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Energy Statement

Berkeley Homes (Southern) Ltd

Worthing Gasworks

Final

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Executive Summary

This Energy Statement has been prepared by Hodkinson Consultancy on behalf of Berkeley Homes (Southern) Limited (the Applicant) for the development at Land at Former Gas Works Site (Worthing Gasworks) pursuant to Condition 21 of the Planning Permission (ref AWDM/0083/24) dated 11th June 2024.

This report proposes an alternative energy strategy to that set out in the Energy Assessment (Revision 1.4 – dated 17th January 2024, Silcock Dawson & Partners) as it has since been concluded that a feasible and viable connection to the Worthing District Heating Network (DHN) cannot be demonstrated in line with Schedule 7 of the Section 106 Agreement.

The proposed energy strategy for the development at Worthing Gasworks has been formulated following the energy hierarchy: **Reduce Energy Demands, Supply Energy Efficiently, Use Renewable Energy**. The overriding objective is the formulation of a strategy which effectively balances a number of key elements, including CO₂ emissions, affordability of heat, and the provision of high-quality buildings. These elements need to work with the regulatory and planning requirements for the development.

It is proposed to change the approved heating strategy for the site from a connection to the Worthing DHN to individual Exhaust Air Heat Pump (EAHP) systems for each dwelling. EAHP will provide space heating, domestic hot water, ventilation and (where required) cooling to dwellings without the need for site-wide heat distribution infrastructure or offsite connections. For this development, EAHPs have been selected for the following reasons:

- > An estimated carbon reduction beyond Part L (2021) of 69%. In absolute terms this results in an estimated reduction in Regulated CO₂ emissions of almost 18 tonnes per year compared to the approved energy strategy.
- > Competitive lifecycle costs and resident energy costs.
- > Reduction of network heat losses and resultant overheating of corridors;
- > EAHP allow “air tempering” to reduce the risk of summer overheating.

Table i, below, summarises the anticipated site wide CO₂ emissions resulting from the proposed energy strategy. The application of the energy hierarchy results in an overall 69% reduction in Regulated CO₂ emissions over the Part L 2021 baseline.

Table ii, below, highlights that the application of the energy hierarchy to the development results in an estimated 53% reduction in delivered electricity and gas demands, representing exemplar energy efficiency performance.

The EAHP system providing space heating and domestic hot water will supply approximately 622,718kWh/yr of heat to the development, representing 90% of all Regulated energy demands, significantly exceeding the requirements of Part A of Policy DM17.

Table i: Regulated Carbon Dioxide Emissions Summary

	Carbon Dioxide Emissions	Carbon Dioxide Emissions Savings	
	(Tonnes CO ₂ per Annum)	(Tonnes CO ₂ per Annum)	%
Baseline: Part L 2021 Compliant Development	174		
Proposed Strategy	54	121	69%

Table ii: Regulated Energy Demands Summary

	Annual Fuel Energy Demands (kWh/yr)						Reduction	
	Space heating	Domestic hot water	Pumps and Fans	Lighting	Solar PV Generation	Total	kWh/yr	%
Part L 2021 Baseline	296,685	587,172	19,608	34,965	-147,682	790,748		
Proposed Strategy	68,155	232,480	29,854	41,213	-	371,702	419,046	53%

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1. INTRODUCTION

- 1.1** This Energy Statement has been prepared by Hodkinson Consultancy on behalf of Berkeley Homes (Southern) Limited (the Applicant) for the development at Land at Former Gas Works Site (Worthing Gasworks) pursuant to Condition 21 of the Planning Permission (ref AWDM/0083/24) dated 11th June 2024.
- 1.2** The energy strategy for the site has been formulated to address a number of key objectives and to provide an improvement on the consented energy strategy:
- > To provide comfortable high-quality homes that people aspire to live in;
 - > To address energy policy;
 - > To be low carbon from the outset, and to decarbonise in line with the electricity grid;
 - > To adapt to climate change; and
 - > To reduce resident energy costs.
- 1.3** A number of these objectives can compete with each other. This energy strategy and the development proposals seek to provide a sensible balance between all considerations.
- 1.4** This statement first establishes a baseline assessment of the energy demands and associated CO₂ emissions. The report will then follow energy hierarchy approach of **Reduce Energy Demands, Supply Energy Efficiently, Use Renewable Energy** to demonstrate CO₂ reductions against the Part L 2021 baseline.

2. DEVELOPMENT OVERVIEW

- 2.1** This document is in relation to the development at Worthing Gasworks covered by planning permission AWDM/0083/24, dated 11th June 2024, comprising:

“Full planning application for the demolition of existing structures, partial removal of boundary walls and the construction of a residential development spread across 5 blocks with associated access, parking, open space and landscaping.”



Figure 1: Site Location Plan – (ECE Architecture)

- 2.2** The consented scheme includes the provision of 228 residential dwellings across the 5 blocks.

Relevant Planning History

- 2.3** Full planning permission for the redevelopment of Worthing Gasworks was originally granted on 2nd October 2022 (Ref: AWDM/1459/21) and has subsequently been varied by planning permission AWDM/0083/24 as outlined above.
- 2.4** The energy strategy proposed within the Energy Statement submitted in support of the planning application AWDM/0083/24 included connection to the Worthing DHN which would supply heat to the site from a combination of air source heat pumps (ASHP) and gas boilers.

2.5 Condition 21 of the Decision Notice (ref: AWD/0083/24) stated:

“Energy & Water Efficiency

- i) The development hereby approved shall (unless alternatives are agreed in writing by the Local Planning Authority), incorporate sustainable energy and heat management measures, in accordance with the details in the submitted Energy Assessment (Revision V1.4 - dated 17th January 2024). If a feasible and viable connection to the District Heating Network cannot be demonstrated, prior to the commencement of development (excluding demolition, remediation works and groundworks) the Applicant must submit an alternative energy strategy to be approved by the Local Planning Authority in writing.*
- ii) Written confirmation, including independent professional verification, shall be submitted to and approved in writing by the Local Planning Authority, within 3 months of the first occupation of the development, (or such other time as shall first be agreed in writing by the Local Planning Authority), to confirm that measures have achieved the CO2 reduction targets set out in the Energy Assessment at i) above, or any approved alternative energy strategy, (which shall be not less than 20% CO2 reduction compared to Building Regulations Part L 2013) and that at least 10% of predicted total energy requirements would be met by renewable and low carbon energy sources, and confirming the installation of water good and fixtures to achieve a target of <105L/Person usage/day.”*

2.6 Schedule 7 of the Deed of Variation to the Section 106 Agreement between Worthing Borough Council (WBC), West Sussex County Council and St William Homes LLP included an obligation for the Applicant to use Reasonable Endeavours to connect the Development to the Worthing DHN. Paragraph 1.6 of Schedule 7 states:

“In the event that connection to the District Heating Network is not deemed viable and feasible by the parties taking into account the considerations of paragraph 1.1 and 1.2 of this Schedule, the Developer shall within 28 days therefore submit details of an alternative energy strategy to the Council for its written approval.”

2.7 It has since been concluded that a feasible and viable connection of the development to the Worthing DHN cannot be demonstrated. In line with the Section 106 and Condition 21, this report presents an alternative energy strategy for approval by Worthing.

Proposed Amendments

2.8 This Energy Statement seeks to vary the approved Energy Assessment (Revision 1.4 – dated 17th January 2024, Silcock Dawson & Partners) with the following proposed change:

- > Change of heating strategy for the site from a connection to the Worthing DHN to the use of exhaust air heat pumps (EAHP).

3. RELEVANT PLANNING POLICY

- 3.1 The following planning policies and requirements will inform the energy strategy for the proposed development.

National Policy: NPPF

- 3.2 The revised National Planning Policy Framework (NPPF) was published on the 12 December 2024 and sets out the Government's planning policies for England.
- 3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Resolution 42/187 of the United Nations General Assembly). These address social progress, economic well-being and environmental protection. At the heart of the framework is a **presumption in favour of sustainable development**.
- 3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:
- a) **An economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
 - b) **A social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
 - c) **An environmental objective** – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Regional Policy: Worthing Borough Council Local Plan (2020 - 2036)

- 3.5 The following policies are considered relevant to this energy strategy:

3.6 **Policy DM16 Sustainable Design, states:**

'a) All development (excluding householder applications) will be required to achieve the relevant minimum standards below unless superseded by national planning policy, Building Regulations or it

can be demonstrated that it is not practicable, feasible or viable (in which case the minimum standard should be met as far as is possible). Applications for major development must be supported by a Sustainability Statement demonstrating that the minimum standards are met and where possible exceeded. All development is encouraged to exceed these minimum standards where possible.

Towards Zero Carbon Development

b) All new build housing will achieve a minimum 20% CO₂ reduction compared to the Building Regulations Part L 2013 standard through energy efficiency measures, unless superseded by national policy or Building Regulations. Developers will be expected to provide evidence of the level of carbon reduction achieved in the dwellings through submission of SAP calculation reports at the design and built stages.

c) New non-domestic buildings will achieve a 27% reduction in CO₂ on average per building compared to the Building Regulations Part L 2013 standard unless superseded by national policy or Building Regulations. Applications for major development should demonstrate how the design and layout of the development has sought to maximise reductions in carbon emissions in line with the energy hierarchy.

d) All new build housing should seek to achieve an A rating (with a minimum expectation of B rating) Energy Performance Certificate. New housing should achieve a minimum of a 'C' rating Energy Performance Certificate.

e) All non-domestic properties (including those created through conversions) should achieve a 'B' rating Energy Performance Certificate.

f) Non residential development of at least 1,000 sqm floorspace should achieve BREEAM New Construction 'Very Good' as a minimum rating based on the latest BREEAM scheme.

3.7 Policy DM17 Energy, states:

'a) All new housing and major non-residential development should incorporate renewable and low carbon energy production equipment to meet at least 10% of predicted total energy requirements (after CO₂ reductions from energy efficiency measures).

b) All proposals for major development must demonstrate that the heating and cooling systems have been selected in accordance with the heating and cooling hierarchy and that the lowest carbon solution that is feasible is used. Applicants will be required to submit a feasibility assessment to provide a rationale for the chosen heating/cooling system.

c) Applicants for major development within areas identified as heat network opportunity clusters should demonstrate how they have considered connecting to district heating networks where:

i) they exist at the time of permission being granted;

ii) the heat network route lies adjacent to the site; and

iii) otherwise it is feasible and viable to do so. Alternatively, where a heat network route is planned but has not been delivered, sites adjacent to the planned heat network routes should consider being heat network ready to enable a future connection.

Policy Summary

Policy DM16

3.8 Approved Document Part L (2013) has been superseded by Part L (2021). This sets target emission rates that are equivalent to a 31% reduction over the Part L (2013) targets.

3.9 It is therefore proposed that by meeting the Part L 2021 target emission rate, compliance with Policy DM16 Part b is met demonstrated. This is in line with the consented Energy Assessment.

Policy DM17

3.10 As summarised in Section 2, Berkeley has concluded for this development that a connection to Worthing's DHN is not feasible and viable and therefore a departure from the heating hierarchy is justified.

3.11 This Energy Statement will therefore set out how the proposed EAHP system will contribute at least 10% of the site's predicted total energy requirements in accordance with Part A of the policy.

4. ASSESSMENT METHODOLOGY – BASELINE EMISSIONS

- 4.1** This statement first establishes a baseline assessment of the energy demands and associated CO₂ emissions for the development. The report will then follow the energy hierarchy approach of **Reduce Energy Demands, Supply Energy Efficiently, Use Renewable Energy**.
- 4.2** The estimated annual energy demand for dwellings has been calculated using Standard Assessment Procedure (SAP) 10.2 methodology. SAP calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items.
- 4.3** It is not considered relevant or appropriate to include Unregulated energy and CO₂ emissions data in this report as there is no nationally recognised methodology for calculating these and they are largely determined by occupant behaviour and choice over which the Applicant has very limited control.
- 4.4** The use of SAP 10.2 methodology is in line with guidance from Approved Document Part L (2021) which is the relevant guidance for the Development.
- 4.5** Calculations have been performed on all 228 dwellings on the site and are therefore an accurate prediction of the anticipated Regulated energy and CO₂ emissions for the site.

Baseline Emissions

- 4.6** A baseline calculation has been carried out to establish the Regulated CO₂ emissions to which this energy strategy will be compared against. Table 1 and Table 2 show the Part L 2021 Regulated baseline CO₂ emissions rates and energy demands respectively. TER data supporting these calculations are presented in Appendix A.

Table 1: Carbon Dioxide Emissions Baseline	
	(Tonnes CO ₂ per Annum)
Part L 2021 Baseline	174

Table 2: Baseline Regulated Energy Demands (kWh/yr)

	Space heating	Domestic hot water	Pumps and Fans	Lighting	Solar PV Generation	Total
Part L 2021 Baseline	296,685	587,172	19,608	34,965	- 147,682	790,748

5. REDUCE ENERGY DEMANDS

- 5.1** This section sets out the measures to be implemented to minimise energy demands, thereby locking in significant CO₂ reductions through a reduction in energy demands.

Insulation Standards

- 5.2** All dwellings will incorporate enhanced insulation in the building envelope (walls, roofs, floors and glazing) to achieve U-values which are likely to be similar to the following:
- > Glazing with a U-value of 1.2 W/m².K;
 - > External wall U-value of 0.15 – 0.23 W/m².K;
 - > Party walls will achieve an effective U-Value of 0.0 W/m².K;
 - > Floor U-values of 0.10 – 0.17W/m².K;
 - > Roof U-values of 0.10 - 0.17 W/m².K.

Air Tightness & Ventilation

- 5.3** Air tightness standards will conform to, and exceed, Approved Document Part L requirements. By reducing air leakage loss and convective bypass of insulation, an improvement of design air permeability rate from 8m³/h.m² to 3m³/h.m² or less for apartments will further reduce space heating requirements.
- 5.4** Parts L & F compliant (System 4) Mechanical Ventilation with Heat Recovery (MVHR) will be installed in all dwellings. These systems will remove stale air and odours from kitchens and wet rooms, whilst retaining the heat within the home, as shown in Figure 2, below. In this way substantial energy savings will be made. The MVHR system will be incorporated into the EAHP system which re-uses the recovered heat to provide heating and hot water.

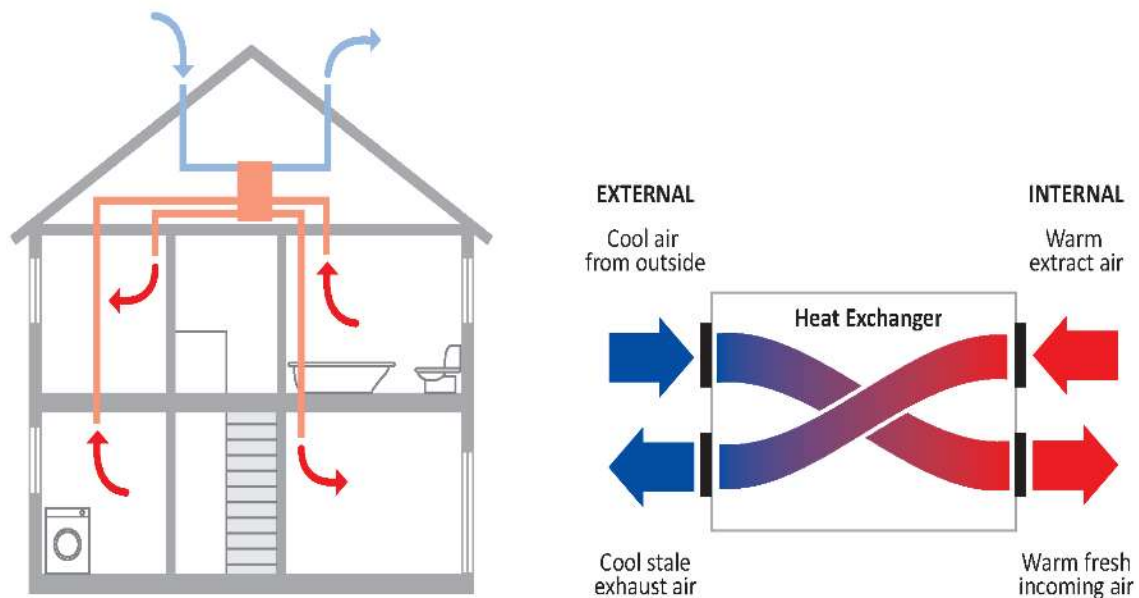


Figure 2: MVHR in operation.

- 5.5** Additionally, all homes will have openable windows and therefore the ability to naturally ventilate should the occupant desire.

Thermal Bridging

- 5.6** In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which occur when highly conductive elements (e.g. metal studs) in the wall construction enable a low resistance escape route for heat. The Applicant is committed to delivering a development which prioritises the conservation of energy through lean design and has therefore placed particular importance on the development of construction details which minimise the effect of thermal bridges.
- 5.7** Figure 3 below illustrates the benefits of reducing thermal bridges.

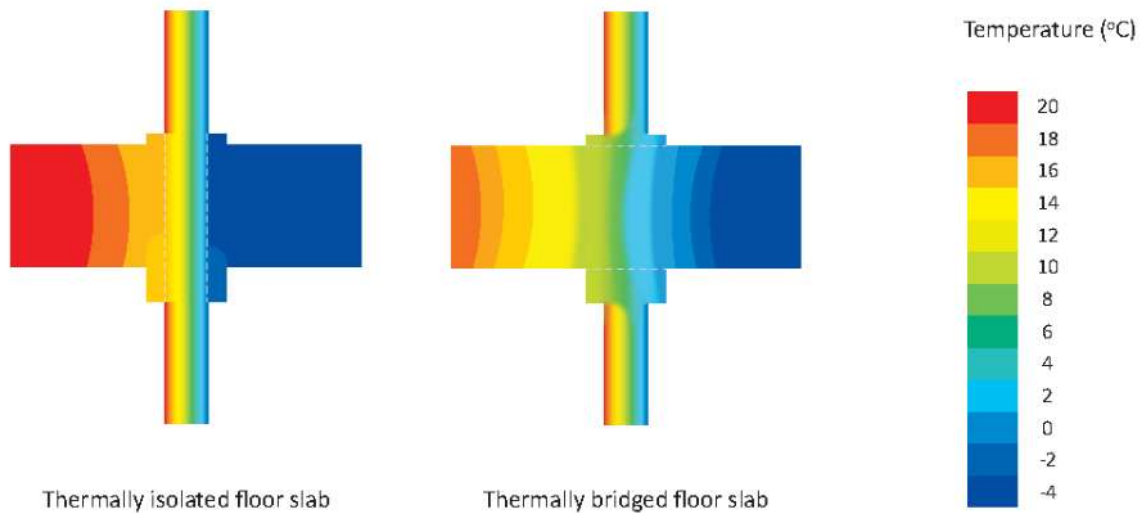


Figure 3: Thermal bridging.

- 5.8 Detailed modelling of all major junctions is to be undertaken at detailed design stage. The results of initial assessments will be used to inform the design process and further modelling will take place to identify areas for further improvement.

Space Heating & Hot Water

- 5.9 As is set out in Sections 6 and 7, heat pumps are proposed to be the predominant heating source for the development, but this does not change the notional dwelling specification or performance.

Lighting & Appliances

- 5.10 Energy efficient LED lighting will be installed in 100% of internal fittings in the homes.
- 5.11 It is very difficult to design and construct homes to reduce the unregulated electricity demands, because this is almost entirely dependent on the occupant of a home and can vary substantially. However, the Applicant is committed to ensuring that all efforts are made to enable the residents to minimise their unregulated electricity consumption.

Fabric Energy Efficiency

- 5.12 Table 3 shows the expected Part L 2021 Fabric Energy Efficiency Standard (FEES) following the proposed Be Lean measures which represents a very high standard of energy efficiency.

Table 3: Fabric Energy Efficiency

	Target Fabric Energy Efficiency (kWh/m²/year)	Design Fabric Energy Efficiency (kWh/m²/year)	Improvement (%)
Development Total	26.54	25.24	5%

6. SUPPLY ENERGY EFFICIENTLY

- 6.1 As summarised in Section 3, it has been concluded following detailed modelling that the most appropriate energy strategy for the site is the use of EAHPs in each apartment.

EAHP

Product and system details

- 6.2 As the design of the scheme has evolved the Applicant has garnered a greater understanding of EAHP products and their potential to further improve the site energy strategy and now seeks to amend the energy strategy in accordance with this document.
- 6.3 The Applicant has identified significant benefits of EAHP in comparison to heat network solutions and currently has a preference to use the Nilan Compact P EAHP (although flexibility to change the specific product following detailed Stage 4 design is needed, should there be supply chain issues or new and improved models available in the market).
- 6.4 The Compact P is an established Passivhaus approved system for space heating, domestic hot water, ventilation and air tempering (cooling). A concept schematic and image of the unit is included in Figure 4.
- 6.5 The unit is designed to fit entirely within the curtilage of each dwelling, using exhaust air to supply a heat pump capable of providing space heating and a limited amount of cooling via the supply air ductwork.
- 6.6 Heating via the ventilation system (warm air) eliminates the need for a wet heating system within each dwelling.
- 6.7 Domestic hot water is also provided via the integral heat pump, with a backup immersion heater rated at 1.5kW.
- 6.8 Ventilation is provided through balanced MVHR integral to the Nilan unit. Heat recovered from the extracted air is used either to preheat the supply air to the dwelling or to power the integral heat pump.
- 6.9 Cooling is also distributed through the ventilation ductwork. The output is limited to approximately 1.3kW and is not temperature controlled, so this unit is classed as 'peak lopping' rather than comfort cooling.



Figure 4: Nilan Compact P (www.nilan.uk.com)

User Experience

- 6.10** Adapting the energy strategy to utilise EAHPs will also improve the experience of residents, when compared with the consented heat network approach. In addition to lowering energy bills, EAHPs also cut down on the number of separate mechanical systems that need operating. Delivering all heating, hot water, and ventilation needs from the same system within the dwelling cuts down on servicing activities and should promote a more balanced indoor environment.
- 6.11** As the Nilan Compact P unit delivers supply air as well as extract, it is most akin to conventional MVHR and therefore also comes with the option of introducing an element of cooling into the dwellings. As this is integral to the unit its presence does not increase servicing costs, thereby making it a much more cost-effective means of tempering the supply air temperature than if delivered from a separate MVHR air tempering system.
- 6.12** As some of this cooling originates from extracting waste heat from the supply air and using it to heat the hot water cylinder, a portion of this cooling is essentially free. Should the occupant desire to open windows they can, as per with an MVHR, system. This could reduce the heat recovery element of the EAHP if external temperatures are significantly lower than the internal temperature. However, if this is the case, the occupant would be desiring lower internal temperature.
- 6.13** The Applicant has promoted overheating mitigation measures within the design, so reliance on the cooling element should be limited. Nonetheless, the climate is warming with projections set out in future CIBSE weather files (DSY 2&3). Providing high-density homes which remain comfortable in 2050 or indeed 2080 may require some form of cooling. Delivering it via an EAHP as opposed to a

purpose-built cooling (CHW) network or separate in-dwelling system is considered preferable, due to reduced running costs and simpler maintenance regimes.

- 6.14** The omission of heated pipework within corridors should also promote indoor comfort and will reduce the energy requirements within corridors to keep them suitably cool.

Summary

- 6.15** It has been identified that a well-selected EAHP product will deliver the following improvements:

- > Significant CO₂ reductions over Part L 2021;
- > Competitive lifecycle costs (including lower energy bills for residents);
- > Ability for residents to choose and change their energy supplier;
- > Reduced heat loss into, and potential need for cooling of, corridors;
- > Greater resident comfort (linked to overheating mitigation).

CO₂ Emissions at *Be Clean* Stage

- 6.16** The proposed heating strategy is the utilisation of an EAHP, which will be represented within the Be Green section of this document. As such the results for the ***Be Clean*** stage are the same as those for the ***Be Lean*** stage.

7. BE GREEN: RENEWABLE ENERGY TECHNOLOGIES

- 7.1** The final part of the Energy Hierarchy is **Be Green** which seeks for renewable energy technologies to be specified to provide, where feasible, a reduction in expected CO₂ emissions.
- 7.2** This section discusses the renewable technologies that are to be used for the proposed development.

Air Source Heat Pumps (including EAHP)

- 7.3** ASHPs generate heat via compression of a refrigerant which has extracted ambient heat from the external air. The compressive action raises the temperature of the refrigerant and allows it to provide heating.
- 7.4** The use of EAHP incorporates this low carbon technology combined with heat recovery. The use of individual EAHP for each dwelling allows the development to continue to decarbonise as the electricity grid decarbonises.

CO₂ Emissions following application of renewable energy

- 7.5** Table 4 and Table 5 below show the Regulated CO₂ reductions and Regulated Energy Demand reductions following the application of renewable energy measures. Summary DER and TER data supporting these calculations are shown in Appendix A.

Table 4: Regulated Carbon Dioxide Emissions following application of renewable energy measures			
	Carbon Dioxide Emissions	Carbon Dioxide Emissions Savings	
	(Tonnes CO ₂ per Annum)	(Tonnes CO ₂ per Annum)	%
Part L 2021 Baseline	174		
Proposed Strategy	54	121	69%

Table 5: Regulated Energy Demands following application of renewable energy measures								
	Annual Energy Demands (kWh/yr)						Reduction	
	Space heating	Domestic hot water	Pumps and Fans	Lighting	Solar PV Generation	Total	kWh/yr	%
Part L 2021 Baseline	296,685	587,172	19,608	34,965	-147,682	790,748		
Proposed Strategy	68,155	232,480	29,854	41,213	-	371,702	419,046	53%

8. SUMMARY

- 8.1 This Energy Statement has been prepared by Hodkinson Consultancy on behalf of Berkeley Homes (Southern) Limited for the development at Land at Former Gas Works Site (Worthing Gasworks) pursuant to Condition 21 of the Planning Permission (ref AWDM/0083/24) dated 11th June 2024.
- 8.2 This report proposes an alternative energy strategy to that set out in the Energy Assessment (Revision 1.4 – dated 17th January 2024, Silcock Dawson & Partners) as it has been concluded that a feasible and viable connection to the Worthing District Heating Network (DHN) cannot be demonstrated for this particular development.
- 8.3 The energy strategy for the development at Worthing Gasworks has been formulated following the energy hierarchy: **Reduce Energy Demands, Supply Energy Efficiently, Use Renewable Energy**. The overriding objective is the formulation of a strategy which effectively balances a number of key elements, including CO₂ emissions, affordability of heat, and the provision of high-quality buildings. These elements need to work with the regulatory and planning requirements for the development.
- 8.4 It is proposed to change the approved heating strategy for the site from a connection to the Worthing DHN to individual Exhaust Air Heat Pump (EAHP) systems for each dwelling. EAHP will provide space heating, domestic hot water, ventilation and (where required) cooling to dwellings without the need for site-wide heat distribution infrastructure or offsite connections. This option has been selected for the following key reasons:
- > Estimated carbon reduction beyond Part L (2021) of 69%.
 - > Competitive lifecycle costs and resident energy costs.
 - > Reduction of network heat losses and resultant overheating of corridors;
 - > EAHP allow “air tempering” to reduce the risk of summer overheating.
- 8.5 Table 6, below, summarises the anticipated site wide CO₂ emissions resulting from the proposed energy strategy. The application of the energy hierarchy results in an overall 69% reduction in Regulated CO₂ emissions over the Part L 2021 baseline.
- 8.6 Table 7, below, highlights that the application of the energy hierarchy to the development results in an estimated 53% reduction in delivered electricity and gas demands, representing exemplar energy efficiency performance. The EAHP system providing space heating and domestic hot water will supply approximately 622,718kWh/yr of heat to the development, representing 90% of all Regulated energy demands significantly exceeding the requirements of Policy DM17.

Table 6: Regulated Carbon Dioxide Emissions Summary

	Carbon Dioxide Emissions	Carbon Dioxide Emissions Savings	
	(Tonnes CO ₂ per Annum)	(Tonnes CO ₂ per Annum)	%
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APPENDICES

Appendix A: Energy and CO₂ Summary Table

APPENDIX A: ENERGY AND CO₂ SUMMARY TABLE

Plot	Floor area (sqm)	DER (kgCO2/sqm/yr)	TER (kgCO2/sqm/yr)	Total Regulated Dwelling Emissions (kgCO2/yr)	Total Regulated Target Emissions (kgCO2/yr)	% Improvement over Part L Target Emissions	Space heating Demand (kWh/yr)	Domestic Hot Water Demand (kWh/yr)	Pumps and fans demand (kWh/yr)	Lighting Demand (kWh/yr)	EAHP system energy delivered (%)
A01	55	4.56	14.54	249	794	69%	1,146	1,873	129	160	91%
A02	74	3.44	11.72	254	865	71%	760	2,139	132	222	89%
A03	76	3.47	11.76	262	888	70%	858	2,159	129	229	89%
A04	57	4.07	13.41	232	766	70%	825	1,912	129	163	90%
A05	52	3.69	12.24	190	632	70%	258	1,827	140	148	88%
A06	52	3.78	12.75	195	658	70%	330	1,827	138	148	88%
A07	67	4.02	11.52	268	767	65%	1,165	2,048	119	206	91%
A08	64	4.43	12.47	284	801	64%	1,545	2,015	116	184	92%
A09	64	4.34	12.28	279	788	65%	1,442	2,015	115	184	92%
A10	51	4.69	13.37	238	680	65%	1,083	1,816	126	145	91%
A11	51	4.69	13.37	238	680	65%	1,083	1,816	126	145	91%
A12	68	4.36	12.84	295	869	66%	1,638	2,063	116	195	92%
A13	62	3.88	11.88	241	738	67%	818	1,986	134	180	90%
A14	74	3.08	9.92	227	732	69%	307	2,139	141	221	87%
A15	76	3.13	10.15	236	767	69%	427	2,159	137	227	88%
A16	57	3.64	11.65	208	665	69%	403	1,912	137	163	89%
A17	52	3.66	10.68	189	551	66%	230	1,827	141	148	88%
A18	52	3.63	10.98	187	567	67%	205	1,827	141	148	88%
A19	67	3.14	9.64	209	642	67%	171	2,048	138	206	87%
A20	64	3.82	12.75	245	819	70%	864	2,015	127	184	90%
A21	64	3.74	12.58	240	808	70%	777	2,015	126	184	90%
A22	51	3.84	11.53	195	586	67%	346	1,816	141	145	88%
A23	51	3.8	11.53	193	586	67%	306	1,816	142	145	88%
A24	68	3.45	10.98	234	743	69%	574	2,063	134	195	89%
A25	62	3.39	10.82	211	672	69%	311	1,986	144	180	88%
A26	74	3.08	9.92	227	732	69%	307	2,139	141	221	87%
A27	76	3.11	10.15	235	767	69%	401	2,159	138	227	88%
A28	57	3.64	11.65	208	665	69%	403	1,912	137	163	89%
A29	52	3.66	10.68	189	551	66%	230	1,827	141	148	88%
A30	52	3.61	10.93	186	564	67%	185	1,827	142	148	87%
A31	67	3.35	10.87	223	723	69%	416	2,048	133	198	88%
A32	51	3.89	12.88	198	655	70%	402	1,816	139	142	89%
A33	51	3.84	11.53	195	586	67%	346	1,816	141	145	88%
A34	68	3.91	13.48	265	913	71%	1,106	2,063	125	195	91%
A35	62	3.8	13.01	236	808	71%	732	1,986	136	180	90%
A36	74	3.46	12.13	255	895	71%	792	2,139	131	221	89%
A37	76	3.58	12.82	270	969	72%	1,009	2,159	126	227	90%
A38	57	4.14	14.43	236	824	71%	888	1,912	127	163	91%
A39	52	3.72	12.53	192	647	70%	280	1,827	139	148	88%
A40	52	3.64	10.93	188	564	67%	215	1,827	141	148	88%
A41	67	3.76	13.47	250	896	72%	884	2,048	122	199	90%
A42	57	4.29	14.92	243	846	71%	1,031	1,905	122	161	91%
A43	51	4.46	15.96	227	812	72%	883	1,816	132	142	91%
A44	64	4.21	15.25	270	977	72%	1,302	2,014	116	184	92%
B01	56	4.2	14.18	235	794	70%	903	1,895	125	161	91%
B02	55	4.08	14.17	222	773	71%	711	1,872	134	155	90%
B03	68	4.23	14.41	289	986	71%	1,525	2,073	117	197	92%
B04	67	4.31	14.45	290	971	70%	1,557	2,057	116	194	92%
B05	68	3.8	12.65	260	866	70%	1,010	2,073	125	197	91%
B06	68	3.72	12.55	255	859	70%	916	2,073	127	197	90%
B07	55	4.04	12.97	220	707	69%	675	1,872	134	155	90%
B08	68	4.45	13.85	304	946	68%	1,789	2,071	106	197	93%
B09	68	3.59	12.09	245	826	70%	785	2,071	122	197	90%
B10	55	3.74	12.49	204	681	70%	402	1,872	139	155	89%
B11	68	3.8	12.65	260	866	70%	1,010	2,073	125	197	91%
B12	68	3.72	12.55	255	859	70%	916	2,073	127	197	90%
B13	55	3.8	12.64	207	689	70%	455	1,872	138	155	89%
B14	68	3.37	11.57	230	790	71%	533	2,071	127	197	89%
B15	68	3.23	11.09	221	757	71%	357	2,071	132	197	88%
B16	55	3.74	12.49	204	681	70%	402	1,872	139	155	89%
B17	68	3.8	12.65	260	866	70%	1,010	2,073	125	197	91%
B18	68	3.72	12.55	255	859	70%	916	2,073	127	197	90%
B19	55	3.8	12.64	207	689	70%	455	1,872	138	155	89%
B20	68	3.37	11.57	230	790	71%	533	2,071	127	197	89%
B21	68	3.23	11.09	221	757	71%	357	2,071	132	197	88%
B22	55	3.74	12.49	204	681	70%	402	1,872	139	155	89%
B23	68	3.8	12.65	260	866	70%	1,010	2,073	125	197	91%
B24	68	3.72	12.55	255	859	70%	916	2,073	127	197	90%
B25	55	3.8	12.64	207	689	70%	455	1,872	138	155	89%
B26	68	3.37	11.57	230	790	71%	533	2,071	127	197	89%
B27	68	3.33	11.51	227	786	71%	485	2,071	128	197	89%

B28	55	3.74	12.49	204	681	70%	402	1,872	139	155	89%
B29	68	3.8	12.65	260	866	70%	1,010	2,073	125	197	91%
B30	68	3.72	12.55	255	859	70%	916	2,073	127	197	90%
B31	55	3.8	12.64	207	689	70%	455	1,872	138	155	89%
B32	68	3.37	11.57	230	790	71%	533	2,071	127	197	89%
B33	68	3.35	11.46	229	783	71%	500	2,071	128	197	89%
B34	55	3.74	12.49	204	681	70%	402	1,872	139	155	89%
B35	68	4.28	14.96	293	1,024	71%	1,580	2,073	116	197	92%
B36	68	4.19	14.86	287	1,017	72%	1,475	2,073	117	197	92%
B37	55	4.02	13.91	219	759	71%	658	1,872	135	155	90%
B38	68	3.72	13.62	254	930	73%	942	2,071	118	197	91%
B39	68	3.72	13.62	254	930	73%	942	2,071	118	197	91%
B40	55	3.98	13.81	217	753	71%	618	1,872	135	155	90%
B41	63	4.87	16.63	306	1,044	71%	1,942	1,996	108	180	93%
B42	63	4.78	16.5	300	1,036	71%	1,854	1,996	109	180	93%
B43	69	4.14	14.9	286	1,030	72%	1,473	2,082	106	199	92%
B44	69	4.01	14.7	277	1,016	73%	1,326	2,082	108	199	92%
C01	45	4.6	15.34	209	697	70%	697	1,733	136	133	90%
C01	74	3.63	11.92	269	884	70%	1,055	2,143	119	216	91%
C01	66	3.78	12.59	248	827	70%	894	2,036	125	186	90%
C01	42	4.52	15.08	192	640	70%	484	1,689	141	123	89%
C01	52	3.99	13.19	206	682	70%	508	1,829	137	148	89%
C01	70	3.43	11.18	239	779	69%	608	2,089	129	211	89%
C01	72	3.77	12.78	271	920	71%	1,153	2,118	117	202	91%
C01	68	4.08	13.55	276	916	70%	1,319	2,062	121	188	92%
C01	42	4.92	15.88	205	661	69%	719	1,677	138	120	90%
C01	45	4.23	13.3	192	604	68%	412	1,733	142	133	89%
C01	74	3.2	10.33	237	766	69%	525	2,143	128	209	89%
C01	66	3.41	10.86	224	713	69%	380	2,036	135	227	87%
C01	42	4.59	12.98	195	551	65%	526	1,689	141	125	89%
C01	52	3.83	11.43	198	591	66%	349	1,829	141	157	88%
C01	70	3	9.42	209	657	68%	105	2,089	141	211	86%
C01	72	3.21	10.87	231	782	70%	460	2,118	130	202	89%
C01	68	3.52	11.67	238	789	70%	670	2,062	131	188	90%
C01	42	4.62	13.1	192	545	65%	508	1,677	142	122	89%
C01	74	4.11	12.07	304	892	66%	1,641	2,141	112	218	92%
C01	70	4.44	13.41	309	932	67%	1,870	2,087	107	193	93%
C01	45	4.28	13.3	194	604	68%	453	1,733	141	133	89%
C01	74	3.22	10.37	239	769	69%	529	2,143	128	216	89%
C01	66	3.43	10.86	225	713	68%	401	2,036	134	227	87%
C01	42	4.55	13.16	193	559	65%	504	1,689	141	123	89%
C01	52	3.88	11.43	201	591	66%	392	1,829	140	157	88%
C01	70	3.02	9.68	211	675	69%	135	2,089	140	211	86%
C01	72	3.85	13.83	277	995	72%	1,253	2,118	116	202	91%
C01	68	4.08	14.45	276	977	72%	1,326	2,062	120	188	92%
C01	42	5.61	17.91	234	746	69%	1,200	1,677	132	122	92%
C01	74	2.94	9.62	217	711	69%	169	2,141	139	218	87%
C01	70	3.82	12.3	266	855	69%	1,115	2,087	117	193	91%
C01	45	4.34	13.3	197	604	67%	497	1,733	140	133	89%
C01	74	3.22	10.37	239	769	69%	529	2,143	128	216	89%
C01	66	3.43	10.86	225	713	68%	401	2,036	134	227	87%
C01	42	4.61	13.16	196	559	65%	546	1,689	140	123	89%
C01	52	3.88	11.43	201	591	66%	392	1,829	140	157	88%
C01	70	3.28	10.53	229	734	69%	433	2,089	134	211	88%
C01	74	3.05	10.16	225	751	70%	304	2,141	136	218	87%
C01	70	3.82	12.3	266	855	69%	1,115	2,087	117	193	91%
C01	45	4.72	15.84	214	720	70%	785	1,733	135	133	90%
C01	74	3.68	13.02	273	965	72%	1,110	2,143	117	216	91%
C01	66	3.91	13.48	257	886	71%	941	2,036	124	227	89%
C01	42	4.99	15.5	212	658	68%	812	1,689	137	125	91%
C01	52	4.27	13.7	221	708	69%	731	1,829	134	157	90%
C01	70	3.76	12.98	262	905	71%	1,000	2,089	124	211	90%
C01	74	3.45	12.51	255	925	72%	794	2,141	126	218	90%
C01	70	3.93	13.93	273	969	72%	1,252	2,087	114	193	92%
C01	39	5.5	18.4	214	716	70%	959	1,639	136	103	92%
C02	69	3.79	12.65	260	868	70%	1,006	2,075	124	198	91%
D03	68	3.91	13.1	264	885	70%	1,093	2,061	125	195	91%
D03	40	4.74	15.54	188	615	69%	499	1,648	142	106	90%
D03	47	4.31	14.55	201	679	70%	536	1,751	143	130	89%
D03	70	3.61	11.73	254	825	69%	841	2,098	130	210	90%
D03	73	3.24	11.02	237	807	71%	498	2,133	131	225	88%
D03	44	4.15	13.88	184	617	70%	333	1,718	142	124	89%
D03	70	3.68	12.51	259	880	71%	920	2,097	127	214	90%
D03	47	4.87	15.5	229	728	69%	1,000	1,756	136	131	91%
D03	104	3.44	11.27	357	1,171	69%	2,281	2,368	164	285	91%
D03	91	3.09	9.8	282	894	68%	894	2,300	174	271	88%
D03	97	3.2	10.3	309	994	69%	1,417	2,333	157	269	90%
C01	70	4.26	13.16	296	915	68%	1,633	2,087	110	201	92%
C02	69	3.64	11.28	251	779	68%	852	2,081	127	199	90%

D16	69	3.34	11.13	229	763	70%	504	2,075	132	191	89%
D17	68	3.39	11.35	229	767	70%	523	2,061	132	187	89%
D18	40	4.97	14.72	197	582	66%	626	1,648	141	114	90%
D19	47	4.22	12.67	197	591	67%	458	1,751	142	137	89%
D20	70	3.14	9.92	221	698	68%	279	2,098	141	210	87%
D21	73	2.89	9.22	212	675	69%	91	2,133	139	217	86%
D22	45	4.23	12.06	190	542	65%	395	1,726	141	134	89%
D23	70	3.26	10.85	229	763	70%	432	2,097	133	210	88%
D24	47	4.35	13.49	204	633	68%	591	1,756	139	131	90%
D25	70	3.58	11.41	249	793	69%	829	2,087	122	193	90%
D26	69	3.08	9.78	213	675	69%	204	2,081	138	196	87%
D27	69	4.03	13.8	276	946	71%	1,313	2,075	118	190	92%
D28	68	4.21	14.16	284	956	70%	1,469	2,061	116	187	92%
D29	40	4.79	16.46	189	651	71%	510	1,648	142	114	89%
D30	47	4.31	12.98	201	605	67%	523	1,751	142	137	89%
D31	70	3.66	10.46	257	735	65%	923	2,097	125	202	90%
D32	73	3.81	11.38	279	833	67%	1,233	2,133	116	217	91%
D33	45	4.23	12.06	190	542	65%	395	1,726	141	134	89%
D34	70	3.22	10.71	226	753	70%	393	2,097	133	210	88%
D35	47	4.35	13.49	204	633	68%	591	1,756	139	131	90%
C00	77	5.13	11.45	394	879	55%	3,095	2,173	101	221	94%
D37	69	4.92	11.23	339	774	56%	2,356	2,079	105	199	94%
D38	70	3.58	11.41	249	793	69%	829	2,087	122	193	90%
D39	69	3.04	9.87	210	681	69%	160	2,081	140	196	87%
D40	67	3.36	11.31	227	763	70%	487	2,060	133	188	89%
D41	41	4.81	13.89	199	576	65%	621	1,675	142	122	90%
D42	45	4.11	13.43	185	603	69%	313	1,726	142	131	88%
D43	70	3.61	13.1	254	921	72%	845	2,097	124	214	90%
D44	47	4.35	13.49	204	633	68%	591	1,756	139	131	90%
D45	69	4.2	14.51	291	1,007	71%	1,574	2,085	109	192	92%
D46	69	3.63	12.81	251	884	72%	868	2,081	121	191	90%
D47	67	3.95	14.11	267	952	72%	1,167	2,060	122	188	91%
D48	51	4.22	14.9	215	760	72%	649	1,818	137	153	89%
D49	85	3.6	13.32	306	1,132	73%	1,539	2,252	115	231	92%
D50	45	4.9	16.36	218	729	70%	897	1,720	135	122	91%
E01	68	3.56	11.08	242	752	68%	703	2,066	128	201	89%
E02	74	3.67	11.99	272	890	69%	1,076	2,144	120	224	90%
E03	68	3.8	11.92	260	814	68%	998	2,072	120	203	90%
E04	77	3.26	9.6	251	738	66%	660	2,174	122	233	89%
E05	50	3.99	12.17	201	614	67%	479	1,809	131	144	89%
E06	52	4.28	13.07	221	674	67%	758	1,826	131	148	90%
E07	64	3.81	12.06	245	775	68%	862	2,017	122	185	90%
E08	64	3.81	12.06	245	775	68%	862	2,017	122	185	90%
E09	52	4.66	13.87	240	715	66%	1,090	1,826	126	148	91%
E01	40	4.87	15.91	195	636	69%	617	1,654	136	107	90%
E11	92	2.92	9.01	268	827	68%	715	2,304	173	240	88%
E12	99	2.99	9.93	297	985	70%	1,262	2,347	154	241	90%
E13	52	3.67	11.19	189	577	67%	232	1,826	141	148	88%
E14	64	3.22	10.25	207	659	69%	227	2,017	137	185	87%
E15	64	3.22	10.25	207	659	69%	227	2,017	137	185	87%
E16	52	3.64	11.04	188	569	67%	203	1,826	142	148	87%
E17	61	4.71	14.21	289	871	67%	1,678	1,974	116	178	93%
E18	68	3.04	9.26	206	629	67%	105	2,066	143	201	86%
E19	74	3.04	10.02	226	743	70%	283	2,144	136	224	87%
E20	68	3.11	9.89	213	676	69%	212	2,072	135	203	87%
E21	77	2.8	7.8	215	600	64%	64	2,174	139	233	86%
E22	50	3.54	10.56	179	533	66%	95	1,809	142	144	87%
E23	52	3.67	11.19	189	577	67%	232	1,826	141	148	88%
E24	64	3.22	10.25	207	659	69%	227	2,017	137	185	87%
E25	64	3.22	10.25	207	659	69%	227	2,017	137	185	87%
E26	52	3.69	10.71	190	552	66%	242	1,826	141	148	88%
E27	61	3.49	11.5	214	705	70%	400	1,974	136	178	88%
E28	68	3.04	9.26	206	629	67%	105	2,066	143	201	86%
E29	74	3.04	10.02	226	743	70%	283	2,144	136	224	87%
E30	68	3.26	10.41	223	711	69%	379	2,072	131	203	88%
E31	77	3.02	9.73	232	748	69%	353	2,174	129	233	87%
E32	50	3.54	10.56	179	533	66%	95	1,809	142	144	87%
E33	68	5.01	12.27	340	834	59%	2,412	2,067	106	198	94%
E34	76	4.71	11.42	356	863	59%	2,582	2,160	100	181	94%
E35	52	4.06	13.52	209	697	70%	567	1,826	134	148	89%
E36	64	3.59	13.06	231	840	73%	620	2,017	128	185	89%
E37	64	3.59	13.06	231	840	73%	620	2,017	128	185	89%
E26	52	3.75	13.01	193	671	71%	298	1,826	139	148	88%
E39	61	4.01	14.85	246	911	73%	939	1,974	126	178	91%
E40	68	3.3	11.63	224	789	72%	397	2,066	134	201	88%
E41	74	3.48	13.18	258	978	74%	834	2,144	124	224	90%
E42	61	3.79	14.06	232	859	73%	703	1,971	127	179	90%
E43	50	4.14	14.7	208	738	72%	601	1,806	128	140	90%
Total	14,236			53,683	174,212	69%	171,288	451,430	29,854	41,213	90%