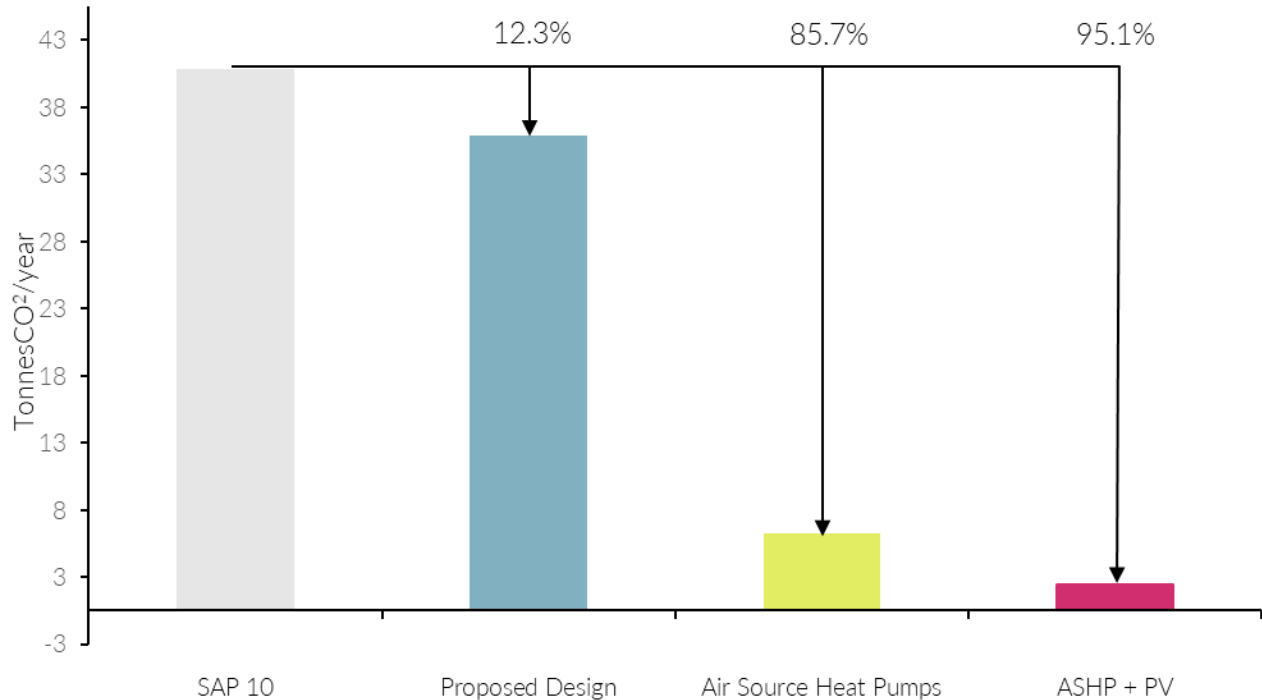


Figure 10: Summary of the estimated total carbon reduction achieved by the Proposed Development - Residential

8.3 Commercial Areas

Initial simulations show that the commercial unit could achieve a 6% decrease in carbon emissions when compared to a Part L baseline.

8.4 Proposed Development

Through the use of efficient building fabric and building services, Air Source Heat pumps, PV and an S106 Contribution, the Caversham Road development can meet the requirements of the emerging Reading Borough Local Plan.

Appendix A: Grid Decarbonisation.

Historic progress.

The carbon factor of the National Grid – the amount of carbon dioxide released per kilowatt hour of electricity generated and distributed – is recognised in current Building Regulations as being 0.519 kgCO₂/kWh. However, the national mix of electricity generation methods is progressing towards greener solutions with renewable sources accounting for 33.4% of the electricity generated in the UK in 2018; up from 24.4% in 2016 (Ofgem).

As a consequence, the Building Regulations Part L 2013 value of the National Grid carbon factor has been shown to be substantially higher than how the grid is performing in reality. This severely impacts the calculated emissions produced by all heat raising plant which use electricity directly, or generate it to offset other emissions. Figure 10 shows how the mix of generation techniques serving the National Grid, as well as the associated carbon factor, has varied over the past seven years – encouragingly, the carbon intensity of the grid has reduced to almost a third of its value in 2012 – just 0.177 kgCO₂/kWh (BEIS).

Therefore, the carbon emissions associated with electricity consumption are much lower than reported in Building Regulations. This means that, under the Part L 2013 methodology the CO₂ emissions associated with electrically-driven plant are being overestimated by almost 200%.



Figure 11: Historic mix of generation methods and associated carbon factor for the National Grid. Transmission and distribution losses are included. Sources: OfGem (generation mix); BEIS Green Book (historic carbon factors).

Future projections.

The Future Energy Scenarios (FES) document, produced by the National Grid, discusses how the UK's energy landscape is changing. Last year's report, FES 2018, makes projections of how the mix of generation in the grid is likely to change between now and 2050 – the year by which the Climate Change Act 2008 set the target of reducing the UK's CO₂ emissions by 80% from 1990 levels. This target has now been revised to be Net Zero in light of the Committee on Climate Change's recent report and the declaration of a Climate Emergency.

FES discusses these projections in one of four scenarios and Figure 11 combines these future trajectories with the actual carbon intensity of the National Grid over the past 13 years. The reported emissions associated with electricity generation have fallen steeply since 2012 and in all cases, the FES 2018 scenarios see the carbon factor of electricity fall below 100 gCO₂/kWh by 2035.

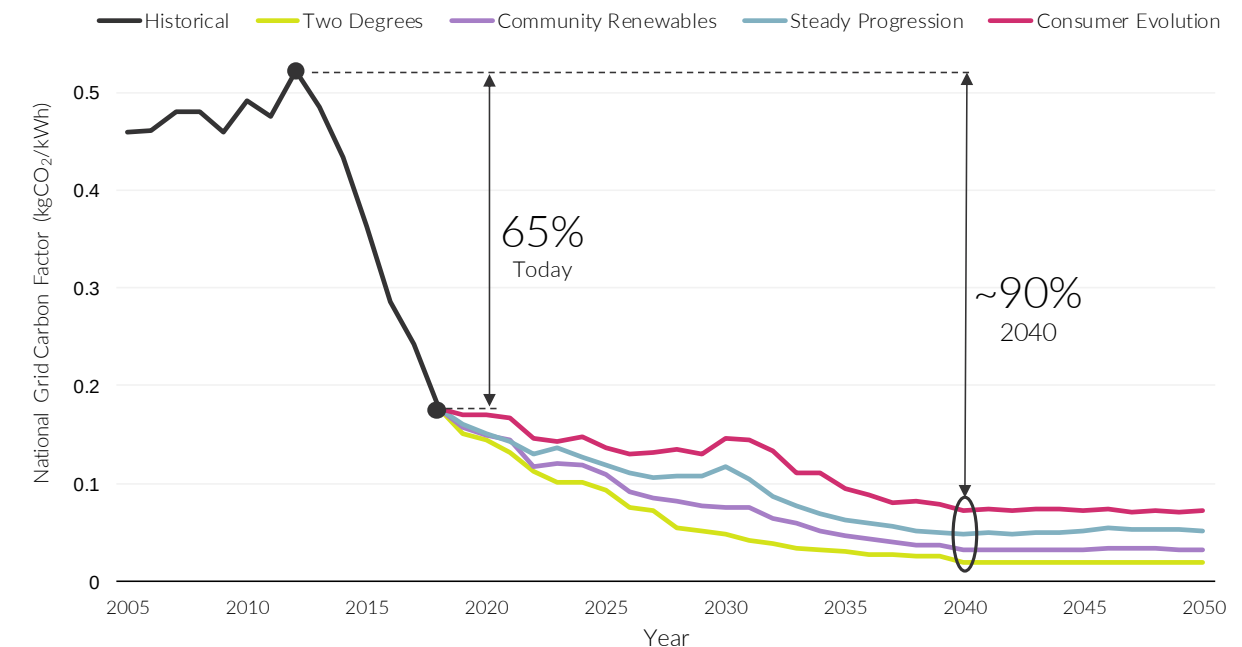


Figure 12: Historic and future projected carbon factor for the National Grid. Transmission and distribution losses are included. Sources: BEIS Green Book (historic carbon factors); National Grid Future Energy Scenarios (FES) 2018 (future projected carbon factors).

Shifting focus.

As the carbon emissions associated with the generation of electricity continue to reduce, the proportion of the UK's overall greenhouse gas emissions for which the electricity sector is responsible will fall. In fact, transport has now replaced energy supply as the greatest single contributor, responsible for 26% of national greenhouse gas emissions (BEIS).

The carbon factor of natural gas is likely to remain relatively static. With 85% of homes in the UK relying on gas to supply their heating and hot water, as well as a significant proportion of commercial buildings, heating buildings and industry represents an ever-greater proportion of UK emissions – 32% in 2015 (BEIS). In order for the UK to maintain a trajectory sufficient to meet the 2050 decarbonisation target, focus must necessarily shift to other contributors.

The BEIS Clean Growth Strategy provides an indication of the direction the UK's energy policy is likely to take and "...sets out [the government's] proposals for decarbonising all sectors of the UK economy through the 2020s." This includes investing in infrastructure and mechanisms to facilitate a transition to low emission vehicles and strengthening the energy performance requirements of new and existing buildings.

Consequences for heating strategies.

Today.

Figure 12 shows the net annual emissions for a medium-scale mixed use development under a variety of servicing strategies using the carbon factors from current building regulations and the reported carbon factor for grid electricity in 2018 (BEIS).

The consequence of the discrepancy between the two are clear. Where CHP offers the greatest emissions reductions under Part L 2013, it is calculated to cause a net emissions *increase* of 60% compared to a gas boiler

using up-to-date carbon factors. Heat pumps, on the other hand, whilst competitive under current building regulations offer substantially greater emissions reductions (70%) using the current carbon factor.

From this, it is appropriate to speculate the detrimental impact such misrepresentative carbon factors enshrined in building regulations may have on the ability of servicing strategies to meaningfully reduce carbon emissions.

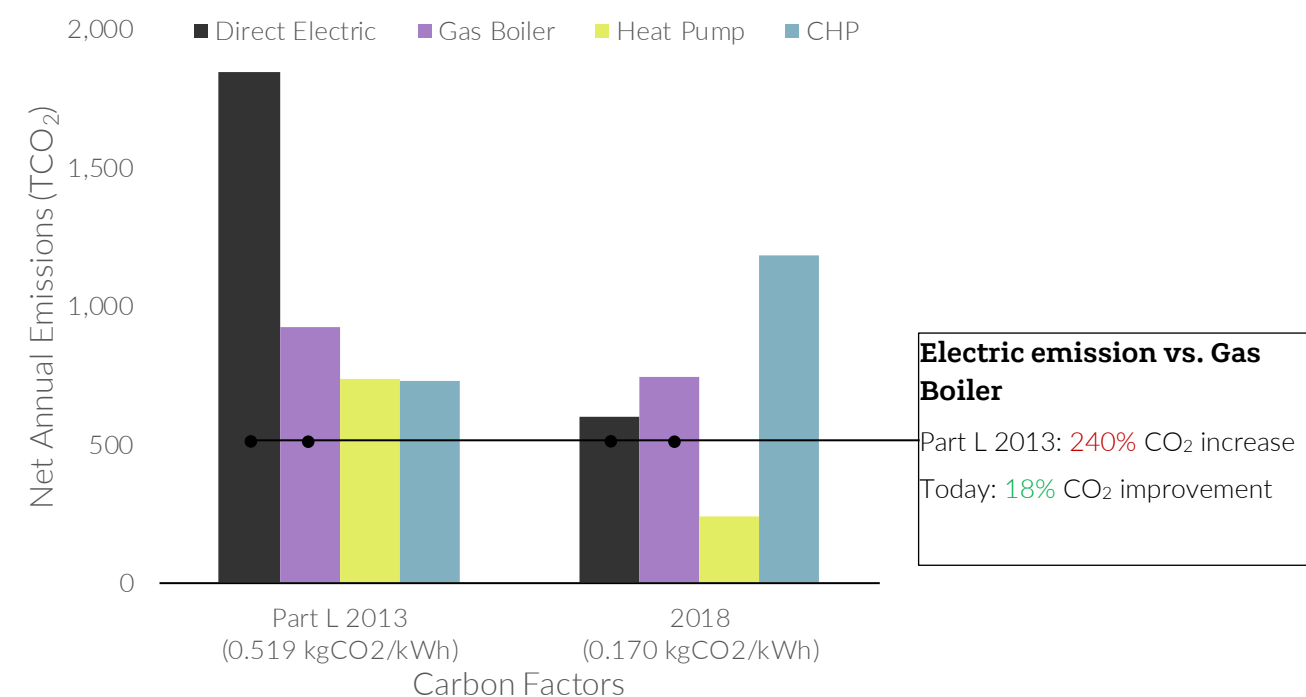


Figure 13: Net annual emissions for a medium scale, mixed-use development for a variety of servicing strategies under Part L 2013 and using the reported carbon factor of the grid in 2018.

Route to zero carbon.

Considering the continued decarbonisation projected for the UK electricity grid, the discrepancy between building regulations and reality is set only to worsen. With an update to Part L likely to come in late 2020 at the earliest, it is important for developers and designers to design not only for compliance, but for future decarbonisation.

This drives us towards electrical servicing strategies. With the carbon factor for electricity currently 18% lower than natural gas and the gap set to widen, an electric servicing strategy offers reduced carbon emissions both now and in the future, particularly if using an efficient heating system such as a heat pump. This is shown in Figure 13.

Electric strategies also provide the only feasible route to net zero emissions. With the carbon factor for electricity set to reduce to below 100 gCO₂/kWh by 2035, through demand reduction and renewable generation, it will be possible to completely offset the operational emissions of a future building.

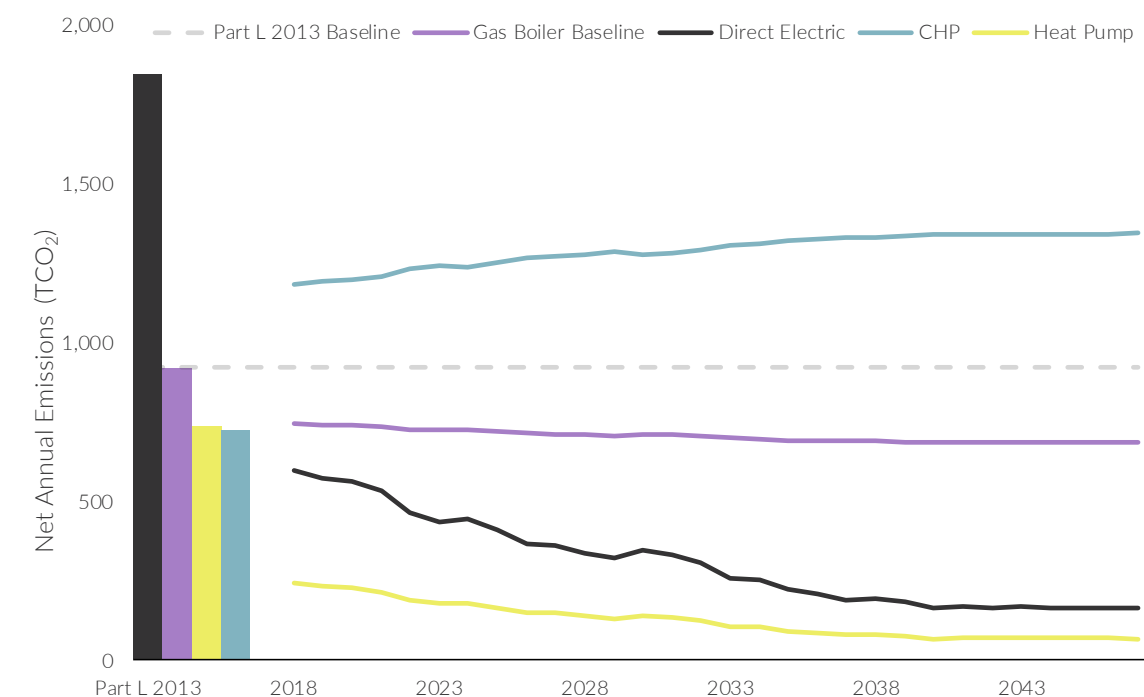


Figure 14: Net annual emissions for a medium scale, mixed-use development for a variety of servicing strategies under Part L 2013 and projected out to 2050 using the Future Energy Scenarios 2018 Steady Progression carbon factors.

Updates to the Standard Assessment Procedure (SAP10)

In July 2018, the BRE released an update to the Standard Assessment Procedure (SAP) – used to assess dwellings' compliance with Building Regulations – for consultation. The following represents a brief summary of the changes to carbon factors over the current methodology, SAP2012.

Carbon factors

Many of the fuel types recognised in SAP have had their fuel types, carbon factors and primary energy factors amended following the decarbonisation of the grid and other national infrastructure changes. The table below shows the changes in carbon factor from SAP 2012 to SAP 10. It is worth noting the significant improvement for the electricity carbon factor (almost half of that used in 2012).

It is likely that the next update to Building Regulations Part L will specify the SAP 10 carbon factors associated with natural gas and electricity.

Fuel	SAP 2012 Carbon Factor (kgCO ₂ /kWh)	SAP 10 Carbon Factor (kgCO ₂ /kWh)
Main Gas	0.216	0.210
Electricity	0.519	0.233

Table 9: Current (SAP2012) and proposed (SAP10) carbon factors for natural gas and grid-supplied electricity.

Appendix B: Part L Model Inputs

Fabric parameters + System inputs - Residential

Parameter	Building Regulations Part L1A Limit	Notional Building	Proposed Design
External Wall U-value (W/m².K)	0.30	0.18	0.15
Roof U-value (W/m².K)	0.20	0.13	0.12
Floor above commercial U-value (W/m².K)	0.25	0.13	0.12
Party Wall (W/m²K)	0.00	0.00	0.00 (Fully filled cavity with edge sealing)
Window U-value (inc. frame) (W/m².K)	2.00	1.40	1.40
Entrance Doors	-	-	1.00
Air Permeability (m³/h.m² at 50Pa)	10.0	3.00	3.00

Table 10: Proposed fabric elements

A G-value of 0.5 has been targeted for the glazing.

Thermal bridge has been calculated using Accredited Construction Details (ACDs). As the design progresses the design team will ensure ACDs or similar are utilised to minimise potential heat loss as a result of thermal bridging.

Light colour roller blinds have been assumed for all apartments.

Heating, cooling and ventilation plant	
Space Heating plant	Radiators supplied by Community Air Source Heat pump Heating SCOP: 3.0 System: Pre-insulated low temp variable flow Controls: Use, Programmer and TRVS
DHW	Heat Interface unit connected to Air Source Heat Pump DHW SCOP: 3.0 Loss factor: 0.01 kWh/day Volume: 2 litres
Ventilation	SFP 1.5W/(l/s); HR eff 90%
Lighting	100% Energy Efficient Light Bulbs
System zones	

Heating, cooling and ventilation plant	
Circulation	It has been assumed that the central core areas (corridors between apartments) are heated.

Table 11: Residential system performances

Fabric parameters + system inputs – Commercial

Parameter	Building Regulations Part L1BLimit	Notional Building	Proposed Design
External Wall U-value (W/m².K)	0.35	0.18	0.20
Ceiling U-value (W/m².K)	-	-	0.12
Floor U-value (W/m².K)	0.25	0.22	0.15
Window U-value (inc. frame) (W/m².K)	2.20	1.60	1.60
Glazed Doors U-value (inc. frame) (W/m².K)	2.20	1.60	1.60
Air Permeability (m³/h.m² at 50Pa)	10.0	5.00	3.00

Table 12: Proposed fabric elements – commercial

A G-value of 0.35 has been targeted for the glazing

Heating, cooling and ventilation plant	
Space Heating/Cooling plant	DX unit: SCOP 4.5 SEER 7.0
DHW	Point of use electric water heater. Eff 100%
Ventilation	Centralised SFP 1.6W/(l/s); HR eff 85%
Lighting	Display lighting 70 lm/W, Lighting 100 lm/W

Table 13: Proposed system efficiencies – commercial.

Appendix C: Example SAP calculation

This output is from the SAP compliant calculation tool, Plan assessor. These figures have then been converted using the SAP 10 carbon emission factors.

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jack Tinsley	Assessor number	9988
Client		Last modified	17/10/2019
Address	3 Caversham road 95, Reading, RG1 8JA		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	69.02 (1a)	x	2.70 (2a)	=	186.35 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 69.02 (4)				
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = 186.35 (5)				

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	0	x 10 =	0 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

			Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	3.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.12 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	76.50 (23c)
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a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Window			10.45	1.33	13.85		(27)						
Exposed floor			69.02	0.12	8.28		(28b)						
External wall			16.25	0.15	2.44		(29a)						
Party wall			62.99	0.00	0.00		(32)						
Total area of external elements ΣA, m ²			95.72				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	24.57	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						250.00	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						14.07	(36)						
Total fabric heat loss					(33) + (36) =	38.65	(37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	16.34	16.16	15.98	15.09	14.91	14.02	14.02	13.84	14.37	14.91	15.27	15.63	(38)
Heat transfer coefficient, W/K (37)m + (38)m	54.99	54.81	54.63	53.74	53.56	52.66	52.66	52.48	53.02	53.56	53.91	54.27	
	Average = Σ(39)1...12/12 =											53.69	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.80	0.79	0.79	0.78	0.78	0.76	0.76	0.76	0.77	0.78	0.78	0.79	
	Average = Σ(40)1...12/12 =											0.78	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N												2.22	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												86.97	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	95.67	92.19	88.71	85.24	81.76	78.28	78.28	81.76	85.24	88.71	92.19	95.67		
												$\Sigma(44)1...12 =$	1043.70	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	141.88	124.09	128.05	111.64	107.12	92.43	85.65	98.29	99.46	115.91	126.53	137.40		
												$\Sigma(45)1...12 =$	1368.45	(45)
Distribution loss $0.15 \times (45)m$														
	21.28	18.61	19.21	16.75	16.07	13.87	12.85	14.74	14.92	17.39	18.98	20.61	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												2.00	(47)	
Water storage loss:														
b) Manufacturer's declared loss factor is not known														
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.03	(51)	
Volume factor from Table 2a												3.91	(52)	
Temperature factor from Table 2b												1.00	(53)	
Energy lost from water storage (kWh/day) $(47) \times (51) \times (52) \times (53)$												0.27	(54)	
Enter (50) or (54) in (55)												0.27	(55)	
Water storage loss calculated for each month $(55) \times (41)m$														
	8.24	7.44	8.24	7.97	8.24	7.97	8.24	8.24	7.97	8.24	7.97	8.24	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$, else (56)														

8.24	7.44	8.24	7.97	8.24	7.97	8.24	8.24	7.97	8.24	7.97	8.24	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

173.38	152.54	159.55	142.12	138.62	122.92	117.16	129.79	129.95	147.42	157.02	168.90	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

173.38	152.54	159.55	142.12	138.62	122.92	117.16	129.79	129.95	147.42	157.02	168.90	
$\Sigma(64)1...12 =$											1739.37	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

72.38	64.02	67.78	61.51	60.82	55.12	53.68	57.88	57.46	63.74	66.46	70.89	(65)
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Metabolic gains (Table 5)

133.33	133.33	133.33	133.33	133.33	133.33	133.33	133.33	133.33	133.33	133.33	133.33	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

45.85	40.73	33.12	25.07	18.74	15.82	17.10	22.23	29.83	37.88	44.21	47.13	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

291.04	294.06	286.45	270.25	249.80	230.58	217.73	214.71	222.33	238.53	258.98	278.20	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

50.55	50.55	50.55	50.55	50.55	50.55	50.55	50.55	50.55	50.55	50.55	50.55	(69)
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
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Losses e.g. evaporation (Table 5)

-88.88	-88.88	-88.88	-88.88	-88.88	-88.88	-88.88	-88.88	-88.88	-88.88	-88.88	-88.88	(71)
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Water heating gains (Table 5)

97.28	95.27	91.10	85.43	81.74	76.56	72.15	77.80	79.81	85.68	92.31	95.28	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

529.17	525.06	505.67	475.75	445.28	417.96	401.98	409.74	426.96	457.08	490.49	515.61	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
NorthWest	0.77	x 1.78	x 11.28	x 0.9 x 0.50	x 0.70	= 4.87	(81)
NorthEast	0.77	x 8.67	x 11.28	x 0.9 x 0.50	x 0.70	= 23.73	(75)

Solar gains in watts $\Sigma(74)m...(82)m$

28.60	58.21	104.88	172.24	231.53	246.84	230.91	184.08	127.80	71.14	35.98	23.35	(83)
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Total gains - internal and solar (73)m + (83)m

557.77	583.27	610.55	647.99	676.81	664.79	632.89	593.82	554.76	528.22	526.47	538.96	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.98	0.96	0.88	0.71	0.50	0.37	0.41	0.65	0.90	0.97	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.46	20.55	20.70	20.88	20.98	21.00	21.00	21.00	20.99	20.88	20.65	20.45	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.26	20.26	20.26	20.27	20.27	20.29	20.29	20.29	20.28	20.27	20.27	20.27	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.94	0.85	0.66	0.45	0.31	0.34	0.58	0.87	0.96	0.99	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.56	19.67	19.89	20.14	20.25	20.28	20.29	20.29	20.27	20.14	19.84	19.54	(90)
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Living area fraction

Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.01	20.12	20.30	20.51	20.62	20.64	20.65	20.65	20.64	20.52	20.25	20.00	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.01	20.12	20.30	20.51	20.62	20.64	20.65	20.65	20.64	20.52	20.25	20.00	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Utilisation factor for gains, ηm

0.98	0.97	0.94	0.86	0.69	0.48	0.34	0.38	0.62	0.88	0.96	0.98	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

547.40	567.03	576.65	555.39	464.38	317.43	213.03	222.79	341.65	463.13	507.43	530.57	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

864.10	833.92	753.65	624.03	477.59	318.34	213.10	222.92	346.52	531.02	708.96	857.38	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

235.62	179.35	131.69	49.42	9.83	0.00	0.00	0.00	0.00	50.51	145.10	243.15	
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Σ(98)1...5, 10...12 = 1044.68 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 15.14 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)

'0' if none 0.00 (301)

Fraction of space heat from community system

1 - (301) = 1.00 (302)

Fraction of community heat from boilers

1.00 (303a)

Fraction of total space heat from community boilers

(302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating

1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating

1.00 (305a)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

1044.68 (98)

Space heat from boilers

(98) x (304a) x (305) x (306) = 1096.92 (307a)

Water heating

Annual water heating requirement

1739.37 (64)

Water heat from boilers

(64) x (303a) x (305a) x (306) = 1826.33 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 29.23 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	426.28	(330a)
Total electricity for the above, kWh/year	426.28	(331)
Electricity for lighting (Appendix L)	323.91	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 3673.45	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1096.92	x	4.24	x 0.01 =	46.51	(340a)
Water heating from boilers	1826.33	x	4.24	x 0.01 =	77.44	(342a)
Pumps and fans	426.28	x	13.19	x 0.01 =	56.23	(349)
Electricity for lighting	323.91	x	13.19	x 0.01 =	42.72	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	342.90	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.26	(357)
SAP value	82.38	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO₂ emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	90.30					(367a)
CO ₂ emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) = 3237.27	x	0.216	=	699.25	(367)
Electrical energy for community heat distribution	29.23	x	0.519	=	15.17	(372)
Total CO ₂ associated with community systems					714.42	(373)
Total CO ₂ associated with space and water heating					714.42	(376)
Pumps and fans	426.28	x	0.519	=	221.24	(378)
Electricity for lighting	323.91	x	0.519	=	168.11	(379)
Total CO ₂ , kg/year				(376)..(382) =	1103.77	(383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	15.99	(384)
EI value					87.03	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	90.30					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) = 3237.27	x	1.22	=	3949.47	(367)
Electrical energy for community heat distribution	29.23	x	3.07	=	89.74	(372)
Total primary energy associated with community systems					4039.21	(373)
Total primary energy associated with space and water heating					4039.21	(376)
Pumps and fans	426.28	x	3.07	=	1308.69	(378)

Electricity for lighting	323.91	x	3.07	=	994.40	(379)
Primary energy kWh/year					6342.31	(383)
Dwelling primary energy rate kWh/m2/year					91.89	(384)

DRAFT

This design draft submission provides evidence towards compliance with Part L of the Building Regulations, in accordance with Appendix C of AD L1A. It has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the 'as built' property. This report covers only items included within the SAP and is not a complete report of regulations compliance.

Assessor name	Mr Jack Tinsley	Assessor number	9988
Client		Last modified	17/10/2019
Address	3 Caversham road 95, Reading, RG1 8JA		

Check	Evidence	Produced by	OK?																		
Criterion 1: predicted carbon dioxide emission from proposed dwelling does not exceed the target																					
TER (kg CO ₂ /m ² .a)	Fuel = N/A Fuel factor = 1.00 TER = 18.22	Authorised SAP Assessor																			
DER for dwelling as designed (kg CO ₂ /m ² .a)	DER = 18.19	Authorised SAP Assessor																			
Are emissions from dwelling as designed less than or equal to the target?	DER 18.19 < TER 18.22	Authorised SAP Assessor	Passed																		
Is the fabric energy efficiency of the dwelling as designed less than or equal to the target?	DFEE 44.2 < TFE 51.3	Authorised SAP Assessor	Passed																		
Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limits																					
Fabric U-values																					
Are all U-values better than the design limits in Table 2?	<table><tr><th>Element</th><th colspan="2">Weighted average Highest</th></tr><tr><td>Wall</td><td>0.15 (max 0.30)</td><td>0.15 (max 0.70)</td></tr><tr><td>Party wall</td><td>0.00 (max 0.20)</td><td>N/A</td></tr><tr><td>Floor</td><td>0.12 (max 0.25)</td><td>0.12 (max 0.70)</td></tr><tr><td>Roof</td><td>(no roof)</td><td></td></tr><tr><td>Openings</td><td>1.40 (max 2.00)</td><td>1.40 (max 3.30)</td></tr></table>	Element	Weighted average Highest		Wall	0.15 (max 0.30)	0.15 (max 0.70)	Party wall	0.00 (max 0.20)	N/A	Floor	0.12 (max 0.25)	0.12 (max 0.70)	Roof	(no roof)		Openings	1.40 (max 2.00)	1.40 (max 3.30)	Authorised SAP Assessor	Passed
Element	Weighted average Highest																				
Wall	0.15 (max 0.30)	0.15 (max 0.70)																			
Party wall	0.00 (max 0.20)	N/A																			
Floor	0.12 (max 0.25)	0.12 (max 0.70)																			
Roof	(no roof)																				
Openings	1.40 (max 2.00)	1.40 (max 3.30)																			
Thermal bridging																					
How has the loss from thermal bridges been calculated?	Thermal bridging calculated from linear thermal transmittances for each junction	Authorised SAP Assessor																			
Heating and hot water systems																					
Does the efficiency of the heating systems meet the minimum value set out in the Domestic Heating Compliance Guide?	Community heating scheme Secondary heating system: None	Authorised SAP Assessor	N/A																		
Does the insulation of the hot water cylinder meet the standards set out in the Domestic Heating Compliance Guide?	No hot water cylinder in the dwelling	Authorised SAP Assessor																			
Do controls meet the minimum controls provision set out in the Domestic Heating Compliance Guide?	Space heating control: Charging system linked to use, programmer and TRVs No hot water cylinder in the dwelling	Authorised SAP Assessor	Passed																		
Fixed internal lighting																					

Check	Evidence	Produced by	OK?
Does fixed internal lighting comply with paragraphs 42 to 44?	Schedule of installed fixed internal lighting Standard lights = 0 Low energy lights = 10 Percentage of low energy lights = 100% Minimum = 75 %	Authorised SAP Assessor	Passed
Criterion 3: the dwelling has appropriate passive control measures to limit solar gains			
Does the dwelling have a strong tendency to high summertime temperatures?	Overheating risk (June) = Not significant (20.01°) Overheating risk (July) = Slight (21.72°) Overheating risk (August) = Slight (21.47°) Region = Thames Thermal mass parameter = 250.00 Ventilation rate in hot weather = 2.00 ach Blinds/curtains = Light-coloured curtain or roller blind	Authorised SAP Assessor	Passed
Criterion 4: the performance of the dwelling, as designed, is consistent with the DER			
Design air permeability (m ³ /(h.m ²) at 50Pa)	Design air permeability = 3.00 Max air permeability = 10.00	Authorised SAP Assessor	Passed
Mechanical ventilation system Specific fan power (SFP)	Mechanical ventilation with heat recovery: SFP = 1.50 W/(litre/sec) Max SFP = 1.5 W/(litre/sec) Heat recovery efficiency = 90.00 % Min heat recovery efficiency = 70.00 %	Authorised SAP Assessor	Passed
Have the key features of the design been included (or bettered) in practice?	The following party walls have a U-value less than 0.2W/m²K: • party wall (0.00) The following floors have a U-value less than 0.13W/m²K: • Floor 1 (0.12) Design air permeability of 3 m³/(h.m²) is less than 4 m³/(h.m²) at 50 Pa	Authorised SAP Assessor	



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