



Tower Terrace

Energy & Overheating
Statement

June 2026

CONTENTS

1	Executive Summary	3
2	Policy Framework	4
3	Energy Calculations – <i>Be Lean</i>	8
4	Overheating	11
5	Decentralised Energy – <i>Be Clean</i>	14
6	Renewable Energy – <i>Be Green</i>	15
7	Energy Monitoring – <i>Be Seen</i>	18
8	Water Efficiency	19
9	Conclusion	20

Appendices

- Appendix 1 – Carbon Emissions Spreadsheet
- Appendix 2 – SAP Calculations – *Be Lean*
- Appendix 3 – SAP Calculations – *Be Green*
- Appendix 4 – Air Source Heat Pump Datasheet

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1 Executive Summary

NRG Consulting have been commissioned to undertake an Energy Statement on a proposed development on **land to the rear of 17 Tower Terrace, Haringey, N22 6SX**.

The description of development is:

Demolition of existing structures and redevelopment of the site to create one new home including access and associated works

This document illustrates a reduction in CO₂ emissions via:

Energy Efficiency – *Be Lean*

- U-Values have been set to maximise fabric efficiency and reduce energy demand.
- High efficiency LED lighting will be provided to all fittings.
- Mechanical ventilation with heat recovery is proposed.
- A very low Air Permeability rate will be sought.

Decentralised Energy – *Be Clean*

A feasibility of the potential for the scheme to connect to decentralised energy sources has been undertaken as per *Policy SI 3 - Energy Infrastructure* of the London Plan. As there are no viable district networks, the scheme will have individual heating.

Renewable Energy – *Be Green*

The on-site provision of renewable energy has been prioritised and following a feasibility review, the following technologies will be provided:

- Air Source Heat Pump

Overall, the scheme achieves a CO₂ reduction over that of Part L 2021 and exceeds the benchmark reduction target as per the GLA guidance.

	CO ₂ Emissions (Tonnes per Annum)
	Residential
Baseline: Part L 2021	2.8
<i>Be Lean: Use Less Energy</i>	2.2
<i>Be Clean: Supply Energy Efficiently</i>	2.2
<i>Be Green: Use Renewable Energy</i>	0.6
CO₂ Savings at <i>Be Green</i> over Part L 2021	77.1%
Table: Carbon Emissions Table	

2 Policy Framework

The proposed development is classified as a **minor** development.

2.1 National Planning Policy Framework (NPPF) (2024)

Climate Change as a Material Consideration:

Paragraph 11: "Plans and decisions should apply a presumption in favour of sustainable development. For plan-making this means that: a) all plans should promote a sustainable pattern of development that seeks to: meet the development needs of their area; align growth and infrastructure; improve the environment; mitigate climate change (including by making effective use of land in urban areas) and adapt to its effects."

Paragraph 161: "The planning system should support the transition to net zero by 2050 and take full account of all climate impacts including overheating, water scarcity, storm and flood risks and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Paragraph 7: "The purpose of the planning system is to contribute to the achievement of sustainable development."

Emphasis on Renewable Energy Projects:

Paragraph 168: "When determining planning applications for renewable and low carbon development, local planning authorities should: a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and b) approve the application if its impacts are (or can be made) acceptable."

2.2 Regional Policy – The London Plan (March 2021)

The London Plan sets out high-end goals for the whole of London based on the energy hierarchy. It also states that its overarching goal is for London to become a net zero-carbon city. This will require reduction of all greenhouse gases, of which carbon dioxide is the most prominent.

Local Boroughs should ensure that all developments maximise opportunities for on-site electricity and heat production and reduce carbon emissions in-line with the stages of the energy hierarchy. In-line with the Zero Carbon Policy, all CO₂ emissions should be offset via a mixture of on-site and off-site measures.

The policies within The London Plan relevant to this assessment are:

- Policy SI 2 Minimising greenhouse gas emissions
- Policy SI 3 Energy Infrastructure
- Policy SI 4 Managing heat risk

In line with the London Plan, major developments are expected to achieve net zero-carbon by following the energy hierarchy:

- **Be Lean:** use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures
- **Be Clean:** exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks
- **Be Green:** maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
- **Be Seen:** monitor, verify and report on energy performance through the Mayor's post construction monitoring platform.

2.3 Regional Policy – GLA Energy Assessment Guidance (June 2022)

On 15th June 2022, with the implementation of Part L of the Building Regulations (2021) and SAP 10.2 a new GLA guidance note was released to supersede the April 2020 guidance.

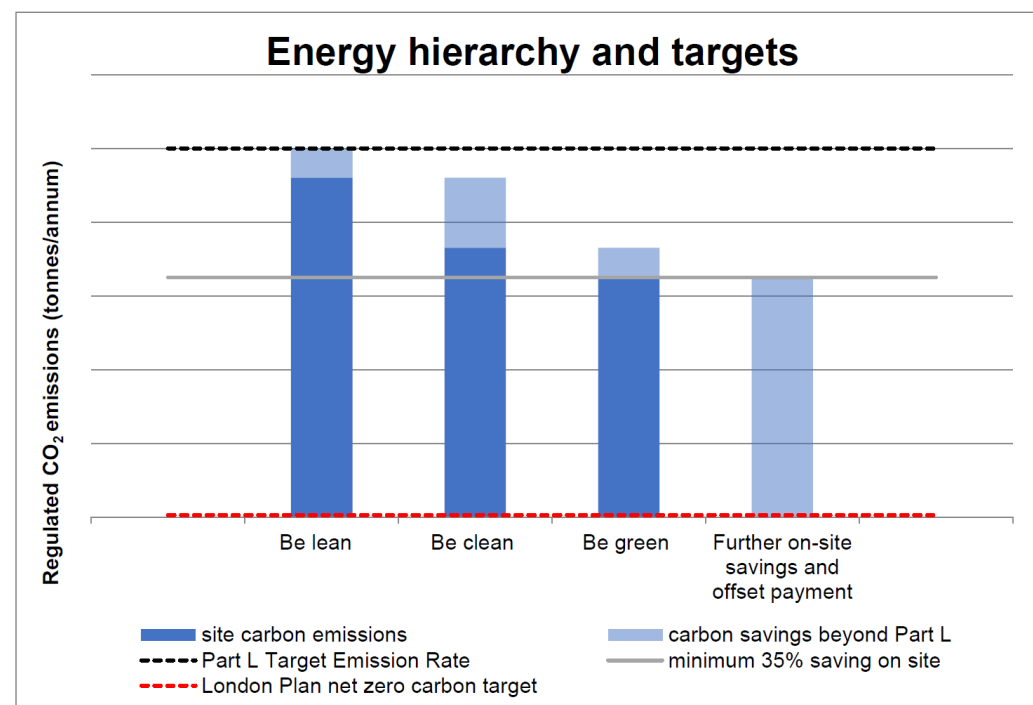
The main clarification within the June 2022 guidance was to confirm that the minimum expected carbon reduction on-site was to remain at 35% better than Part L 2021; the same target as the previous Building Regulation version.

A new benchmark target of 50% better than Part L 2021 was introduced for residential developments. The cover notes for the new version states:

The Mayor's net zero carbon target for major developments

The updated guidance confirms that all major developments in London must continue to meet the London Plan net zero carbon target by following the energy hierarchy (Policy SI 2), the heating hierarchy (Policy SI 3) and by maximising on-site carbon reductions. Planning applicants will be expected to demonstrate that at each stage of the energy hierarchy they have maximised opportunities for carbon reduction to achieve as close to zero as possible.

An on-site carbon reduction of at least 35 per cent beyond Part L 2021 of building regulations should be achieved. Once it has been demonstrated that carbon reductions have been maximised, any remaining emissions to zero should be offset by a contribution to the relevant borough's carbon offset fund.



2.4 Local Policy

Haringey's Local Plan – Strategic Policies (2013-2026)

London Borough of Haringey's Local Plan Strategic Policies (2013 with 2017 updates) set out the vision for the Borough until 2026. The following policies represent some of the key minimum planning requirements

- SP4 - Working towards a Low Carbon Haringey
- SP5 - Water Management and Flooding
- SP6 - Waste and Recycling
- SP7 - Transport
- SP13 - Open Space and Biodiversity
- SP14 - Health and Wellbeing

Emerging Local Plan

The London Borough of Haringey is currently in the process of updating its Local Plan, intended to be implemented in 2026. The New Local Plan document includes this statement on Climate change and sustainability:

The existing Local Plan (2017) requires all new development to be net zero carbon. We propose keeping this target and supporting it with a more comprehensive and ambitious set of policies designed to promote net zero on-site.

These include achieving more on or near site carbon emission reductions, addressing unregulated carbon emissions and measuring emissions.

Development Management DOD (2017)

Policy DM21 - Sustainable Design, Layout and Construction.

A All new development, including building and landscape works, will be expected to consider and implement sustainable design, layout and construction techniques. Proposals should:

- a Apply the energy hierarchy to minimise energy use in order to meet, and if possible exceed, minimum carbon dioxide reduction requirements;
- b Apply the cooling hierarchy to reduce the potential for overheating and limit reliance on mechanical air conditioning systems;
- c Maximise opportunities to enhance biodiversity on-site, including through appropriate landscaping, Sustainable Drainage Systems, living roofs and green walls
- d Wherever possible, use building materials with high environmental performance ratings; and

C Proposals that fail to demonstrate adequate consideration for sustainable design, layout and construction techniques will be resisted.

D Consideration will be given to the use of carbon offset payments, to be secured by planning obligations, where it can be demonstrated that proposals are unable to meet carbon dioxide emission reduction targets on-site.

Declaration of Climate Emergency

Following its declaration of a Climate Emergency, Haringey Council revisited their initial action plan and is aiming to be Net Zero carbon by 2041. In March 2021, Haringey's Cabinet voted unanimously to adopt the Haringey Climate Change Action Plan (CCAP). One of the Plan's key objectives is:

H6 - Achieve zero carbon in new and redeveloped homes on site

Ensuring new homes are built to the highest fabric and energy efficiency standards the first-time round, will avoid these homes needing to be retrofitted in the future.

2.5 Part L of the Building Regulations (2021)

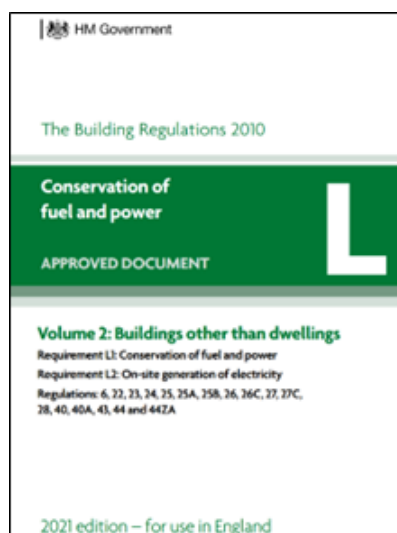
In July 2018 the then Department for Business Energy & Industrial Strategy (BEIS) published their proposed update to SAP 9.92 (Part L 2013), called SAP 10.

In June 2022, Part L 2021 of the Building Regulations came into force. As per the requirements, all new homes must produce 31% less CO₂ emissions than that of Part L 2013 in-order to achieve Building Regulation compliance.

One of the major change in the regulations was the change in carbon factor of electricity to represent the decarbonisation of the National Grid and the push towards net-zero carbon developments.

Part L 2021 also introduced three targets for Part L compliance:

- TER Target Emission Rate
- TPER Target Primary Energy Rate
- TFEE Target Fabric Energy Efficiency



2.6 The Future Homes and Buildings Standard

In October 2019, the then Ministry of Housing, Communities and Local Government (MHCLG) issued a consultation on changes to Part L. Dubbed *The Future Homes Standard*, it was an aspiration to ensure all new homes will have low carbon heating and “world-leading levels of energy efficiency” by 2025 and was intended to be the primary driver in achieving the net-zero carbon commitment made by the Government.

On 13th December 2023, consultation documents were issued by the Department for Levelling Up, Housing and Communities for *The Future Homes and Buildings Standard*. While still at a consultation age, this document details potential scenarios in how new build dwellings and buildings in the UK will become *net-zero ready*.

A separate consultation was published to discuss the withdrawal of the Standard Assessment Procedure (SAP) and replace it with a Home Energy Model (HEM).

Key points within the consultation document are:

- Removal of Gas Boilers from the Notional Dwelling Specification and;
- Fossil fuel-powered boilers in new buildings will be prohibited from 2025
- Further reduction in the carbon factor of electricity as the grid-decarbonises.
- Hybrid & hydrogen-ready boilers “will not meet the proposed standards”
- No major changes to M&E or Fabric requirements from Part L 2021.

Fuel	Part L 2013 (kg/CO ₂ /kWh)	Part L 2021 (kg/CO ₂ /kWh)	Part L 2025 (kg/CO ₂ /kWh)	Percentage Reduction
Electricity	0.519	0.136	0.086	83.43%

Table: Change in Carbon Factor for Electricity from Part L 2013 to Part L 2026

3 Energy Calculations – Be Lean

3.1 Energy Calculations

To estimate the CO₂ emissions for the site, SAP calculations have been carried out by an accredited OCDEA Domestic Energy Assessor using Design SAP 10's online platform.

The baseline CO₂ emissions covered by Part L 2021 of the Building Regulations are expressed as the Target Emission Rate (TER) and the proposed actual emissions are the Dwelling Emission Rate (DER). These use the unit of measurement of kilograms of CO₂ per square-metre per annum (kg/CO₂/m²). To calculate the overall proposed emissions, these figures can be multiplied by the size of the dwellings and/or site and this figure is presented in tonnes/annum. These are the figures expressed within this report.

This covers regulated carbon emissions from:

- Heating (and Cooling)
- Hot Water
- Lighting
- Auxiliary (Pumps and Fans)

3.2 Passive Design Measures

Passive measures utilised in the concept and development of the design include:

- High levels of insulation more than the Part L 2021 notional values.
- Through good design, air infiltration will be minimised.
- Where possible, orientation and site layout to reduce energy demand.
- Provision of cross-ventilation.
- A high-performance glazing system to reduce heat demand and increase solar gains.

Element	Part L1 Limiting U-Vales	Proposed U-Values (W/m ² K)
<i>Walls</i>		
External Cavity Wall	0.26 W/m ² K	0.16 W/m ² K
Basement Walls	0.26 W/m ² K	0.16 W/m ² K
<i>Floors</i>		
Basement Floor	0.18 W/m ² K	0.1 W/m ² K
<i>Roof</i>		
Roof (Flat)	0.16 W/m ² K	0.11 W/m ² K
<i>Openings</i>		
Windows	1.6 W/m ² K	1.2 W/m ² K
Front Door	1.6 W/m ² K	1.2 W/m ² K
Rooflights	1.6 W/m ² K	1.3 W/m ² K
<i>Air Permeability</i>		
2.0 m ³ /(hm ²) @50Pa		
<i>Thermal Bridging</i>		
<i>Recognised Construction Details and manually calculated to details</i>		
Table: Proposed Fabric Specification		

3.3 Active Design (Residential)

The development will incorporate efficient building services to limit carbon emissions, including a zero-NO_x heating system, smart metering and the following measures:

Element		Proposed Details	
Ventilation	Type	Mechanical Ventilation with Heat Recovery	
	Details	SFP 0.55 l/s	90% efficiency
	Part F Compliant	Yes	
Heating		Air Source Heat Pump	
Heating Controls		Time and Temperature Zone Control	
Heat Emitters		Radiators	
Hot Water	Type	Hot Water Cylinder	
	Details	200ltr (TBC)	
Secondary Heating		Wood Log Burner (Closed Room, HETAS Approved)	
Secondary Heating		DEFRA Exempt List	Yes
Cooling		No	
Lighting		LED	
Under 110ltrs/person/day Water		Yes	

Table: Proposed Mechanical and Electrical Specification

3.4 Lighting

In-line with exceeding Part L minimum requirements, all residential light fittings should be LEDs with a luminous efficiency per circuit watt of at least 95 lumens/Watt.

3.5 Unregulated Emissions (Residential)

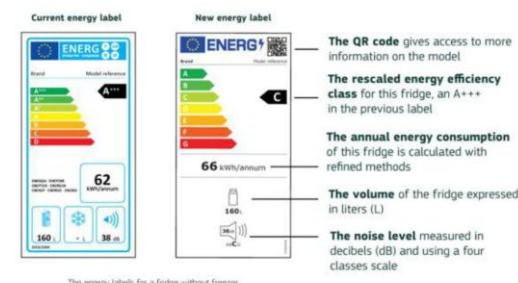
Unregulated energy use and their carbon emissions are from systems or processes that are harder to quantify than regulated emissions which are from fixed systems. Unregulated energy is not counted within SAP for the purpose of Part L compliance. This is because the emissions from these items are variable and dependant on occupant behaviour and specification.

For the proposed residential units, unregulated emissions consist of:

- Equipment (Small Power devices)
- Cooking
- External Lighting
- Appliances

Appliances and white goods can use significant amounts of energy in a building. This energy use becomes relatively more important in low energy buildings where passive design and low-flow fittings have reduced demand from space heating and hot water. High efficiency appliances are recommended to limit total energy consumption and minimise overheating risk from waste energy given off as heat.

In March 2021 the energy labelling ratings for appliances were updated, and are now rated A-G. What may have been an A+++ before is now a B or a C rating. Very few appliances achieve an A rating currently, as the new system leaves room for the industry to improve. Therefore, appliances should be sourced with the highest rating available.



3.6 Space Heating Demand and EUI

There is a requirement to disclose the anticipated Energy Use Intensity and space heating demand at design, pre-occupation stage and over at least the first five operational years (covered within *Be Seen*). For this scheme, the figures are illustrated below and compared against the benchmark figures.

	EUI (kWh/m ² /year)	Space Heating (kWh/m ² /year)
<i>Benchmark</i>	35	15
Proposed Scheme	17.84	34
Table: EUI and Space Heating Demand		

Every effort has been made to reduce the space heating demand. As can be seen in the *Proposed Fabric Specification Table* and the *Proposed Mechanical and Electrical Specification*, insulation and fabric levels have been maximized.

3.7 Carbon Savings at *Be Lean*

London Plan Policy SI 2 targets for *energy efficiency* at the *Be Lean* stage are:

- Residential developments should achieve at least a 10 per cent improvement on Building Regulations from energy efficiency measures alone.

The current guidance is to model the proposed heating for the *Be Lean* as per the Part L notional. To confirm, this is:

	Notional Dwelling Heating	Efficiency
Residential	Gas Boiler	89.5%
Table: Notional Dwelling - <i>Be Lean</i>		

Be Lean calculations have been undertaken, and the heating has been modelled according to the GLA Guidance on Energy Statements. A copy of these calculations can be found in the Appendices.

Be Lean Measures

This scheme proposes:

- U-Values below the Part L 2021 notional dwelling
- High-efficiency double-glazing
- Improved Thermal Bridging
- Mechanical Ventilation with Heat Recovery (MVHR)
- A low air permeability target

And can be considered a fabric efficient scheme with passive measures prioritised.

Final results at *Be Lean* are:

	CO ₂ Emissions (Tonnes per Annum)
	Residential
Baseline: Part L 2021	4.3
<i>Be Lean</i>: Use Less Energy	3.3
CO₂ Savings at <i>Be Lean</i>	22.2%
Table: Carbon Emissions Table (<i>Be Lean</i>)	

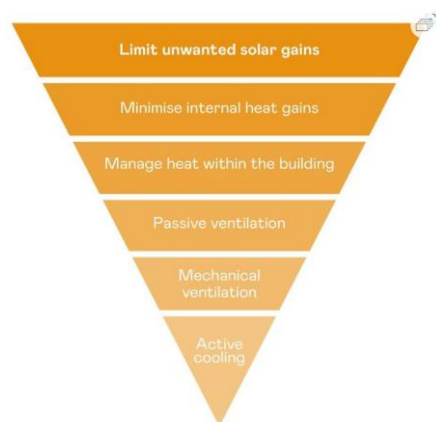
4 Overheating

This development will be compliant with Part O of the Building Regulations.

The scheme has been designed to avoid overheating with the early stages of the cooling hierarchy prioritised and with the following being major factors in mitigating potential risk:

- Individual heating meaning a lack of communal heat distribution.
- Windows are openable for overheating purposes.
- Provision of a Mechanical Ventilation with Heat Recovery (MVHR) system.

On this page the cooling hierarchy is examined to highlight the measures introduced to mitigate the potential for overheating throughout the design process.



Overheating Assessment

A sample overheating assessment has been undertaken to support the planning application. Details and results of this are in the remaining part of this section.

Cooling Hierarchy	Measures Undertaken
<i>Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.</i>	High albedo materials will be prioritised where possible.
	Insulation levels in-line with Part L 2021 have been proposed.
<i>Minimise internal heat generation through energy efficient design:</i>	Individual heating proposed so no communal heat distribution.
	LED lighting will reduce internal heat gains.
<i>Manage the heat within the building through exposed internal thermal mass and high ceilings:</i>	Thermal mass will be maximised where possible within the design.
	The Floor to Ceiling Height complies with National Space Standards.
<i>Provide Passive Ventilation</i>	Openable Windows are proposed to all dwellings which will allow for nighttime purge ventilation if required.
	The dwellings benefits from the provision of cross-ventilation
<i>Provide Mechanical Ventilation</i>	Mechanical Ventilation with Heat Recovery is proposed with enhanced flow rates (2 x Part F minimum) .
	This system will have a summer by-pass mode. This will automatically divert outgoing air around the heat recovery cell, so that the incoming air will no longer be warmed by the outgoing air.

4.1 General Overheating Assessment Information

Project Information	
Building Category	Category II – New Builds
Weather File Location	London Weather Centre
Weather File (Baseline)	DSY1, 2020s, High Emission, 50% percentile scenario
Summer Days	May 1st to September 30th – 153 days
Internal Heat Gains	Table 2 Occupancy and equipment gain description – TM59
Table: Project information	

4.2 Specific Overheating Inputs – Windows, Doors and Shading

Opening Type	Proposed G-Value	Openable Area	Opening Hours
Sliding Doors	0.4	100%	As per Section 3.3 of Approved Document O
Rooflight	0.35	20°	
External Window Shading	External blinds to be fitted to the kitchen & living room rooflights.		
Internal Window Shading	None. Internal Blinds or Curtains have not been modelled.		
Door Type	Opening Hours		
Internal Doors	Assumed open in the daytime and closed at night		
Table: Window and doors opening details			

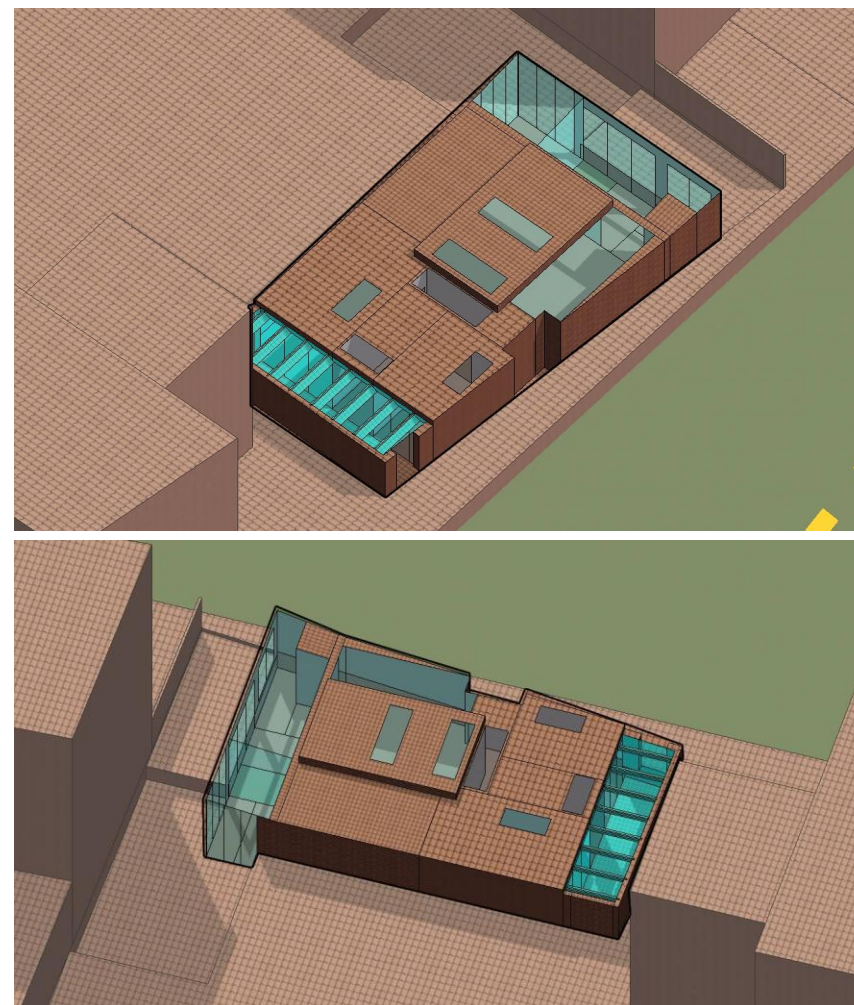


Figure: Overheating Model Images

4.3 Overheating Assessment – Considerations

As per Part O, considerations need to be made when undertaking the overheating assessment to ensure the specification used does not impact the residents negatively.

Ensuring the Overheating Strategy is Usable		
Consideration	Issue	Comments / Actions
Noise	☐	No known concerns
Pollution	☐	No air quality concerns. MVHR specified.
Security	☒	All bedroom sliding doors closed at night
Protection from Falling	☐	No known concerns
Protection from Entrapment	☐	No louvered shutters, window railings or ventilation grilles
Table: Review of potential impacts to overheating strategy		

4.4 Results

Room	CIBSE TM59 – Predominantly Naturally Ventilated Homes		
	Criterion A	Criterion B – Bedrooms only	Compliance
Bedroom 1	1	22	Y
Bedroom 2	1.1	21	Y
Kitchen Dining & Living Area	1.9		Y
Hobby/Entertainment Space	0		Y
Table: Results			

4.5 Conclusion

A full dynamic overheating assessment has been undertaken and the results show that based on CIBSE TM59 (Part O version) that without mitigation measures, there is a potential risk of overheating.

These risks have been mitigated via:

- Specification of External Blinds for the rooflights
- Modelling of a reduced g-value for decreased solar gain.
- Windows are openable for overheating purposes.
- Provision of an MVHR system with boosted flow rates.

With these measures, compliance with CIBSE TM59 (Part O version) has been achieved.

5 Decentralised Energy – Be Clean

In the context of the London Plan, decentralised energy refers to low- and zero-carbon power and/or heat generated and delivered within London. This includes on-site heat networks and energy centres, through to large-scale district heat networks.

The London Heat Map displays connections to heat networks within London including both operational and future connections as well as displaying areas designated as Heat Network Priority Areas.

5.1 Connection to Existing Heating Networks (and Future Networks)

Following a review of the London Heat Map as well as a review of the Local Authority Website, the following details the closest existing or proposed heat network to the development (whichever is more appropriate).

Feature	Description/Unit
Nearest District Heat Network	HDEN Phase 1
Distance from Scheme	35m
Proposed Year of Operation	Status: Proposed
Table: Closest Viable Heat Network Details	

Based on the:

- Low heat density area and very low scheme heat demand;
- Chosen method of heating via renewable energy and;
- Carbon reduction on-site that will increase further with National Grid decarbonisation.

It is not proposed to connect to an offsite network nor provide a future heat network connection.

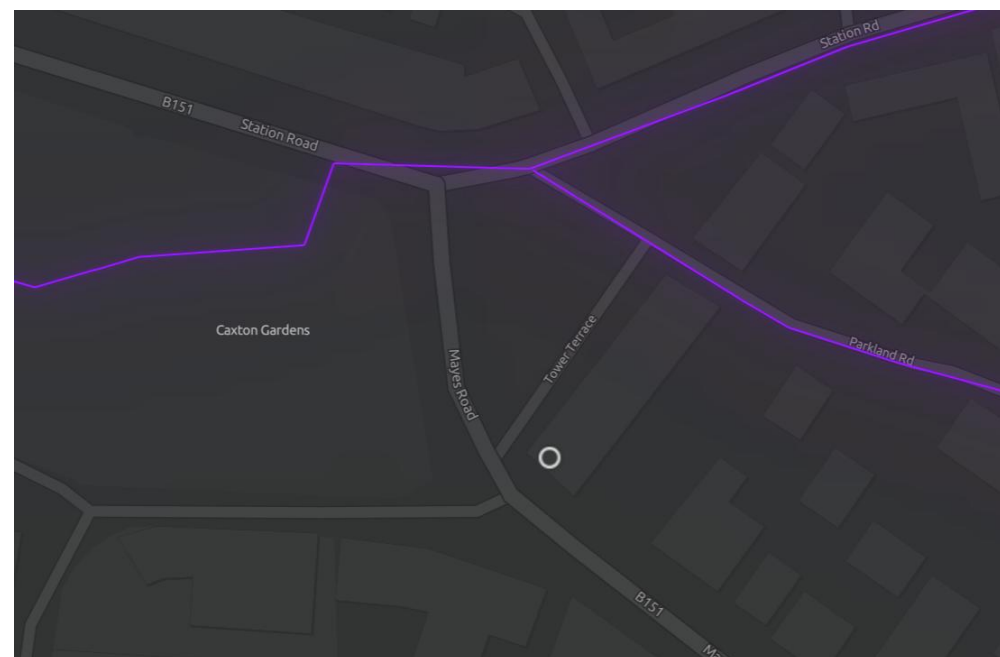


Figure: London Heat Map

6 Renewable Energy – Be Green

Renewable Energy is typically defined as:

“Energy derived from a source that is continually replenished, such as wind, wave, solar, hydroelectric and energy from plant material, but not fossil fuels or nuclear energy. Although not strictly renewable, geothermal energy is generally included.”

As per Renewable Energy Directive (2018/2001/EU) aerothermal and hydrothermal technologies are also officially included within the definition.

Based on recent legislation including the *Clean Air Act* and *The Future Homes and Buildings Standards: 2023 consultation* as well as the location of the scheme, the following technologies have been discounted and are not discussed further:

- Wind Turbines
- Hydropower / Wave Technology
- Biogas / Biofuel / Biomass
- Hydrogen
- Hybrid Heat Pumps

The feasibility of remaining renewable and low carbon technologies has been undertaken based on the following parameters:

1. Practicality of installation of the technology
2. Energy demand profile for the project
3. Environmental impact & land use
4. Economic feasibility and overall payback (including available financial incentives)
5. Planning and regulatory issues i.e. conservation and heritage areas and aspects
6. Noise & aesthetic considerations

It should be noted that due to decarbonisation and the decrease in carbon factor for electricity, factors such as energy security and lowering running costs are deemed equal or more important to that of the offset of CO₂.

Non-Chosen Technologies

Solar Hot Water

Solar Hot Water can provide free hot water to a dwelling, mainly during the summer months thus it requires a high hot water demand to be at its most effective and offer a sufficient payback. However, when the dwelling is heated by a renewable source like an ASHP, this reduces the renewable energy generated due to an overlap in provision.

To avoid high pipework heat losses, it is recommended that pipe runs are as small as possible so usually the technology is recommended for houses and top floor dwellings only. The system requires a dedicated hot water cylinder or a dual-cylinder. In apartments where space is at a premium, this additional equipment would take up valuable storage space.

For this project, while not unviable, other technologies are preferred to achieve higher levels of carbon reduction within a quicker payback period and less visual impact.

PV Panels

The main benefit of PV has evolved in recent times from financial (Feed-In-Tariff era) to CO₂ offset (Part 2013) to currently providing a tangible saving on energy bills with a correctly sized and installed system. While system costs are higher in 2024 due to inflation and shipping costs, a domestic directly inverted system of 5kWp has a payback of around 7-10 years. The CO₂ offset of PV in Part L 2025 is projected to be 36.76% less than Part L 2021 therefore carbon savings for the technology are set to further diminish as the grid decarbonises.

PV panel systems without battery systems face significant inefficiencies due to the seasonal mismatch between power generation and energy demand. These panels generate the most power during summer, when daylight is abundant, but this coincides with lower energy demand. In winter, when energy demand peaks, PV output is significantly reduced.

The technology does benefits from having no noise implications, creates no additional land-use and when correctly specified has very limited aesthetic impact.

For this scheme, other technologies are preferred due to the very low CO₂ savings that the technology offers.

Exhaust Air Heat Pumps and Hot Water Heat Pumps

Exhaust Air Heat Pumps (EAHP) are based on heat-pump technology and provide heating, hot water and ventilation in a large all-internal unit. However, these are suited to Passivhaus style developments or small apartments as the units have a very low heat output (<2kW) so if not, it does need to be supplemented with electric panel heaters. They also have noise considerations and ease-of-maintenance is unknown as a new technology in England. There are also limited manufacturers and availability in the UK market presently. Based on the proposed scheme having large houses with a demand beyond the optimum system size, EAHPs are not deemed the most feasible technology for the scheme.

Hot Water Heat Pumps (HWHP) are essentially hot water cylinders integrated with a small heat pump to raise the efficiency of the system above the 1 of a standard electric cylinder. This provides domestic hot water at efficiencies above that of an ASHP (as the pump is dedicated for the Hot Water) when it comes to hot water generation.

As they do not provide any contribution towards heating, they are best suited for projects where there is both limited external space, a higher hot water than heating demand, making them ideal for 1 or 2 bedroom apartments. They are not best suited to larger houses or dwellings with multiple bathrooms due to the size of the cylinder (litres) and the output (kW) of the heat pump.

Ground Source Heat Pumps

Ground Source Heat Pumps (GSHP) differ from Air Source Heat Pumps in that they draw their heat from the ground rather than the air. This allows for both a more consistent temperature and higher efficiency given that in the winter months, the ground is warmer than the air. This allows the running costs of the system to be lower, although maintenance costs are higher.

To install a GSHP, you either need to install a ground-loop (*slinky*) system or to have deep boreholes installed during the piling phase of the scheme. The introduction of boreholes comes at significant capital cost, especially for schemes where raft or strip foundations are proposed so unless a significant amount of land is available then this can make the capital cost prohibitive.

GSHPs are suited to very large dwellings, having a higher kW output than air source heat pumps and dwellings in a more secluded and detached location, with the external units noisier and less aesthetic than air source. Based on the development proposals here, other technologies are preferred as piling is not anticipated.

Table: Renewable Energy Feasibility

Renewable Energy Tariffs

For new-build developments within England, there are no grants available for the installation of renewable technologies.

Previous schemes such as the Feed-In-Tariff (FiT) and Renewable Heat Incentive (RHI) are now closed to new applications.

The only scheme available is the Smart Export Guarantee for PV systems, administered through utility companies where a small payment for exported energy is paid.

Feasibility Conclusion

Following a review of the available technologies, the following have been integrated into the scheme:

- Air Source Heat Pump

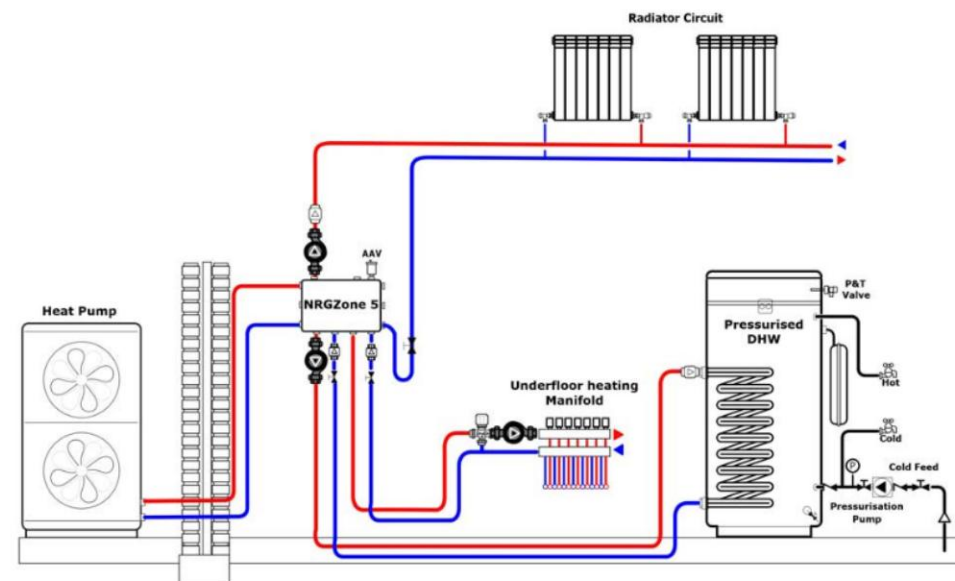
6.1 Air Source Heat Pumps (Individual)

Air Source Heat Pumps (ASHPs) are designed to extract heat from the external air, a process that is effective even during colder conditions. Despite low temperatures, the air contains heat energy that can be utilised. Through a refrigerant system, ASHPs absorb this ambient heat at a lower temperature, use a compressor to increase its temperature, and subsequently transfer the elevated heat via a heat exchanger into the building's heating system. The functionality of ASHPs is based on refrigerant, which easily transitions between liquid and gaseous states. During the evaporation process, the refrigerant absorbs heat; when it is compressed and condensed back into a liquid, it releases heat.

Scheme Proposals

At this early stage, an indicative Air Source Heat Pump has been modelled for the purpose of Part L compliance based on the estimated kW output and by using a common manufacturer that performs averagely in SAP. This is due to using a SAP default ASHP causes a disproportionately poor result within the software that would not be reflective of the final scheme.

A final make & model will be supplied during M&E design at RIBA Stage 3 / 4.



ASHP System Details	
Number of Heat Pumps	One
Provides	Space Heating and Hot Water
Make and Model	Vaillant aroTHERM plus (for SAP modelling purposes)
SCOP	TBC depending on model but in excess of 3 (300%)
External Unit Location	Rear Garden
Table: Proposed ASHP Specification	

7 Energy Monitoring – Be Seen

Policy SI 2 of The London Plan (March 2021) introduced a fourth hierarchy – *Be Seen*. This element has been introduced to try and narrow the performance gap by monitoring and reporting energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor’s net zero-carbon target.

It is also the aim that the energy performance data that will be collected will also provide an evidence base which could help inform future industry-wide benchmarks or performance ratings for major building typologies based on in-use performance.

In line with GLA guidance on “*Be Seen*” *Energy Monitoring (September 2021)*, this requirement will cover the operational phase of the development for at least 5 years. The *Be Seen* portal is hosted on the London Building Stock Model (LBSM) website and contains a summary of the building’s estimated and actual performance.

Applicants are expected to report against the performance indicators at each stage of the process by uploading the evidence to the GLA Webform:

[Be Seen Planning Stage webform | London City Hall](#)

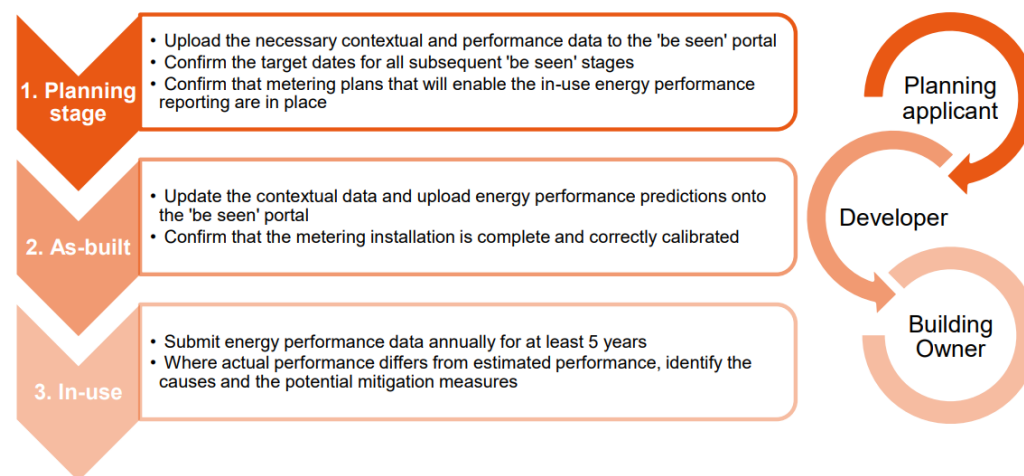
Before uploading information to the webform, applicants can view the required information in the [‘be seen’ spreadsheet](#).

This spreadsheet can be used for all stages of the process featuring separate tabs for each reporting stage (i.e. planning stage, as-built stage, in-use stage) before the information is uploaded to the webform.

Proposed Scheme

For this scheme the relevant data will be uploaded at the appropriate stages.

Figure 2.1 ‘Be seen’ process and responsibilities



8 Water Efficiency

The Local Plan requires that all developments must incorporate water conservation:

Residential development must not exceed a maximum water use of 105 litres per head per day (excluding the allowance of up to 5 litres for external water consumption) using the 'Fittings Approach' in Table 2.2 of Part G of Building Regulations.

This target is the same as the optional target included within Part G of the Building Regulations which encourages the efficient use of potable water. The specification proposed has been produced using the calculation methodology used to assess compliance against the water performance targets in Building Regulations 17.K and is based on the Government's "The Water Efficiency Calculator for new dwellings – September 2009" (withdrawn in June 2016).

The current guidance and calculation methodology can now be found within *Approved Document G - Sanitation, hot water safety and water efficiency* (2015 edition with 2016 amendments):

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/504207/BR_PDF_AD_G_2015_with_2016_amendments.pdf

The proposed specification for the scheme can be found on the right-hand side of the page. For the Dishwashers and Washing Machines, default consumption figures have been used.



The Water Efficiency Calculator for new dwellings
The Government's national calculation methodology for
assessing water efficiency in new dwellings in support of:
The Code for Sustainable Homes, May 2009 and subsequent versions
The Building Regulations 2009 (as amended)
The Building (Approved Inspector etc) Regulations 2009 (as amended)



The Building Regulations 2010

**Sanitation, hot water safety
and water efficiency**



APPROVED DOCUMENT

G1 Cold water supply
G2 Water efficiency
G3 Hot water supply and systems
G4 Sanitary conveniences and washing facilities
G5 Bathrooms
G6 Food preparation areas
Water efficiency calculator for new dwellings

Proposed Sanitaryware Specification

Element	Specification	Unit of Measurement
WC	6/3 dual flush	<i>Litres per Flush</i>
Basin Taps	5	<i>Litres per Minute</i>
Kitchen Sink Taps	9	<i>Litres per Minute</i>
Shower	8	<i>Litres per Minute</i>
Bath	155	<i>Capacity to Overflow</i>
Washing Machine	8.17	<i>Litres per Kilo (Dry)</i>
Dishwasher	1.25	<i>Litres per Place Setting</i>
Total Consumption (Litres / Person / Day)		104.7
Compliant with Local Policy		Yes
Table: Proposed Water Consumption (litres/person/day)		

9 Conclusion

An energy assessment has been undertaken on the proposed scheme in-line with the energy hierarchy. These calculations illustrate a reduction in CO₂ emissions over the baseline of Part L via:

Energy Efficiency Measures (*Be Lean*)

- Thermal insulation specified to achieve U-Values lower than the Part L 2021 notional.
- LED lighting with high luminous efficacy (lm/W) will be provided to all fittings.
- A low air permeability has been targeted.
- Mechanical ventilation with heat recovery has been specified/

Decentralised Energy (*Be Clean*)

Following a review of the scheme, individual heating is proposed.

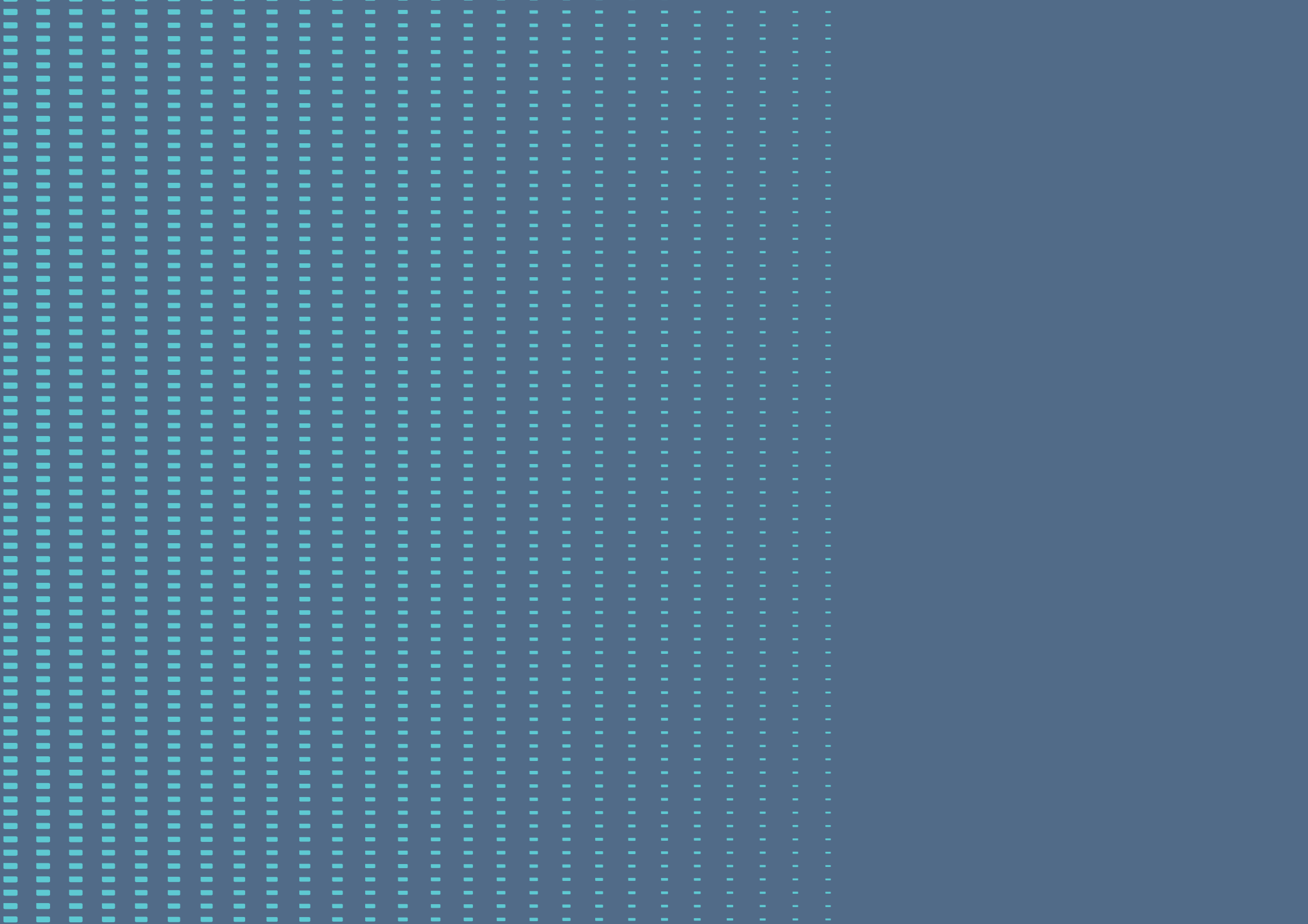
Renewable Technologies (*Be Green*)

A feasibility on renewable technologies has been undertaken, and the following systems are proposed for the scheme:

- Air Source Heat Pump

Therefore, the scheme achieves the requirements of local policy and exceeds the 50% benchmark reduction target from The London Plan ensuring a low-carbon and sustainable scheme.

	CO ₂ Emissions (Tonnes per Annum)
	Residential
Baseline: Part L 2021	2.8
<i>Be Lean</i> : Use Less Energy	2.2
<i>Be Clean</i> : Supply Energy Efficiently	2.2
<i>Be Green</i> : Use Renewable Energy	0.6
CO ₂ Savings at <i>Be Green</i> over Part L 2021	77.1%
Table: Carbon Emissions Table	



Appendix 1



Project: Tower Terrace

Plots	Floor Area	Target Emissions (TER) <i>Part L Baseline</i>	Total TER	Energy Generation Technologies within TER (Row 269)	Dwelling Emissions (DER) <i>Be Lean</i>	Total DER <i>Be Lean</i>	DER <i>Be Green</i>	Total DER <i>Be Green</i>
	m ²	kg/CO ₂ /m ² /year	kg/CO ₂ /year	kg/CO ₂ /year	kg/CO ₂ /m ² /year	kg/CO ₂ /year	kg/CO ₂ /m ² /year	kg/CO ₂ /year
House	244.15	11.57	2,825	-816	12.34	3,013	2.65	647
Total Site Area Assessed (m ²):	244		2,825	-816	<i>Be Lean</i> Emissions (minus EGT)	2,196		647
		1m ² TER	11.57		1m ² DER (BL)	9.00	1m ² DER (BG)	2.65
Total Site Area (m ²):	244		2,825	-816	<i>Be Lean</i> Emissions (minus EGT)	2,196		647

Results		
Baseline Emissions - Total Site	2,825	kg/CO ₂ /year
<i>Be Lean</i> Emissions - Total Site	2,196	kg/CO ₂ /year
<i>Be Lean</i> Saving	22.25	%

Overall Results		
Final CO ₂ Emissions at <i>Be Green</i>	647	kg/CO ₂ /year
CO ₂ Savings at <i>Be Green</i>	77.10	%
Total CO ₂ reduction achieved	2,178	kg/CO ₂ /year

Results by Hierarchy Stage		
CO ₂ Reduction at <i>Be Lean</i>	628	kg/CO ₂ /year
CO ₂ Reduction at <i>Be Green</i>	1,549	kg/CO ₂ /year

Appendix 2



Summary for Input Data

Plot Reference	Tower Terrace		Issued on Date	04/03/2026
Assessment Reference	BE LEAN	Plot Type Ref	ES L1A	
Plot Address	17, Tower Terrace, LONDON, N22		SAP Version	10.2

SAP Rating	85 B	DER	12.34	TER	11.57
Environmental	86 B	% DER < TER			-6.66
CO ₂ Emissions (t/year)	2.54	DFEE	57.91	TFEE	58.88
Compliance Check	See BREL	% DFEE < TFEE			1.65
% DPER < TPER	-7.61	DPER	66.31	TPER	61.62

Assessor Details	Mr. Neil Rotheron	Assessor ID	L759-0001
Client	example, example		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South	
Property Tenture	1	
Transaction Type	6	
Terrain Type	Urban	
1.0 Property Type	House, Detached	
2.0 Number of Storeys	2	
3.0 Date Built	2026	
4.0 Sheltered Sides	4	
5.0 Sunlight/Shade	Average or unknown	
6.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	194.89	kJ/m²

7.0 Electricity Tariff	Standard
Smart electricity meter fitted	No
Smart gas meter fitted	No

7.0 Measurements		Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Basement:	47.50 m	127.80 m ²	3.60 m
	Ground floor:	46.20 m	116.35 m ²	3.60 m

8.0 Living Area	62.63	m ²
-----------------	-------	----------------

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area(m ²)	Nett Area (m ²)	Shelter Res	Shelter	Openings	Area Calculation Type
main above ground	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.16	60.00	166.32	102.81	0.00	None	63.51	Enter Gross Area
basement wall	Solid Wall	Solid wall : plasterboard on dabs, insulation, any outside structure	0.16	9.00	171.00	171.00	0.00	None	0.00	Enter Gross Area

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
Internal Wall 1	Plasterboard on timber frame	9.00	174.24

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area(m ²)	Nett Area (m ²)	Shelter Code	Shelter Factor	Calculation Type	Openings
Main Roof	External Flat Roof	Plasterboard, insulated flat roof	0.11	9.00	116.35	97.25	None	0.00	Enter Gross Area	19.10
Over basement	External Flat Roof	Plasterboard, insulated flat roof	0.11	9.00	11.45	11.45	None	0.00	Enter Gross Area	0.00

Description	Storey	Construction	Kappa	Area (m ²)
Internal Ceiling 1	Basement	Other	100.00	116.35

Description	Type	Storey Index	Construction	U-Value (W/m ² K)	Shelter Code	Shelter Factor	Kappa (kJ/m ² K)	Area (m ²)
Basement Floor	Ground Floor - Solid	Basement	Slab on ground, screed over insulation	0.10	None	0.00	110.00	127.80

11.2 Internal Floors

Summary for Input Data

Description	Storey Index	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Lowest occupied	Other	100.00	116.35

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Front door	Manufacturer	Window	Double Low-E Hard 0.2			0.40		0.70	1.20
Windows	Manufacturer	Window	Double Low-E Hard 0.15			0.40		0.70	1.20
Roof Glazing	Manufacturer	Roof Light	Double Low-E Soft 0.1			0.40		0.70	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Area (m²)	Pitch
Front door	Front door	main above ground	East	2.31	
Windows side to walkway rear	Windows	main above ground	East	27.00	
side window to walkway	Windows	main above ground	North	4.68	
Roof Light	Windows	main above ground	West	29.52	
Roof glazing	Roof Glazing	Main Roof	North	9.18	0
	Roof Glazing	Main Roof	North	9.92	0

14.0 Conservatory

None

15.0 Draught Proofing

100

 %

16.0 Draught Lobby

No

17.0 Thermal Bridging

Calculate Bridges

17.1 List of Bridges

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E2 Other lintels (including other steel lintels)	Independently assessed	18.10	0.02	0.02 rcd	Yes
E3 Sill	Independently assessed	18.10	0.02	0.02 rcd	Yes
E4 Jamb	Independently assessed	40.20	0.02	0.02 rcd	Yes
R11 Upstands or kerbs of rooflights	Independently assessed	41.56	0.12	0.12 assumed calculated	Yes
E22 Basement floor	Independently assessed	47.50	0.11	0.11 assumed calculated	No
E14 Flat roof	Table K1 - Default	10.60	0.16	0.16 over basement	No
E24 Eaves (insulation at ceiling level - inverted)	Table K1 - Default	7.80	0.15	0.15 df	No
E6 Intermediate floor within a dwelling	Independently assessed	36.70	0.06	0.06 rcd	No
E16 Corner (normal)	Table K1 - Default	14.40	0.18	0.18 basement	No
E15 Flat roof with parapet	Table K1 - Default	46.20	0.30	0.30 main	No
E16 Corner (normal)	Independently assessed	3.60	0.04	0.04 rcd upper	No

Y-value

0.06

 W/m²K

19.0 Mechanical Ventilation

Mechanical Ventilation

Mechanical Ventilation System Present

 Yes

Mechanical Ventilation data Type

 Data Sheet

Type

 Balanced mechanical ventilation with heat recovery

Manufacturer SFP

 0.55

Duct Type

 Flexible

MVHR Efficiency

 90.00

Wet Rooms

 2

Brand, Model

 tbc

SFP from Installer Commissioning Certificate

 Yes

MVHR System Location

 Inside heated envelope (installed exclusively)

Duct Installation Specification

 Level 1

20.0 Fans, Open Fireplaces, Flues

Number of open chimneys

 0

Number of open flues

 0

Number of chimneys/flues attached to closed fire

 0

Number of flues attached to solid fuel boiler

 0

Number of flues attached to other heater

 0

Number of blocked chimneys

 0

Number of intermittent extract fans

 0

Number of passive vents

 0

Number of flueless gas fires

 0

Summary for Input Data

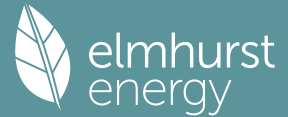
21.0 Fixed Cooling System	No				
22.0 Pressure Testing	Yes				
Designed AP ₅₀	2.00	m ² /(h.m ²) @ 50 Pa			
Test Method	Blower Door				
22.0 Lighting	No				
No Fixed Lighting	No				
	Name Lighting 1	Efficacy 95.00	Power 5.00	Capacity 475.00	Count 17
24.0 Main Heating 1	Manufacturer				
Percentage of Heat	100.00 %				
Fuel Type	Mains gas				
SAP Code	102				
In Winter	89.50				
In Summer	89.50				
Model Name	tbc				
Manufacturer	tbc				
Controls SAP Code	2110				
Controls description	Time and temperature zone control by arrangement				
Delayed Start Stat	No				
Burner Control	Modulating				
Flue Type	None or Unknown				
Fan Assisted Flue	No				
Is MHS Pumped	Pump in heated space				
Heating Pump Age	2013 or later				
Heat Emitter	Radiators				
Flow Temperature	Unknown				
Boiler Interlock	Yes				
25.0 Main Heating 2	None				
26.0 Heat Networks	None				
27.0 Secondary Heating	SAP table				
SAP Code	633				
Heating System Description	Solid fuel Closed room heater				
Fuel Type	Smokeless Fuel				
SHS efficiency	60.00 %				
HETAS Approved System	Yes				
28.0 Water Heating	Main Heating 1				
Water Heating	Main Heating 1				
SAP Code	901				
Flue Gas Heat Recovery System	No				
Waste Water Heat Recovery Instantaneous System 1	No				
Waste Water Heat Recovery Instantaneous System 2	No				
Waste Water Heat Recovery Storage System	No				
Solar Panel	No				
Water use <= 125 litres/person/day	Yes				
Cold Water Source	From mains				
Bath Count	1				
28.1 Showers					

Summary for Input Data



Description	Shower Type	Flow Rate [l/min]	Rated Power [kW]	Connected	Connected To						
es	Vented hot water system	7.00		No							
28.3 Waste Water Heat Recovery System											
29.0 Hot Water Cylinder											
	Hot Water Cylinder										
Cylinder Stat	Yes										
Cylinder In Heated Space	Yes										
Independent Time Control	Yes										
Insulation Type	Measured Loss										
Cylinder Volume	200.00			L							
Loss	1.80			kWh/day							
Pipes insulation	Fully insulated primary pipework										
31.0 Thermal Store											
	None										
34.0 Small-scale Hydro											
	None										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recommendations											
Lower cost measures											
None											
Further measures to achieve even higher standards											
None											

Full SAP Calculation Printout



Plot Reference	Tower Terrace				Issued on Date	04/03/2026	
Assessment Reference	BE LEAN			Plot Type Ref	ES L1A		
Plot Address	17, Tower Terrace, LONDON, N22				SAP Version	10.2	
SAP Rating	85 B		DER	12.34		TER	11.57
Environmental	86 B		% DER < TER				-6.66
CO ₂ Emissions (t/year)	2.54		DFEE	57.91		TFEE	58.88
Compliance Check	See BREL		% DFEE < TFEE				1.65
% DPER < TPER	-7.61		DPER	66.31		TPER	61.62
Assessor Details	Mr. Neil Rothon				Assessor ID	L759-0001	
Client	example, example						

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Basement floor	127.8000 (1a)	x 3.6000 (2a)	= 460.0800 (1a) - (3a)
Ground floor	116.3500 (1b)	x 3.6000 (2b)	= 418.8600 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	244.1500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 878.9400 (5)

2. Ventilation rate

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	
Pressure test	0.0000 / (5) =	0.0000 (8)
Pressure Test Method	Yes	
Measured/design AP50	Blower Door	2.0000 (17)
Infiltration rate		0.1000 (18)
Number of sides sheltered		4 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0700 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000	(22)
Wind factor	1.2750 1.2500 1.2250 1.1000 1.0750 0.9500 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750	(22a)
Adj infilt rate	0.0892 0.0875 0.0857 0.0770 0.0752 0.0665 0.0665 0.0648 0.0700 0.0752 0.0787 0.0822	(22b)
Balanced mechanical ventilation with heat recovery		
If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		81.0000 (23c)
Effective ac	0.1842 0.1825 0.1807 0.1720 0.1702 0.1615 0.1615 0.1597 0.1650 0.1702 0.1737 0.1772	(25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Front door			2.3100	1.1450	2.6450		(27)
Windows			61.2000	1.1450	70.0763		(27)
Roof Glazing			19.1000	1.2357	23.6027		(27a)
Basement Floor			127.8000	0.1000	12.7800	110.0000	14058.0000 (28a)
main above ground	166.3200	63.5100	102.8100	0.1600	16.4496	60.0000	6168.6000 (29a)
basement wall	171.0000		171.0000	0.1600	27.3600	9.0000	1539.0000 (29a)
Main Roof	116.3500	19.1000	97.2500	0.1100	10.6975	9.0000	875.2500 (30)
Over basement	11.4500		11.4500	0.1100	1.2595	9.0000	103.0500 (30)
Total net area of external elements A _{um} (A, m ²)			592.9200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	164.8706		(33)
Main dwelling							
Internal Wall 1			174.2400			9.0000	1568.1600 (32c)
Internal Floor 1			116.3500			100.0000	11635.0000 (32d)
Internal Ceiling 1			116.3500			100.0000	11635.0000 (32e)

194.8886 (35)

$$(33) + (36) + (36a) = 198.1865 \quad (37)$$

Average = $\text{Sum}(39)m / 12 =$ 247.9483

3.0593 (42)

Average daily hot water use (litres/day)	141.6269 (43)
--	---------------

36.6019	32.2067	33.8382	28.8882	27.4089	24.0544	23.2884	24.5838	25.2606	28.9352	31.7006	36.0922 (46)
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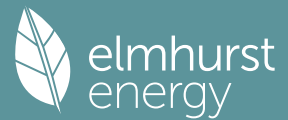
[illegible]

Heat gains from water heating, kWh/month	123 8409	109 8734	117 7236	105 3731	103 4720	94 6591	94 3391	97 2006	97 3219	106 8551	111 6072	122 7109 (65)
Heat gains from water heating, kWh/month	123 8409	109 8734	117 7236	105 3731	103 4720	94 6591	94 3391	97 2006	97 3219	106 8551	111 6072	122 7109 (65)

857.0827 880.7629 842.3616 814.5017 771.4088 740.5545 710.8217 710.4135 732.6082 760.0283 807.2323 837.4170 (73)

[Jan]	Area	Solar flux	g	FF	Access	Gains
	m2	Table 6a	Specific data	Specific data	factor	W
		W/m2	or Table 6b	or Table 6c	Table 6d	

Full SAP Calculation Printout



East	2.3100	19.6403	0.4000	0.7000	0.7700	8.8034 (76)
North	4.6800	10.6334	0.4000	0.7000	0.7700	9.6563 (74)
East	27.0000	19.6403	0.4000	0.7000	0.7700	102.8969 (76)
West	29.5200	19.6403	0.4000	0.7000	0.7700	112.5006 (80)
North	19.1000	26.0000	0.4000	0.7000	1.0000	125.1432 (82)

Solar gains	359.0004	716.9510	1215.7108	1825.7593	2282.9797	2356.8389	2235.6916	1890.2345	1431.2684	860.0554	450.3001	293.4991 (83)
Total gains	1216.0831	1597.7139	2058.0724	2640.2609	3054.3885	3097.3934	2946.5132	2600.6480	2163.8767	1620.0837	1257.5324	1130.9161 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	52.5268	52.6330	52.7396	53.2792	53.3884	53.9414	53.9414	54.0534	53.7188	53.3884	53.1704	52.9541
alpha	4.5018	4.5089	4.5160	4.5519	4.5592	4.5961	4.5961	4.6036	4.5813	4.5592	4.5447	4.5303
util living area	0.9973	0.9907	0.9652	0.8682	0.6892	0.4951	0.3636	0.4273	0.7096	0.9514	0.9935	0.9981 (86)
MIT	19.3675	19.6559	20.0995	20.6113	20.8919	20.9809	20.9963	20.9925	20.9109	20.4336	19.7919	19.3233 (87)
Th 2	20.0579	20.0596	20.0613	20.0700	20.0717	20.0803	20.0803	20.0821	20.0769	20.0717	20.0682	20.0648 (88)
util rest of house	0.9966	0.9883	0.9563	0.8391	0.6364	0.4282	0.2887	0.3445	0.6376	0.9343	0.9915	0.9976 (89)
MIT 2	18.1286	18.4977	19.0580	19.6794	19.9812	20.0687	20.0789	20.0789	20.0129	19.4870	18.6790	18.0767 (90)
Living area fraction	18.4464	18.7948	19.3251	19.9184	20.2148	20.3027	20.3142	20.3133	20.2433	19.7298	18.9645	18.3965 (91)
MIT	18.4464	18.7948	19.3251	19.9184	20.2148	20.3027	20.3142	20.3133	20.2433	19.7298	18.9645	18.3965 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4464	18.7948	19.3251	19.9184	20.2148	20.3027	20.3142	20.3133	20.2433	19.7298	18.9645	18.3965 (93)

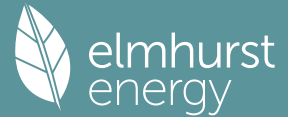
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9948	0.9838	0.9475	0.8338	0.6450	0.4447	0.3079	0.3656	0.6515	0.9264	0.9880	0.9961 (94)
Useful gains	1209.7035	1571.7764	1949.9559	2201.4429	1970.0078	1377.3370	907.2505	950.7970	1409.7059	1500.8167	1242.4123	1126.5481 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	3559.6320	3489.2742	3214.1472	2733.4026	2107.9966	1397.3355	910.0965	956.8819	1511.5194	2260.2488	2949.3128	3543.4169 (97)
Space heating kWh	1748.3468	1288.5585	940.5584	383.0110	102.6637	0.0000	0.0000	0.0000	0.0000	565.0175	1228.9684	1798.1504 (98a)
Space heating requirement - total per year (kWh/year)												8055.2747
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	1748.3468	1288.5585	940.5584	383.0110	102.6637	0.0000	0.0000	0.0000	0.0000	565.0175	1228.9684	1798.1504 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8055.2747
Space heating per m2										(98c) / (4) =		32.9931 (99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												89.5000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1748.3468	1288.5585	940.5584	383.0110	102.6637	0.0000	0.0000	0.0000	0.0000	565.0175	1228.9684	1798.1504 (98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000 (210)
Space heating fuel (main heating system)	1758.1141	1295.7572	945.8129	385.1507	103.2372	0.0000	0.0000	0.0000	0.0000	568.1740	1235.8341	1808.1959 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	268.9764	198.2398	144.7013	58.9248	15.7944	0.0000	0.0000	0.0000	0.0000	86.9258	189.0721	276.6385 (215)
Water heating												
Water heating requirement	297.4072	262.9388	278.9826	244.2600	236.1205	212.0345	208.6502	217.2865	220.0760	246.2954	263.0091	294.0088 (64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000 (216)
Fuel for water heating, kWh/month	332.2985	293.7864	311.7124	272.9162	263.8218	236.9100	233.1287	242.7782	245.8950	275.1904	293.8649	328.5014 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	58.5811	52.9120	58.5811	56.6914	58.5811	56.6914	58.5811	58.5811	56.6914	58.5811	56.6914	58.5811 (231)
Lighting	53.8510	43.2013	38.8980	28.4983	22.0129	17.9847	20.0809	26.1019	33.9038	44.4837	50.2442	55.3477 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												8100.2762 (211)
Space heating fuel - main system 2												0.0000 (213)

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Space heating fuel - secondary	1239.2730 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3330.8040 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.1000, SFP = 0.6050)	
mechanical ventilation fans (SFP = 0.6050)	648.7456 (230a)
central heating pump	41.0000 (230c)
Total electricity for the above, kWh/year	689.7456 (231)
Electricity for lighting (calculated in Appendix L)	434.6085 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	13794.7073 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	8100.2762	0.2100	1701.0580 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	1239.2730	0.3660	453.5739 (263)
Water heating (other fuel)	3330.8040	0.2100	699.4688 (264)
Space and water heating			2854.1008 (265)
Pumps, fans and electric keep-hot	689.7456	0.1387	95.6762 (267)
Energy for lighting	434.6085	0.1443	62.7274 (268)
Total CO2, kg/year			3012.5044 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.3400 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	8100.2762	1.1300	9153.3121 (275)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	1239.2730	1.2610	1562.7233 (277)
Water heating (other fuel)	3330.8040	1.1300	3763.8085 (278)
Space and water heating			14479.8438 (279)
Pumps, fans and electric keep-hot	689.7456	1.5128	1043.4472 (281)
Energy for lighting	434.6085	1.5338	666.6171 (282)
Total Primary energy kWh/year			16189.9081 (286)
Dwelling Primary energy Rate (DPER)			66.3100 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

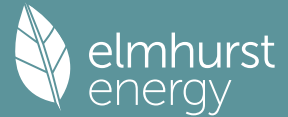
	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Basement floor	127.8000 (1a)	x 3.6000 (2a)	= 460.0800 (1a) - (3a)
Ground floor	116.3500 (1b)	x 3.6000 (2b)	= 418.8600 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	244.1500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	878.9400 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0455 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2955 (18)
Number of sides sheltered	4 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.7000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2069 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)

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Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2637	0.2586	0.2534	0.2275	0.2224	0.1965	0.1965	0.1913	0.2069	0.2224	0.2327	0.2431 (22b)
Effective ac	0.5348	0.5334	0.5321	0.5259	0.5247	0.5193	0.5193	0.5183	0.5214	0.5247	0.5271	0.5295 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Opening Type			46.9300	1.1450	53.7366		(27)
TER Roof Light			14.1100	1.5918	28.5312		(27a)
Basement Floor			127.8000	0.1300	16.6140		(28a)
main above ground	166.3200	46.9300	119.3900	0.1800	21.4902		(29a)
basement wall	171.0000		171.0000	0.1800	30.7800		(29a)
Main Roof	116.3500	14.1100	102.2400	0.1100	11.2464		(30)
Over basement	11.4500		11.4500	0.1100	1.2595		(30)
Total net area of external elements Aum(A, m2)			592.9200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	163.6580		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

194.8886 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	18.1000	0.0500	0.9050
E3 Sill	18.1000	0.0500	0.9050
E4 Jamb	40.2000	0.0500	2.0100
R11 Upstands or kerbs of rooflights	41.5600	0.0800	3.3248
E22 Basement floor	47.5000	0.0700	3.3250
E14 Flat roof	10.6000	0.0800	0.8480
E24 Eaves (insulation at ceiling level - inverted)	7.8000	0.2400	1.8720
E6 Intermediate floor within a dwelling	36.7000	0.0000	0.0000
E16 Corner (normal)	14.4000	0.0900	1.2960
E15 Flat roof with parapet	46.2000	0.5600	25.8720
E16 Corner (normal)	3.6000	0.0900	0.3240
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			40.6818 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	204.3398 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	155.1130	154.7213	154.3373	152.5338	152.1964	150.6256	150.6256	150.3347	151.2307	152.1964	152.8790	153.5927 (38)
Heat transfer coeff	359.4528	359.0611	358.6771	356.8736	356.5362	354.9654	354.9654	354.6745	355.5705	356.5362	357.2188	357.9325 (39)
Average = Sum(39)m / 12 =												356.8720

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.4723	1.4707	1.4691	1.4617	1.4603	1.4539	1.4539	1.4527	1.4564	1.4603	1.4631	1.4660 (40)
HLP (average)												1.4617
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

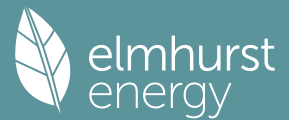
4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0593 (42)
Hot water usage for mixer showers	75.5147	74.3799	72.7262	69.5622	67.2272	64.6232	63.1432	64.7843	66.5834	69.3792	72.6112	75.2254 (42a)
Hot water usage for baths	32.5970	32.1129	31.4312	30.1742	29.2330	28.1893	27.6256	28.3025	29.0396	30.1564	31.4392	32.4868 (42b)
Hot water usage for other uses	45.9605	44.2893	42.6180	40.9467	39.2754	37.6041	37.6041	39.2754	40.9467	42.6180	44.2893	45.9605 (42c)
Average daily hot water use (litres/day)												141.6269 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	154.0723	150.7820	146.7753	140.6830	135.7355	130.4166	128.3728	132.3622	136.5696	142.1535	148.3397	153.6727 (44)
Distribution loss (46)m = 0.15 x (45)m	244.0128	214.7116	225.5882	192.5880	182.7261	160.3625	155.2558	163.8921	168.4040	192.9010	211.3371	240.6144 (45)
Water storage loss (or HIU loss):										Total = Sum(45)m =		2352.3935
Store volume	36.6019	32.2067	33.8382	28.8882	27.4089	24.0544	23.2884	24.5838	25.2606	28.9352	31.7006	36.0922 (46)
a) If manufacturer declared loss factor is known (kWh/day):												200.0000 (47)
Temperature factor from Table 2b												1.6525 (48)
Enter (49) or (54) in (55)												0.5400 (49)
Total storage loss												0.8924 (55)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
Primary loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (57)
Combi loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
WWHRS	294.9389	260.7093	276.5143	241.8713	233.6522	209.6458	206.1819	214.8182	217.6873	243.8271	260.6204	291.5404 (62)
PV diverter	-34.5222	-30.5317	-31.9710	-26.4733	-24.6721	-21.1121	-19.7893	-21.0439	-21.8434	-25.7510	-29.1727	-33.8829 (63a)
Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
12Total per year (kWh/year)	260.4167	230.1776	244.5432	215.3980	208.9800	188.5336	186.3926	193.7743	195.8439	218.0761	231.4476	257.6576 (64)
Electric shower(s)								Total per year (kWh/year) = Sum(64)m =				2631.2414 (64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
								Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =				0.0000 (64a)
Heat gains from water heating, kWh/month												
	121.8751	108.1898	115.7489	103.4621	101.4973	92.7472	92.3634	95.2350	95.4210	104.8804	109.6962	120.7451 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
(66)m	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
207.4450	229.6713	207.4450	214.3599	207.4450	214.3599	207.4450	207.4450	214.3599	207.4450	214.3599	207.4450	207.4450 (67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	411.2830	415.5508	404.7960	381.9004	352.9987	325.8351	307.6883	303.4204	314.1752	337.0709	365.9726	393.1361 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730 (71)
Water heating gains (Table 5)	163.8106	160.9967	155.5765	143.6974	136.4211	128.8155	124.1444	128.0040	132.5291	140.9683	152.3559	162.2918 (72)
Total internal gains	854.4286	878.1087	839.7075	811.8475	768.7547	737.9004	708.1675	707.7594	729.9541	757.3742	804.5782	834.7629 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North				3.4600	10.6334	0.6300	0.7000		0.7700		11.2440 (74)	
East				21.6600	19.6403	0.6300	0.7000		0.7700		130.0102 (76)	
West				21.8100	19.6403	0.6300	0.7000		0.7700		130.9106 (80)	
North				14.1100	26.0000	0.6300	0.7000		1.0000		145.6067 (82)	
Solar gains	417.7716	834.3183	1414.7212	2124.6288	2656.6920	2742.6409	2601.6626	2199.6573	1665.5635	1000.8477	524.0171	341.5476 (83)
Total gains	1272.2001	1712.4271	2254.4287	2936.4763	3425.4467	3480.5413	3309.8302	2907.4167	2395.5176	1758.2219	1328.5953	1176.3105 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	36.7704	36.8106	36.8500	37.0362	37.0712	37.2353	37.2353	37.2658	37.1719	37.0712	37.0004	36.9266	
alpha	3.4514	3.4540	3.4567	3.4691	3.4714	3.4824	3.4824	3.4844	3.4781	3.4714	3.4667	3.4618	
util living area	0.9963	0.9894	0.9677	0.8978	0.7636	0.5925	0.4530	0.5256	0.7859	0.9591	0.9924	0.9972 (86)	
MIT	18.6492	18.9706	19.5002	20.1633	20.6515	20.8956	20.9689	20.9485	20.7157	19.9939	19.1861	18.5940 (87)	
Th 2	19.7084	19.7096	19.7108	19.7163	19.7174	19.7223	19.7223	19.7232	19.7204	19.7174	19.7153	19.7131 (88)	
util rest of house	0.9952	0.9864	0.9583	0.8687	0.7016	0.4949	0.3299	0.3948	0.7018	0.9419	0.9897	0.9963 (89)	
MIT 2	16.9867	17.3974	18.0674	18.8805	19.4268	19.6611	19.7117	19.7035	19.5176	18.6991	17.6784	16.9189 (90)	
Living area fraction	17.4132	17.8010	18.4349	19.2095	19.7409	19.9777	20.0342	20.0229	19.8249	19.0312	18.0652	17.3486 (92)	
MIT	17.4132	17.8010	18.4349	19.2095	19.7409	19.9777	20.0342	20.0229	19.8249	19.0312	18.0652	17.3486 (93)	
Temperature adjustment												0.0000	
adjusted MIT	17.4132	17.8010	18.4349	19.2095	19.7409	19.9777	20.0342	20.0229	19.8249	19.0312	18.0652	17.3486 (93)	

8. Space heating requirement

Utilisation	0.9920	0.9795	0.9453	0.8546	0.7029	0.5157	0.3610	0.4272	0.7098	0.9290	0.9843	0.9938 (94)	
Useful gains	1262.0586	1677.3028	2131.0439	2509.4580	2407.7387	1794.7464	1194.9944	1242.1705	1700.2307	1633.4701	1307.7435	1169.0332 (95)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)	
Heat loss rate W	4713.5600	4632.2382	4280.7922	3679.2032	2866.8873	1908.9116	1219.0310	1284.9482	2035.6179	3006.0419	3916.9696	4706.3204 (97)	
Space heating kWh	2567.9170	1985.7166	1599.4127	842.2166	341.6065	0.0000	0.0000	0.0000	0.0000	1021.1934	1878.6428	2631.7417 (98a)	
Space heating requirement - total per year (kWh/year)												12868.4474	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)	
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2567.9170	1985.7166	1599.4127	842.2166	341.6065	0.0000	0.0000	0.0000	0.0000	1021.1934	1878.6428	2631.7417 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												12868.4474	
Space heating per m2												52.7071 (99)	

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													92.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	2567.9170	1985.7166	1599.4127	842.2166	341.6065	0.0000	0.0000	0.0000	0.0000	1021.1934	1878.6428	2631.7417 (98)	
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)	
Space heating fuel (main heating system)	2782.1419	2151.3723	1732.8415	912.4773	370.1046	0.0000	0.0000	0.0000	0.0000	1106.3850	2035.3660	2851.2911 (211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	260.4167	230.1776	244.5432	215.3980	208.9800	188.5336	186.3926	193.7743	195.8439	218.0761	231.4476	257.6576 (64)	
Efficiency of water heater (217)m	87.8874	87.7717	87.4914	86.8061	85.1547	79.8000	79.8000	79.8000	79.8000	87.0719	87.7149	79.8000 (216)	
Fuel for water heating, kWh/month	296.3074	262.2458	279.5055	248.1370	245.4121	236.2577	233.5747	242.8249	245.4184	250.4551	263.8635	293.0730 (219)	
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)	
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)	

Full SAP Calculation Printout



Lighting	43.1030	34.5788	31.1344	22.8104	17.6194	14.3952	16.0730	20.8923	27.1370	35.6053	40.2161	44.3009	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-102.1153	-135.9153	-184.4712	-195.3086	-200.6951	-183.5708	-180.9039	-175.2138	-164.3380	-148.9731	-109.1756	-89.2220	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-85.0090	-174.7722	-340.3255	-501.4608	-654.2031	-654.4562	-647.0980	-552.1957	-410.3255	-247.0378	-112.4752	-67.5733	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												13941.9798	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3097.0751	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												347.8658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-6316.8352	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												11156.0855	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	13941.9798	0.2100	2927.8158 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3097.0751	0.2100	650.3858 (264)
Space and water heating			3578.2015 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	347.8658	0.1443	50.2078 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1869.9028	0.1359	-254.1073
PV Unit electricity exported	-4446.9324	0.1265	-562.3480
Total			-816.4553 (269)
Total CO2, kg/year			2823.8833 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5700 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	13941.9798	1.1300	15754.4372 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3097.0751	1.1300	3499.6949 (278)
Space and water heating			19254.1321 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	347.8658	1.5338	533.5681 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1869.9028	1.5023	-2809.1746
PV Unit electricity exported	-4446.9324	0.4642	-2064.3105
Total			-4873.4851 (283)
Total Primary energy kWh/year			15044.3159 (286)
Target Primary Energy Rate (TPER)			61.6200 (287)

Appendix 3



Summary for Input Data

Plot Reference	Tower Terrace		Issued on Date	04/03/2026
Assessment Reference	BE GREEN	Plot Type Ref	ES L1A	
Plot Address	17, Tower Terrace, LONDON, N22		SAP Version	10.2

SAP Rating	86 B	DER	2.65	TER	11.57
Environmental	97 A	% DER < TER			77.10
CO ₂ Emissions (t/year)	0.57	DFEE	57.91	TFEE	58.88
Compliance Check	See BREL	% DFEE < TFEE			1.65
% DPER < TPER	55.23	DPER	27.59	TPER	61.62

Assessor Details	Mr. Neil Rotheron	Assessor ID	L759-0001
Client	example, example		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South	
Property Tenture	1	
Transaction Type	6	
Terrain Type	Urban	
1.0 Property Type	House, Detached	
2.0 Number of Storeys	2	
3.0 Date Built	2026	
4.0 Sheltered Sides	4	
5.0 Sunlight/Shade	Average or unknown	
6.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	194.89	kJ/m²

7.0 Electricity Tariff	Standard
Smart electricity meter fitted	No
Smart gas meter fitted	No

7.0 Measurements		Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Basement:	47.50 m	127.80 m ²	3.60 m
	Ground floor:	46.20 m	116.35 m ²	3.60 m

8.0 Living Area	62.63	m ²
-----------------	-------	----------------

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area(m ²)	Nett Area (m ²)	Shelter Res	Shelter	Openings	Area Calculation Type
main above ground	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.16	60.00	166.32	102.81	0.00	None	63.51	Enter Gross Area
basement wall	Solid Wall	Solid wall : plasterboard on dabs, insulation, any outside structure	0.16	9.00	171.00	171.00	0.00	None	0.00	Enter Gross Area

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
Internal Wall 1	Plasterboard on timber frame	9.00	174.24

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area(m ²)	Nett Area (m ²)	Shelter Code	Shelter Factor	Calculation Type	Openings
Main Roof	External Flat Roof	Plasterboard, insulated flat roof	0.11	9.00	116.35	97.25	None	0.00	Enter Gross Area	19.10
Over basement	External Flat Roof	Plasterboard, insulated flat roof	0.11	9.00	11.45	11.45	None	0.00	Enter Gross Area	0.00

Description	Storey	Construction	Kappa	Area (m ²)
Internal Ceiling 1	Basement	Other	100.00	116.35

Description	Type	Storey Index	Construction	U-Value (W/m ² K)	Shelter Code	Shelter Factor	Kappa (kJ/m ² K)	Area (m ²)
Basement Floor	Ground Floor - Solid	Basement	Slab on ground, screed over insulation	0.10	None	0.00	110.00	127.80

11.2 Internal Floors

Summary for Input Data

Description	Storey Index	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Lowest occupied	Other	100.00	116.35

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Front door	Manufacturer	Window	Double Low-E Hard 0.2			0.40		0.70	1.20
Windows	Manufacturer	Window	Double Low-E Hard 0.15			0.40		0.70	1.20
Roof Glazing	Manufacturer	Roof Light	Double Low-E Soft 0.1			0.40		0.70	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Area (m²)	Pitch
Front door	Front door	main above ground	East	2.31	
Windows side to walkway rear	Windows	main above ground	East	27.00	
side window to walkway	Windows	main above ground	North	4.68	
Roof Light	Windows	main above ground	West	29.52	
Roof glazing	Roof Glazing	Main Roof	North	9.18	0
	Roof Glazing	Main Roof	North	9.92	0

14.0 Conservatory

None

15.0 Draught Proofing

100

 %

16.0 Draught Lobby

No

17.0 Thermal Bridging

Calculate Bridges

17.1 List of Bridges

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E2 Other lintels (including other steel lintels)	Independently assessed	18.10	0.02	0.02 rcd	Yes
E3 Sill	Independently assessed	18.10	0.02	0.02 rcd	Yes
E4 Jamb	Independently assessed	40.20	0.02	0.02 rcd	Yes
R11 Upstands or kerbs of rooflights	Independently assessed	41.56	0.12	0.12 assumed calculated	Yes
E22 Basement floor	Independently assessed	47.50	0.11	0.11 assumed calculated	No
E14 Flat roof	Table K1 - Default	10.60	0.16	0.16 over basement	No
E24 Eaves (insulation at ceiling level - inverted)	Table K1 - Default	7.80	0.15	0.15 df	No
E6 Intermediate floor within a dwelling	Independently assessed	36.70	0.06	0.06 rcd	No
E16 Corner (normal)	Table K1 - Default	14.40	0.18	0.18 basement	No
E15 Flat roof with parapet	Table K1 - Default	46.20	0.30	0.30 main	No
E16 Corner (normal)	Independently assessed	3.60	0.04	0.04 rcd upper	No

Y-value

0.06

 W/m²K

19.0 Mechanical Ventilation

Mechanical Ventilation

Mechanical Ventilation System Present

 Yes

Mechanical Ventilation data Type

 Data Sheet

Type

 Balanced mechanical ventilation with heat recovery

Manufacturer SFP

 0.55

Duct Type

 Flexible

MVHR Efficiency

 90.00

Wet Rooms

 2

Brand, Model

 tbc

SFP from Installer Commissioning Certificate

 Yes

MVHR System Location

 Inside heated envelope (installed exclusively)

Duct Installation Specification

 Level 1

20.0 Fans, Open Fireplaces, Flues

Number of open chimneys

 0

Number of open flues

 0

Number of chimneys/flues attached to closed fire

 0

Number of flues attached to solid fuel boiler

 0

Number of flues attached to other heater

 0

Number of blocked chimneys

 0

Number of intermittent extract fans

 0

Number of passive vents

 0

Number of flueless gas fires

 0

Summary for Input Data

21.0 Fixed Cooling System	No				
22.0 Pressure Testing	Yes				
Designed AP ₅₀	2.00	m ² /(h.m ²) @ 50 Pa			
Test Method	Blower Door				
22.0 Lighting	No				
No Fixed Lighting	No				
	Name Lighting 1	Efficacy 95.00	Power 5.00	Capacity 475.00	Count 17
24.0 Main Heating 1	Database				
Percentage of Heat	100.00 %				
Database Ref. No.	103788				
Fuel Type	Electricity				
In Winter	386.93				
In Summer	268.33				
Model Name	aroTHERM 10kW				
Manufacturer	Vaillant Group UK Ltd				
System Type	Heat Pump				
Controls SAP Code	2207				
Controls description	Time and temperature zone control by arrangement				
Is MHS Pumped	Pump in heated space				
Heating Pump Age	2013 or later				
Heat Emitter	Radiators				
Flow Temperature	Enter value				
Flow Temperature Value	35.00				
25.0 Main Heating 2	None				
26.0 Heat Networks	None				
27.0 Secondary Heating	SAP table				
SAP Code	633				
Heating System Description	Solid fuel Closed room heater				
Fuel Type	Smokeless Fuel				
SHS efficiency	60.00 %				
HETAS Approved System	Yes				
28.0 Water Heating	Main Heating 1				
Water Heating	Main Heating 1				
SAP Code	901				
Flue Gas Heat Recovery System	No				
Waste Water Heat Recovery Instantaneous System 1	No				
Waste Water Heat Recovery Instantaneous System 2	No				
Waste Water Heat Recovery Storage System	No				
Solar Panel	No				
Water use <= 125 litres/person/day	Yes				
Cold Water Source	From mains				
Bath Count	1				
Immersion Only Heating Hot Water	No				
28.1 Showers					
Description	Shower Type	Flow Rate [l/min]	Rated Power [kW]	Connected	Connected To
es	Vented hot water system	7.00		No	

Summary for Input Data

28.3 Waste Water Heat Recovery System

29.0 Hot Water Cylinder

Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	200.00	L
Loss	1.80	kWh/day
Pipes insulation	Fully insulated primary pipework	

31.0 Thermal Store

None

34.0 Small-scale Hydro

None

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

Recommendations

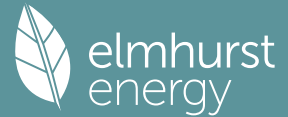
Lower cost measures

None

Further measures to achieve even higher standards

None

Full SAP Calculation Printout



Plot Reference	Tower Terrace			Issued on Date	04/03/2026
Assessment Reference	BE GREEN	Plot Type Ref	ES L1A		
Plot Address	17, Tower Terrace, LONDON, N22			SAP Version	10.2
SAP Rating	86 B	DER	2.65	TER	11.57
Environmental	97 A	% DER < TER			77.10
CO ₂ Emissions (t/year)	0.57	DFEE	57.91	TFEE	58.88
Compliance Check	See BREL	% DFEE < TFEE			1.65
% DPER < TPER	55.23	DPER	27.59	TPER	61.62
Assessor Details	Mr. Neil Rothon			Assessor ID	L759-0001
Client	example, example				

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Basement floor	127.8000 (1a)	x 3.6000 (2a)	= 460.0800 (1a) - (3a)
Ground floor	116.3500 (1b)	x 3.6000 (2b)	= 418.8600 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	244.1500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 878.9400 (5)

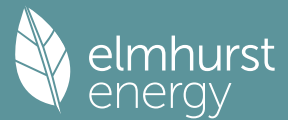
2. Ventilation rate

	m ³ per hour											
Number of open chimneys	0 * 80 = 0.0000 (6a)											
Number of open flues	0 * 20 = 0.0000 (6b)											
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)											
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)											
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)											
Number of blocked chimneys	0 * 20 = 0.0000 (6f)											
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)											
Number of passive vents	0 * 10 = 0.0000 (7b)											
Number of flueless gas fires	0 * 40 = 0.0000 (7c)											
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 0.0000 / (5) = 0.0000 (8)											
Pressure test	Yes											
Pressure Test Method	Blower Door											
Measured/design AP50	2.0000 (17)											
Infiltration rate	0.1000 (18)											
Number of sides sheltered	4 (19)											
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.7000 (20)											
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.0700 (21)											
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.0892	0.0875	0.0857	0.0770	0.0752	0.0665	0.0665	0.0648	0.0700	0.0752	0.0787	0.0822 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1842	0.1825	0.1807	0.1720	0.1702	0.1615	0.1615	0.1597	0.1650	0.1702	0.1737	0.1772 (25)

3. Heat losses and heat loss parameter

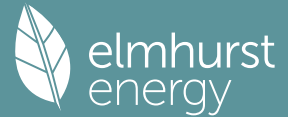
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Front door			2.3100	1.1450	2.6450		(27)
Windows			61.2000	1.1450	70.0763		(27)
Roof Glazing			19.1000	1.2357	23.6027		(27a)
Basement Floor			127.8000	0.1000	12.7800	110.0000	14058.0000 (28a)
main above ground	166.3200	63.5100	102.8100	0.1600	16.4496	60.0000	6168.6000 (29a)
basement wall	171.0000		171.0000	0.1600	27.3600	9.0000	1539.0000 (29a)
Main Roof	116.3500	19.1000	97.2500	0.1100	10.6975	9.0000	875.2500 (30)
Over basement	11.4500		11.4500	0.1100	1.2595	9.0000	103.0500 (30)
Total net area of external elements A _{um} (A, m ²)			592.9200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	164.8706		(33)
Main dwelling							
Internal Wall 1			174.2400			9.0000	1568.1600 (32c)
Internal Floor 1			116.3500			100.0000	11635.0000 (32d)
Internal Ceiling 1			116.3500			100.0000	11635.0000 (32e)

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Heat capacity Cm = Sum(A x k)											
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K											
List of Thermal Bridges											
K1 Element											
E2 Other lintels (including other steel lintels)											
E3 Sill											
E4 Jamb											
R11 Upstands or kerbs of rooflights											
E22 Basement floor											
E14 Flat roof											
E24 Eaves (insulation at ceiling level - inverted)											
E6 Intermediate floor within a dwelling											
E16 Corner (normal)											
E15 Flat roof with parapet											
E16 Corner (normal)											
Thermal bridges (Sum(L x Psi) calculated using Appendix K)											
Point Thermal bridges											
Total fabric heat loss											
(28)...(30) + (32) + (32a)...(32e) = 47582.0600 (34)											
194.8886 (35)											
Length											
Psi-value											
Total											
18.1000 0.0240 0.4344											
18.1000 0.0210 0.3801											
40.2000 0.0160 0.6432											
41.5600 0.1200 4.9872											
47.5000 0.1100 5.2250											
10.6000 0.1600 1.6960											
7.8000 0.1500 1.1700											
36.7000 0.0600 2.2020											
14.4000 0.1800 2.5920											
46.2000 0.3000 13.8600											
3.6000 0.0350 0.1260											
33.3159 (36)											
(36a) = 0.0000											
(33) + (36) + (36a) = 198.1865 (37)											
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)											
(38)m											
Heat transfer coeff											
Average = Sum(39)m / 12 =											
HLP											
HLP (average)											
Days in mont											
4. Water heating energy requirements (kWh/year)											
Assumed occupancy											
Hot water usage for mixer showers											
Hot water usage for baths											
Hot water usage for other uses											
Average daily hot water use (litres/day)											
Daily hot water use											
Energy conte											
Energy content (annual)											
Distribution loss (46)m = 0.15 x (45)m											
Water storage loss (or HIU loss):											
Store volume											
a) If manufacturer declared loss factor is known (kWh/day):											
Temperature factor from Table 2b											
Enter (49) or (54) in (55)											
Total storage loss											
If cylinder contains dedicated solar storage											
Primary loss											
Combi loss											
Total heat required for water heating calculated for each month											
WWHRS											
PV diverter											
Solar input											
FGHRS											
Output from w/h											
12Total per year (kWh/year)											
Electric shower(s)											
Heat gains from water heating, kWh/month											
5. Internal gains (see Table 5 and 5a)											
Metabolic gains (Table 5), Watts											
(66)m											
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5											
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5											
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5											
Pumps, fans											
Losses e.g. evaporation (negative values) (Table 5)											
Water heating gains (Table 5)											
Total internal gains											
6. Solar gains											
[Jan]											
Area											
Solar flux											
Specific data											
Specific data											
Access											
factor											
Gains											
W											

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East			2.3100		19.6403		0.4000		0.7000		0.7700		8.8034 (76)
North			4.6800		10.6334		0.4000		0.7000		0.7700		9.6563 (74)
East			27.0000		19.6403		0.4000		0.7000		0.7700		102.8969 (76)
West			29.5200		19.6403		0.4000		0.7000		0.7700		112.5006 (80)
North			19.1000		26.0000		0.4000		0.7000		1.0000		125.1432 (82)

Solar gains	359.0004	716.9510	1215.7108	1825.7593	2282.9797	2356.8389	2235.6916	1890.2345	1431.2684	860.0554	450.3001	293.4991	(83)
Total gains	1213.0831	1594.7139	2055.0724	2637.2609	3051.3885	3097.3934	2946.5132	2600.6480	2163.8767	1617.0837	1254.5324	1127.9161	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5268	52.6330	52.7396	53.2792	53.3884	53.9414	53.9414	54.0534	53.7188	53.3884	53.1704	52.9541	
alpha	4.5018	4.5089	4.5160	4.5519	4.5592	4.5961	4.5961	4.6036	4.5813	4.5592	4.5447	4.5303	
util living area	0.9973	0.9908	0.9654	0.8686	0.6897	0.4951	0.3636	0.4273	0.7096	0.9517	0.9936	0.9981	(86)
Living	19.3659	19.6543	20.0981	20.6104	20.8916	20.9809	20.9963	20.9925	20.9109	20.4323	19.7903	19.3217	
Non living	18.1265	18.4957	19.0563	19.6784	19.9809	20.0687	20.0789	20.0789	20.0129	19.4855	18.6770	18.0746	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1640	19.6543	20.0981	20.6104	20.8916	20.9809	20.9963	20.9925	20.9109	20.4323	19.7903	19.5564	(87)
Th 2	20.0579	20.0596	20.0613	20.0700	20.0717	20.0803	20.0803	20.0821	20.0769	20.0717	20.0682	20.0648	(88)
util rest of house	0.9966	0.9884	0.9565	0.8395	0.6369	0.4282	0.2887	0.3445	0.6376	0.9347	0.9916	0.9976	(89)
MIT 2	19.2879	18.4957	19.0563	19.6784	19.9809	20.0687	20.0789	20.0789	20.0129	19.4855	18.6770	18.4333	(90)
Living area fraction									fLA = Living area /	(4) =		0.2565	(91)
MIT	19.5127	18.7929	19.3235	19.9175	20.2145	20.3027	20.3142	20.3133	20.2433	19.7283	18.9626	18.7214	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5127	18.7929	19.3235	19.9175	20.2145	20.3027	20.3142	20.3133	20.2433	19.7283	18.9626	18.7214	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9839	0.9477	0.8342	0.6455	0.4447	0.3079	0.3656	0.6515	0.9268	0.9881	0.9965	(94)
Useful gains	1208.3795	1568.9934	1947.5803	2200.0300	1969.5287	1377.3370	907.2505	950.7970	1409.7059	1498.6534	1239.5772	1123.9866	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3827.9363	3488.8027	3213.7404	2733.1708	2107.9246	1397.3355	910.0965	956.8819	1511.5194	2259.8831	2948.8381	3624.5080	(97)
Space heating kWh	1948.9503	1290.1119	942.0232	383.8614	102.9665	0.0000	0.0000	0.0000	0.0000	566.3549	1230.6678	1860.3879	(98a)
Space heating requirement - total per year (kWh/year)												8325.3238	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1948.9503	1290.1119	942.0232	383.8614	102.9665	0.0000	0.0000	0.0000	0.0000	566.3549	1230.6678	1860.3879	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8325.3238	
Space heating per m2										(98c) / (4) =		34.0992	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													386.9348 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1948.9503	1290.1119	942.0232	383.8614	102.9665	0.0000	0.0000	0.0000	0.0000	566.3549	1230.6678	1860.3879	(98)
Space heating efficiency (main heating system 1)	386.9348	386.9348	386.9348	386.9348	386.9348	0.0000	0.0000	0.0000	0.0000	386.9348	386.9348	386.9348	(210)
Space heating fuel (main heating system)	503.6896	333.4184	243.4579	99.2057	26.6108	0.0000	0.0000	0.0000	0.0000	146.3696	318.0556	480.8014	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	297.4072	262.9388	278.9826	244.2600	236.1205	212.0345	208.6502	217.2865	220.0760	246.2954	263.0091	294.0088	(64)
Efficiency of water heater													
(217)m	268.3307	268.3307	268.3307	268.3307	268.3307	268.3307	268.3307	268.3307	268.3307	268.3307	268.3307	268.3307	(216)
Fuel for water heating, kWh/month	110.8361	97.9906	103.9697	91.0295	87.9961	79.0198	77.7586	80.9771	82.0167	91.7880	98.0168	109.5696	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	55.0989	49.7668	55.0989	53.3216	55.0989	53.3216	55.0989	55.0989	53.3216	55.0989	53.3216	55.0989	(231)
Lighting	53.8510	43.2013	38.8980	28.4983	22.0129	17.9847	20.0809	26.1019	33.9038	44.4837	50.2442	55.3477	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

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Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year												
Space heating fuel - main system 1											2151.6092	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											268.3307	
Water heating fuel used											1110.9686	(219)
Space cooling fuel											0.0000	(221)

Electricity for pumps and fans: (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.1000, SFP = 0.6050)												
mechanical ventilation fans (SFP = 0.6050)											648.7456	(230a)
Total electricity for the above, kWh/year											648.7456	(231)
Electricity for lighting (calculated in Appendix L)											434.6085	(232)

Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation											0.0000	(233)
Wind generation											0.0000	(234)
Hydro-electric generation (Appendix N)											0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)											0.0000	(235)
Appendix Q - special features												
Energy saved or generated											-0.0000	(236)
Energy used											0.0000	(237)
Total delivered energy for all uses											4345.9319	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2151.6092	0.1565	336.6998	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1110.9686	0.1410	156.6174	(264)
Space and water heating			493.3172	(265)
Pumps, fans and electric keep-hot	648.7456	0.1387	89.9890	(267)
Energy for lighting	434.6085	0.1443	62.7274	(268)
Total CO2, kg/year			646.0337	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.6500	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2151.6092	1.5793	3398.0194	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1110.9686	1.5213	1690.0872	(278)
Space and water heating			5088.1066	(279)
Pumps, fans and electric keep-hot	648.7456	1.5128	981.4224	(281)
Energy for lighting	434.6085	1.5338	666.6171	(282)
Total Primary energy kWh/year			6736.1461	(286)
Dwelling Primary energy Rate (DPER)			27.5900	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

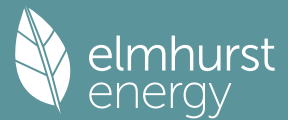
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling				
Basement floor	127.8000 (1a)	x 3.6000 (2a)	= 460.0800 (1a) - (3a)	
Ground floor	116.3500 (1b)	x 3.6000 (2b)	= 418.8600 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	244.1500		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	878.9400 (5)	

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	Air changes per hour	
Pressure test	40.0000 / (5) =	0.0455 (8)
Pressure Test Method	Yes	
Measured/design AP50	Blower Door	
Infiltration rate	5.0000	(17)
Number of sides sheltered	0.2955	(18)
	4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2069 (21)

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Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
Effective ac	0.2637	0.2586	0.2534	0.2275	0.2224	0.1965	0.1965	0.1913	0.2069	0.2224	0.2327	0.2431	(22b)
	0.5348	0.5334	0.5321	0.5259	0.5247	0.5193	0.5193	0.5183	0.5214	0.5247	0.5271	0.5295	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Opening Type			46.9300	1.1450	53.7366		(27)
TER Roof Light			14.1100	1.5918	28.5312		(27a)
Basement Floor			127.8000	0.1300	16.6140		(28a)
main above ground	166.3200	46.9300	119.3900	0.1800	21.4902		(29a)
basement wall	171.0000		171.0000	0.1800	30.7800		(29a)
Main Roof	116.3500	14.1100	102.2400	0.1100	11.2464		(30)
Over basement	11.4500		11.4500	0.1100	1.2595		(30)
Total net area of external elements Aum(A, m2)			592.9200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	163.6580	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

194.8886 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	18.1000	0.0500	0.9050
E3 Sill	18.1000	0.0500	0.9050
E4 Jamb	40.2000	0.0500	2.0100
R11 Upstands or kerbs of rooflights	41.5600	0.0800	3.3248
E22 Basement floor	47.5000	0.0700	3.3250
E14 Flat roof	10.6000	0.0800	0.8480
E24 Eaves (insulation at ceiling level - inverted)	7.8000	0.2400	1.8720
E6 Intermediate floor within a dwelling	36.7000	0.0000	0.0000
E16 Corner (normal)	14.4000	0.0900	1.2960
E15 Flat roof with parapet	46.2000	0.5600	25.8720
E16 Corner (normal)	3.6000	0.0900	0.3240
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			40.6818 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 204.3398 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	155.1130	154.7213	154.3373	152.5338	152.1964	150.6256	150.6256	150.3347	151.2307	152.1964	152.8790	153.5927	(38)
Heat transfer coeff	359.4528	359.0611	358.6771	356.8736	356.5362	354.9654	354.9654	354.6745	355.5705	356.5362	357.2188	357.9325	(39)
Average = Sum(39)m / 12 =												356.8720	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4723	1.4707	1.4691	1.4617	1.4603	1.4539	1.4539	1.4527	1.4564	1.4603	1.4631	1.4660	(40)
HLP (average)												1.4617	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

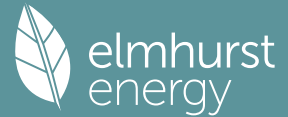
4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0593 (42)
Hot water usage for mixer showers													
75.5147	74.3799	72.7262	69.5622	67.2272	64.6232	63.1432	64.7843	66.5834	69.3792	72.6112	75.2254	75.2254	(42a)
Hot water usage for baths													
32.5970	32.1129	31.4312	30.1742	29.2330	28.1893	27.6256	28.3025	29.0396	30.1564	31.4392	32.4868	32.4868	(42b)
Hot water usage for other uses													
45.9605	44.2893	42.6180	40.9467	39.2754	37.6041	37.6041	39.2754	40.9467	42.6180	44.2893	45.9605	45.9605	(42c)
Average daily hot water use (litres/day)													141.6269 (43)
Daily hot water use													
154.0723	150.7820	146.7753	140.6830	135.7355	130.4166	128.3728	132.3622	136.5696	142.1535	148.3397	153.6727	153.6727	(44)
Energy conte	244.0128	214.7116	225.5882	192.5880	182.7261	160.3625	155.2558	163.8921	168.4040	192.9010	211.3371	240.6144	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													
36.6019	32.2067	33.8382	28.8882	27.4089	24.0544	23.2884	24.5838	25.2606	28.9352	31.7006	36.0922	36.0922	(46)
Water storage loss (or HIU loss):													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6525 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8924 (55)
Total storage loss													
27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	(56)
If cylinder contains dedicated solar storage													
27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
294.9389	260.7093	276.5143	241.8713	233.6522	209.6458	206.1819	214.8182	217.6873	243.8271	260.6204	291.5404	291.5404	(62)
WWHRS	-34.5222	-30.5317	-31.9710	-26.4733	-24.6721	-21.1121	-19.7893	-21.0439	-21.8434	-25.7510	-29.1727	-33.8829	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
260.4167	230.1776	244.5432	215.3980	208.9800	188.5336	186.3926	193.7743	195.8439	218.0761	231.4476	257.6576	257.6576	(64)
12Total per year (kWh/year)													
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month													
121.8751	108.1898	115.7489	103.4621	101.4973	92.7472	92.3634	95.2350	95.4210	104.8804	109.6962	120.7451	120.7451	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
(66)m	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	152.9662	(66)

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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	207.4450	229.6713	207.4450	214.3599	207.4450	214.3599	207.4450	214.3599	207.4450	214.3599	207.4450 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	411.2830	415.5508	404.7960	381.9004	352.9987	325.8351	307.6883	303.4204	314.1752	337.0709	365.9726 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966	38.2966 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730	-122.3730 (71)
Water heating gains (Table 5)	163.8106	160.9967	155.5765	143.6974	136.4211	128.8155	124.1444	128.0040	132.5291	140.9683	152.3559 (72)
Total internal gains	854.4286	878.1087	839.7075	811.8475	768.7547	737.9004	708.1675	707.7594	729.9541	757.3742	804.5782 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
North	3.4600	10.6334	0.6300	0.7000	0.7000	0.7700	11.2440 (74)
East	21.6600	19.6403	0.6300	0.7000	0.7000	0.7700	130.0102 (76)
West	21.8100	19.6403	0.6300	0.7000	0.7000	0.7700	130.9106 (80)
North	14.1100	26.0000	0.6300	0.7000	0.7000	1.0000	145.6067 (82)
Solar gains	417.7716	834.3183	1414.7212	2124.6288	2656.6920	2742.6409	2601.6626 (83)
Total gains	1272.2001	1712.4271	2254.4287	2936.4763	3425.4467	3480.5413	3309.8302 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	36.7704	36.8106	36.8500	37.0362	37.0712	37.2353	37.2353	37.2658	37.1719	37.0712	37.0004	36.9266	
alpha	3.4514	3.4540	3.4567	3.4691	3.4714	3.4824	3.4824	3.4844	3.4781	3.4714	3.4667	3.4618	
util living area	0.9963	0.9894	0.9677	0.8978	0.7636	0.5925	0.4530	0.5256	0.7859	0.9591	0.9924	0.9972 (86)	
MIT	18.6492	18.9706	19.5002	20.1633	20.6515	20.8956	20.9689	20.9485	20.7157	19.9939	19.1861	18.5940 (87)	
Th 2	19.7084	19.7096	19.7108	19.7163	19.7174	19.7223	19.7223	19.7232	19.7204	19.7174	19.7153	19.7131 (88)	
util rest of house	0.9952	0.9864	0.9583	0.8687	0.7016	0.4949	0.3299	0.3948	0.7018	0.9419	0.9897	0.9963 (89)	
MIT 2	16.9867	17.3974	18.0674	18.8805	19.4268	19.6611	19.7117	19.7035	19.5176	18.6991	17.6784	16.9189 (90)	
Living area fraction	17.4132	17.8010	18.4349	19.2095	19.7409	19.9777	20.0342	20.0229	19.8249	19.0312	18.0652	17.3486 (91)	
MIT	17.4132	17.8010	18.4349	19.2095	19.7409	19.9777	20.0342	20.0229	19.8249	19.0312	18.0652	17.3486 (92)	
Temperature adjustment												0.0000	
adjusted MIT	17.4132	17.8010	18.4349	19.2095	19.7409	19.9777	20.0342	20.0229	19.8249	19.0312	18.0652	17.3486 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9920	0.9795	0.9453	0.8546	0.7029	0.5157	0.3610	0.4272	0.7098	0.9290	0.9843	0.9938 (94)	
Useful gains	1262.0586	1677.3028	2131.0439	2509.4580	2407.7387	1794.7464	1194.9944	1242.1705	1700.2307	1633.4701	1307.7435	1169.0332 (95)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)	
Heat loss rate W	4713.5600	4632.2382	4280.7922	3679.2032	2866.8873	1908.9116	1219.0310	1284.9482	2035.6179	3006.0419	3916.9696	4706.3204 (97)	
Space heating kWh	2567.9170	1985.7166	1599.4127	842.2166	341.6065	0.0000	0.0000	0.0000	0.0000	1021.1934	1878.6428	2631.7417 (98a)	
Space heating requirement - total per year (kWh/year)												12868.4474	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)	
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2567.9170	1985.7166	1599.4127	842.2166	341.6065	0.0000	0.0000	0.0000	0.0000	1021.1934	1878.6428	2631.7417 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												12868.4474	
Space heating per m2										(98c) / (4) =		52.7071 (99)	

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													92.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	2567.9170	1985.7166	1599.4127	842.2166	341.6065	0.0000	0.0000	0.0000	0.0000	1021.1934	1878.6428	2631.7417 (98)	
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)	
Space heating fuel (main heating system)	2782.1419	2151.3723	1732.8415	912.4773	370.1046	0.0000	0.0000	0.0000	0.0000	1106.3850	2035.3660	2851.2911 (211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	260.4167	230.1776	244.5432	215.3980	208.9800	188.5336	186.3926	193.7743	195.8439	218.0761	231.4476	257.6576 (64)	
Efficiency of water heater (217)m	87.8874	87.7717	87.4914	86.8061	85.1547	79.8000	79.8000	79.8000	79.8000	87.0719	87.7149	79.8000 (216)	
Fuel for water heating, kWh/month	296.3074	262.2458	279.5055	248.1370	245.4121	236.2577	233.5747	242.8249	245.4184	250.4551	263.8635	293.0730 (219)	
Space cooling fuel requirement													

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(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	43.1030	34.5788	31.1344	22.8104	17.6194	14.3952	16.0730	20.8923	27.1370	35.6053	40.2161	44.3009	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-102.1153	-135.9153	-184.4712	-195.3086	-200.6951	-183.5708	-180.9039	-175.2138	-164.3380	-148.9731	-109.1756	-89.2220	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-85.0090	-174.7722	-340.3255	-501.4608	-654.2031	-654.4562	-647.0980	-552.1957	-410.3255	-247.0378	-112.4752	-67.5733	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												13941.9798	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3097.0751	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												347.8658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-6316.8352	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												11156.0855	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	13941.9798	0.2100	2927.8158 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3097.0751	0.2100	650.3858 (264)
Space and water heating			3578.2015 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	347.8658	0.1443	50.2078 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1869.9028	0.1359	-254.1073
PV Unit electricity exported	-4446.9324	0.1265	-562.3480
Total			-816.4553 (269)
Total CO2, kg/year			2823.8833 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5700 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	13941.9798	1.1300	15754.4372 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3097.0751	1.1300	3499.6949 (278)
Space and water heating			19254.1321 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	347.8658	1.5338	533.5681 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1869.9028	1.5023	-2809.1746
PV Unit electricity exported	-4446.9324	0.4642	-2064.3105
Total			-4873.4851 (283)
Total Primary energy kWh/year			15044.3159 (286)
Target Primary Energy Rate (TPER)			61.6200 (287)

Appendix 4





Air-to-water heat pumps • aroTHERM plus

Technical
information

Be ready for the energy change



Vaillant Comfort for your home

A safe investment in the future



State-of-the-art heating technology with minimal environmental impact

Vaillant is continuously advancing the development of heat pump technology. The Vaillant research and development teams constantly strive to develop the most efficient and quiet heat pumps on the market, thoroughly testing them in our own testing centres for durability and performance. For example, we have climate and hail chambers where we can test for robustness and reliability in extreme conditions. Vaillant also manufactures only in Europe, so we can guarantee you and your customers receive the high quality expected from a Vaillant appliance.

Vaillant offers a great new model in our portfolio of air-to-water heat pumps with the introduction of the aroTHERM plus. This award-winning heat pump is the first in our range to use natural refrigerant R290. This refrigerant, commonly used in many household appliances, has a very low Global Warming Potential (GWP) that offers many advantages over refrigerants traditionally used in heat pumps.

The new aroTHERM plus heat pump has technical features for improved efficiency, as well as higher flow temperatures, so it's perfect for new and existing heating systems (including hybrid). It's also impressively quiet in operation and has been accredited by Quiet Mark*.

*Models 3.5, 5, 7 and 12kW

Always the right choice

Reliability and performance of the highest standards ensure peace of mind for your customers. It's so quiet, they won't even know it's on.



High performance

The aroTHERM plus heat pump has been designed to deliver the very best performance with low running costs, making it suitable for radiators as well as underfloor heating. With a flow temperature of up to 75°C, the aroTHERM plus can deliver more usable hot water with high hot water comfort levels and removes the need for direct electric immersion to sterilise the water, protecting from legionella.



Higher energy-efficiency

With a SCOP of up to 5.03, the aroTHERM plus is extremely energy efficient, enabling high energy savings against certain fossil fuels. The aroTHERM plus can also be combined with photovoltaic systems and integrated into smart power grids (SG-ready), so your customers can enjoy the benefits of variable electricity tariffs.



Super quiet

With sound power as low as 54 dB for easier planning and siting, the aroTHERM plus is suitable for use in densely built-up terraced housing estates.



Natural refrigerant

Already fulfilling the next NZEB requirements, the aroTHERM plus uses monobloc technology with a hermetically sealed refrigerant circuit using the natural refrigerant, R290, to deliver the one of the lowest GWP of 3.



Why R290?

R290 is a natural refrigerant with a very low GWP* of three. This offers the following advantages:

- future-proof, as not affected by the F-Gas Regulation
- higher flow temperature of up to 75°C
- higher hot water comfort and protection against legionella without electric auxiliary heating
- wider performance envelope with operating temperature ranging between -25°C and +46°C
- Already fulfilling the next NZEB requirements, the aroTHERM plus uses monobloc technology with a hermetically sealed refrigerant circuit using natural refrigerant R290 to deliver the one of the lowest GWP of 3
- Reduced refrigerant charge compared to R410a and R32

Natural refrigerants are already used in many areas of our daily lives, e.g. in refrigerators and heat pump tumble-driers

Model calculation

R290 (aroTHERM plus)

$$0.6 \text{ kg R290} \times 3 \text{ GWP} = 1.8 \text{ kg CO}_2$$



15 km journey
by car

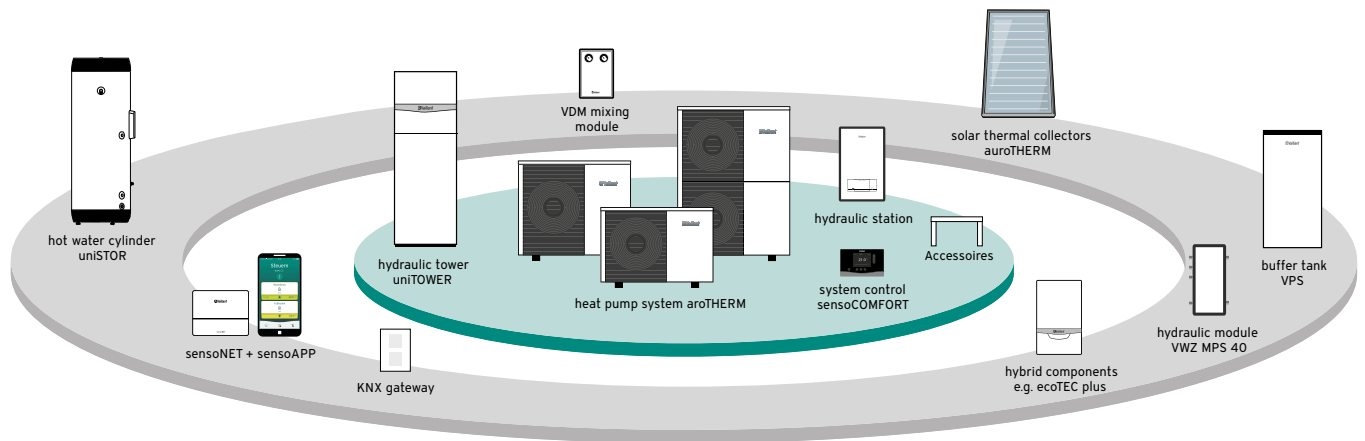
*Comparison of refrigerant GWP values:

CO ₂	1
R290	3
R32	675
R410a	2,088

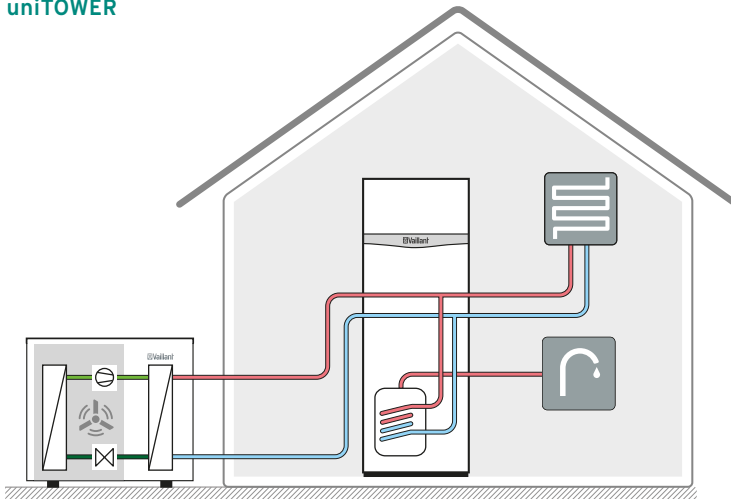


Introducing the perfect partner

Your customers have widely differing wishes and needs. We offer the system components that enable you to fulfil them all – whether they wish to integrate photovoltaics, a solar-thermal system or smart home technology. All conveniently manageable with a single controller – the new sensoCOMFORT. This enables you to quickly commission the system and lets your customers change daily settings at the flick of a wrist.

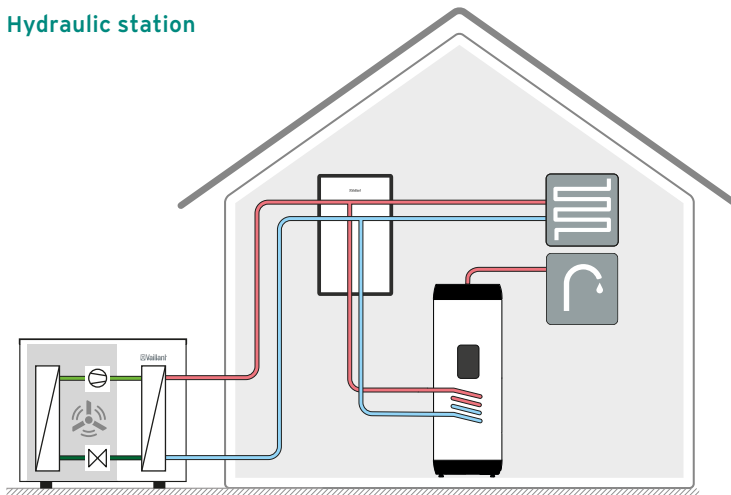


uniTOWER



The uniTOWER is an integrated 190 litre cylinder with hydraulic components which can easily provide sufficient hot water for the needs of a family of five, including the use of rain showers. Thanks to its space-saving dimensions, the system is the perfect choice for new buildings. Installed indoors, the uniTOWER is about the size of a fridge freezer and saves valuable space in the room where it's installed.

Hydraulic station



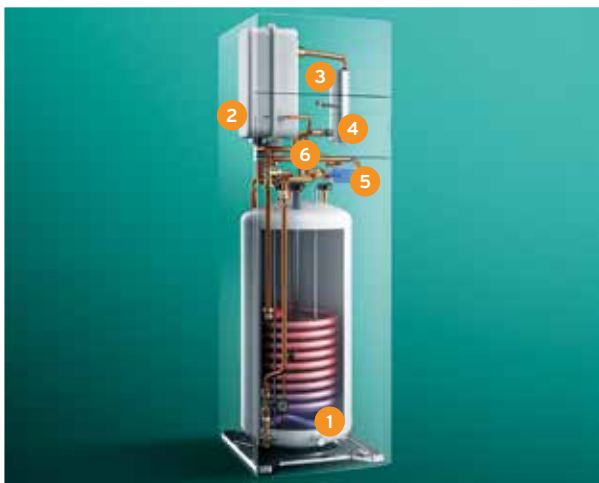
In the case of higher hot water demand, the aroTHERM plus can be used together with a wall-mounted hydraulic station and a wide range of accessories, including the uniSTOR heat pump cylinders and buffer tanks.

Features and benefits



aeroTHERM plus

- 1 Hermetically sealed – no refrigerant certification required
- 2 Floating floor design absorbs vibration and reduces noise
- 3 Vortex sensor for accurate performance analysis
- 4 Weatherproof material and paint make it an ideal choice for coastal areas
- 5 Integrated tray and trace heater to ensure clear condensation run



uniTOWER

- 1 190-litre storage cylinder capacity, corresponds to up to 380-litres of usable hot water output
- 2 Hydraulic components already integrated, e.g. 15-litre expansion vessel
- 3 System accessory options, ready for integration, e.g. heating zone packs, 18-litre buffer or system separation plate heat exchanger
- 4 Modulating electric auxiliary heater with up to 6 kW
- 5 3-way diverter valve
- 6 Electric wiring interface



Hydraulic module

- 1 Hydraulic components already integrated, including 10-litre expansion vessel
- 2 Modulating electric auxiliary heater with up to 6 kW
- 3 3-way diverter valve
- 4 Continued use of existing hot water storage cylinders
- 5 Electric wiring interface



Heat pump interface

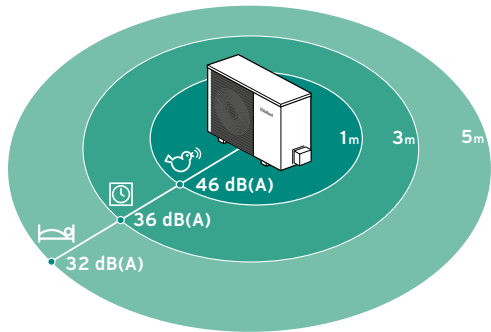
- Suitable for standard set-up and hybrid systems
- Heating system components can be placed to suit property layout
- Compatible with all Vaillant heat pump accessories including back-up heater, heat exchanger module and uniSTOR heat pump cylinders



SCOP and heating output

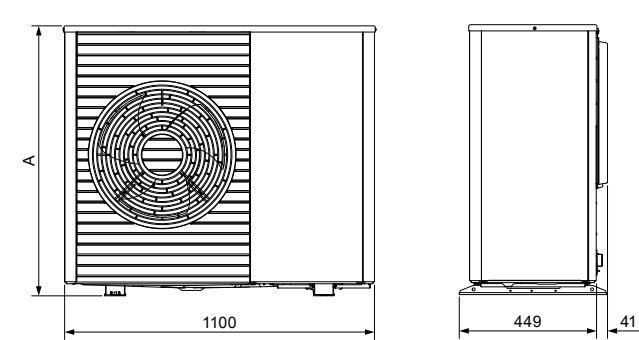
aroTHERM output		35°C flow		40°C flow		45°C flow		50°C flow		55°C flow	
		Output	SCOP	Output	SCOP	Output	SCOP	Output	SCOP	Output	SCOP
3.5kW	-5°C	4.2	4.41	4.1	4.03	4	3.65	3.9	3.37	3.8	3.10
	-3°C	4.6		4.4		4.3		4.2		4	
	0°C	4.7		4.7		4.6		4.5		4.4	
	2°C	4.9		4.9		4.9		4.7		4.6	
5kW	-5°C	6.3	4.48	6	4.13	5.6	3.77	5.5	3.41	5.4	3.06
	-3°C	6.8		6.4		6.1		5.9		5.8	
	0°C	6.9		6.7		6.6		6.4		6.2	
	2°C	7.1		7		6.9		6.7		6.5	
7kW	-5°C	8.2	4.36	8.1	4.13	8	3.91	7.5	3.65	7	3.39
	-3°C	8.8		8.6		8.4		7.9		7.4	
	0°C	9.5		9.3		9.1		8.6		8.1	
	2°C	10		9.8		9.6		9		8.5	
10kW	-5°C	9.9	5.03	9.7	4.58	9.4	4.13	9.1	3.85	8.8	3.58
	-3°C	10.7		10.3		10		9.6		9.2	
	0°C	11.9		11.6		11.3		10.7		10.2	
	2°C	12.8		12.5		12.1		11.5		10.9	
12kW	-5°C	13.1	4.88	12.8	4.55	12.5	4.21	11.7	3.92	10.8	3.63
	-3°C	13.9		13.4		12.9		12.1		11.2	
	0°C	15.2		14.6		14.1		13.2		12.3	
	2°C	16		15.5		14.9		13.9		13	

Sound power

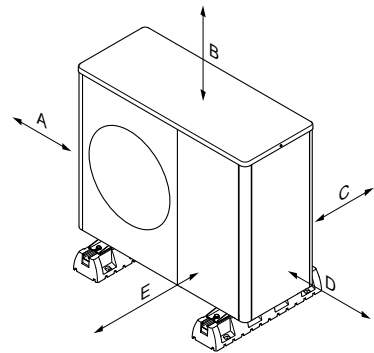


Model	Sound Power Level A7/W55	Sound Pressure Level		
		1m distance	3m distance	5m distance
aroTHERM plus 3.5kW	54 dB	46 dB(A)	36 dB(A)	32 dB(A)
aroTHERM plus 5kW	54 dB	46 dB(A)	36 dB(A)	32 dB(A)
aroTHERM plus 7kW	55 dB	47 dB(A)	37 dB(A)	33 dB(A)
aroTHERM plus 10kW	60 dB	52 dB(A)	42 dB(A)	38 dB(A)
aroTHERM plus 12kW	60 dB	52 dB(A)	42 dB(A)	38 dB(A)

Dimensions and clearances



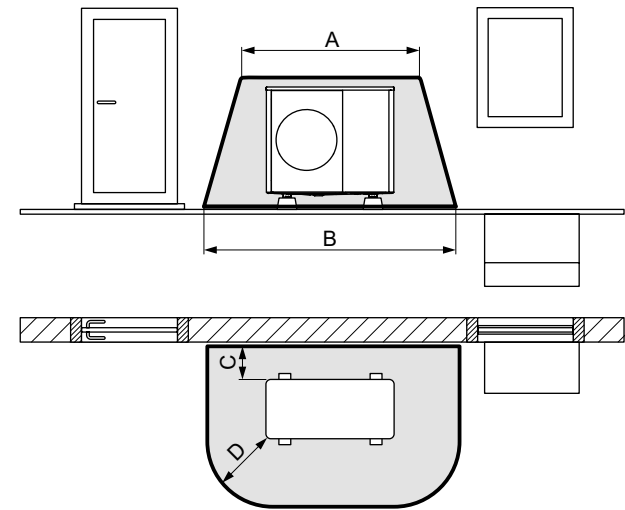
aroTHERM plus	Unit	Dimension A
3.5kW	mm	765
5kW	mm	765
7kW	mm	965
10kW	mm	1565
12kW	mm	1565



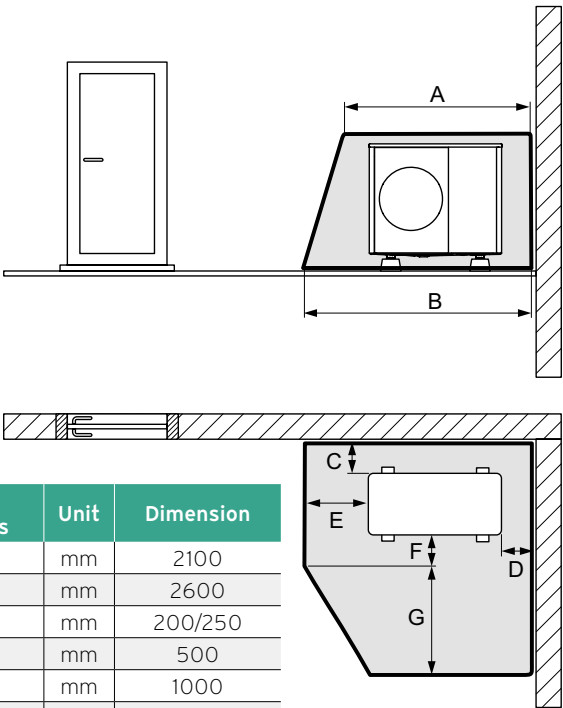
Minimum clearance	Unit	Heating mode	Heating and cooling mode
A	mm	100	100
B	mm	1000	1000
C	mm	200	250
D	mm	500	500
E	mm	600	600

R290 clearances

Clearances required for any drains, light wells or other openings



Minimum clearances	Unit	Dimension
A	mm	2100
B	mm	3100
C	mm	200/250
D	mm	1000

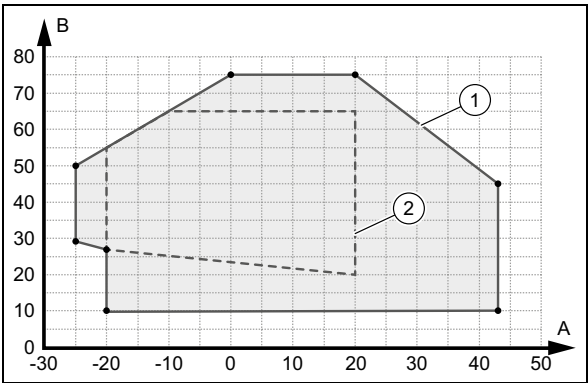


Minimum clearances	Unit	Dimension
A	mm	2100
B	mm	2600
C	mm	200/250
D	mm	500
E	mm	1000
F	mm	500
G	mm	1800

Application limits

heating mode

In heating mode, the product works at outdoor temperatures of -25 °C to 46 °C

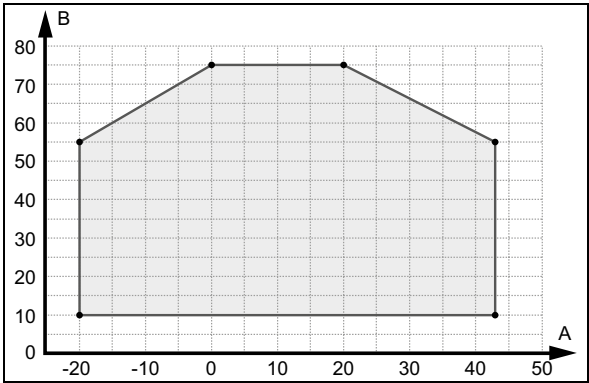


A Outdoor temperature 1 Application limits, heating mode

B Heating water temperature 2 Area of application, in accordance with EN 14511

DHW mode

For domestic hot water generation, the product works at outdoor temperatures of -20 °C to 46 °C.



A Outdoor temperature B Heating water temperature



Technical specifications

aroTHERM plus	Unit	3.5kW VWL 35 / 6	5kW VWL 55 / 6	7kW VWL 75 / 6	10kW VWL 105 / 6	12kW VWL 125 / 6
General						
Width	mm	1,100				
Height	mm	765		965	1,565	
Depth	mm	450				
Weight, ready for operation	kg	114		128	194	
Connection, heating circuit		G 1 1/4"				
Rated voltage	V	230 V (+10%/- 15%), 50 Hz, 1~/N/PE				
Rated current, maximum	A	14.3		15.0	23.3	
Fuse size		16			25	
Fuse type	A	C/D				
RCD type		A				
eBUS (2-core communication cable)	mm2	0.75				
Maximum length eBUS cable (communication cable)	m	50				
IP rating		IP 15 B				
Fan, power consumption	W	40			50	
Fan quantity		1			2	
Fan, air flow , maximum	m³ /h	2,300			5,100	
Heating pump, power consumption	W	2 - 50			3 - 87	
Heating circuit						
Heating water temperature, minimum/maximum	° C	20 - 75				
Basic length of the heating water pipe, maximum, between the outdoor unit and indoor unit	m	20				
Operating pressure, minimum	bar	0.50				
Operating pressure, maximum	bar	3.00				
Volume flow, minimum	l/h	400		540	995	
Volume flow, maximum	l/h	860		1,205	2,065	
Water volume, in the outdoor unit	l	1.5		2.0	2.5	
Water volume, in the heating circuit, minimum, thawing mode, activated/deactivated back-up heater	l	15 / 40		20 / 55	45 / 150	
Remaining feed pressure, hydraulic	kPa (mbar)	56.0 (560.0)		44.0 (440.0)	55.0 (550.0)	

aroTHERM plus	Unit	3.5kW VWL 35 / 6	5kW VWL 55 / 6	7kW VWL 75 / 6	10kW VWL 105 / 6	12kW VWL 125 / 6
Refrigerant circuit						
Fluid type		R290				
Fluid fill quantity	kg	0.6		0.9	1.3	
Refrigerant, Global Warming Potential (GWP)		3				
CO ₂ equivalent	t	0.0018		0.0027	0.0039	
Permissable operating pressure	bar	31.5				
Compressor type		Rotary piston			Scroll compressor	
Compressor oil type		Specific polyalkylene glycol (PAG)				
Compressor, control		Electronic				

Noise emissions, heating mode						
Sound power, EN 12102, EN 14511 LWA, A7/W35	dB(A)	51	53	58		
Sound power, EN 12102, EN 14511 LWA, A7/W45	dB(A)	53		58		
Sound power, EN 12102, EN 14511 LWA, A7/W55	dB(A)	54	55	60		

Efficiency						
Energy efficiency class 35°C	(A+++ to F)	A+++				
Energy efficiency class 55°C	(A+++ to F)	A++				

Combination with uniTOWER						
Energy efficiency class	(A+++ to F)	A++				
Energy efficiency class for hot water supply	(A+ to F)	A				

uniTOWER	Unit	VIH QW 190 / 6
Total storage cylinder capacity	l	188
Temperature hot water (max. – with auxiliary heating)	°C	55 - 75
Dimensions, unpacked (height/width/depth)	mm	1880 x 599 x 693
Weight, unpacked	kg	175
Auxiliary electric heater	kW	6kW (230V/50Hz) / 9kW (400V/50Hz)

Hydraulic station	Unit	VWZ MEH 97
Dimensions, unpacked (height/width/depth)	mm	720 x 440 x 350
Weight, unpacked	kg	15
Power electric backup heater	kW	6 kW (230V/50Hz) / 9 kW (400V/50Hz)



Air-to-water heat pumps

Description	Article number
aroTHERM plus with heat pump interface	
aroTHERM plus 3.5kW - VWL 35 / 6	0010037211
aroTHERM plus 5kW - VWL 55 / 6	0010037212
aroTHERM plus 7kW - VWL 75 / 6	0010037213
aroTHERM plus 10kW - VWL 105 / 6	0010037214
aroTHERM plus 12kW - VWL 125 / 6	0010037215
aroTHERM plus with hydraulic module	
aroTHERM plus 3.5kW - VWL 35 / 6	0010037206
aroTHERM plus 5kW - VWL 55 / 6	0010037207
aroTHERM plus 7kW - VWL 75 / 6	0010037208
aroTHERM plus 10kW - VWL 105 / 6	0010037209
aroTHERM plus 12kW - VWL 125 / 6	0010037210
aroTHERM plus with uniTOWER	
aroTHERM plus 3.5kW - VWL 35 / 6	0010037201
aroTHERM plus 5kW - VWL 55 / 6	0010037202
aroTHERM plus 7kW - VWL 75 / 6	0010037203
aroTHERM plus 10kW - VWL 105 / 6	0010037204
aroTHERM plus 12kW - VWL 125 / 6	0010037205

Compatible with



Accessories	Article number
aroTHERM connection kit for ground install	0010027971
aroTHERM connection kit for ground install extension	0010027972
aroTHERM connection kit for wall install	0010027974
aroTHERM straight pipe connection kit	0010027976
750mm flexihose for air-to-water heat pump (pair)	0020165288
Snow Spacer	0010027984
Wall bracket for insulated wall	0020250224
Wall bracket for non-insulated wall	0020250225
Anti-vibration feet large	0020250226
Anti-vibration rubber feet small	0020252091
Coding resistor active cooling	0020269259
Discharge vessel	0020145563
aroTHERM 45 litre buffer	0010038365
aroTHERM heat exchanger module	0020222285
aroTHERM inline 6kW back-up heater	0020222286
VR 10 temperature sensor	306787
WH40 low-loss header (flow rates up to 3,000 litres per hour)	306720
WH95 low-loss header (flow rates up to 8,000 litres per hour)	306721
VR 32/B eBUS coupler (includes housing)	0020235465
VR 32 eBUS coupler	0020139895
Ball filter valve 28mm	0010038133
uniTOWER accessories	
uniTOWER decoupling module (small) for 3.5 - 7kW model	0010027982
uniTOWER decoupling module (large) for 10 and 12kW model	0010027973
uniTOWER 1" adapter connection kit	0020269275
18l Buffer cylinder for uniTOWER	0020269273
uniTOWER multi-zone kit - 1 direct zone	0020170507
uniTOWER extension set - 2 direct zones	0020170509
uniTOWER extension set - 1 mixed zone	0020170508
Circulation set without pump	0020170502
Circulation set with pump	0020170503
2l brine expansion vessel	0010030975

Description	Pack contents	Article number
VRC 700		
VRC 700 wired, weather compensating programmable room thermostat	-	0020236291
VRC 700f wireless, weather compensating, programmable room thermostat	-	0020259829
One wired heating zone and hot water system	VRC 700, VR 70	0020236292
One wireless heating zone and hot water system	VRC 700f, VR 70	0020259830
One wired heating zone and solar thermal hot water system	VRC 700, VR 70, VR 11	0020236295
One wireless heating zone and solar thermal hot water system	VRC 700f, VR 70, VR 11	0020259833
Two wired heating zones and hot water system	VRC 700, VR 70, VR 91	0020236293
Two wireless heating zones and hot water system	VRC 700f, VR 70, VR 91f	0020259831
Two wired heating zones and solar thermal hot water system	VRC 700, VR 70, VR 11, VR 91	0020259834
Two wireless heating zones and solar thermal hot water system	VRC 700f, VR 70, VR 11, VR 91f	0020259835
Three wired heating zones and hot water system	VRC 700, VR 71, two VR 91	0020236294
Three wireless heating zones and hot water system	VRC 700f, VR 71, two VR 91f	0020259832
VR 70 wiring centre for up to two zones	-	0020184844
VR 71 wiring centre for up to three zones	-	0020184847
VR 91 wired, additional room thermostat	-	0020171334
VR 91f wireless, additional room thermostat	-	0020231566
VR 40 two-in-seven multifunction module	-	0020017744
VR 11 solar collector NTC	-	306788
VR 10 immersion or contact sensor bare ends	-	306787
VR 32 eBUS coupler	-	0020139895
sensoCOMFORT		
sensoCOMFORT wired weather compensating programmable room thermostat	-	0010036819
sensoCOMFORT RF wireless weather compensating programmable room thermostat	-	0010036820
One wired heating zone and hot water system	sensoCOMFORT, VR 71	0010036821
One wireless heating zone and hot water system	sensoCOMFORT RF, VR 71	0010036826
Two wired heating zones and hot water system	sensoCOMFORT, VR 71, VR 92	0010036822
Two wireless heating zones and hot water system	sensoCOMFORT RF, VR 71, VR 92f	0010036827
Three wired heating zones and hot water system	sensoCOMFORT, VR 71, 2x VR 92	0010036823
Three wireless heating zones and hot water system	sensoCOMFORT RF, VR 71 and 2x VR 92f	0010036828
Four wired heating zones and hot water system	sensoCOMFORT, VR 71, VR 70, 3x VR 92	0010036824
Five wired heating zones and hot water system	sensoCOMFORT, VR 71, VR 70, 4x VR 92	0010036825
VR 10 immersion or contact sensor bare ends	-	306787
VR 32 eBUS coupler	-	0020139895
VR 70 wiring centre	-	0020184844
VR 71 wiring centre	-	0020184847
VR 92 wired additional room thermostat	-	0020260925
VR 92f wireless additional room thermostat	-	0020260940
sensoNET internet gateway	-	0020260963
VR 40 two-in-seven multifunctional module	-	0020017744
VR 32/B eBUS coupler (includes housing)	-	0020235465

Our experience is your guarantee

For over 140 years, Vaillant has been among the technology leaders when it comes to innovative heating solutions, with specific expertise in the area of heat pumps for more than 40 years. Our proprietary solutions – many of which are patented – have made this technology reliable, efficient and suitable for everyday life. More than 200,000 heat pumps installed around the world prove this in use each day. Benefit from our experience:

- Products developed in Germany and manufactured exclusively in the EU
- 100% test for each heat pump on the production line
- Toughest weather conditions simulated at our own test centres, in cold chambers with temperatures down to -25°C
- Vaillant heat pumps are among the quietest on the market
- High level of safety due to use of playground standards
- Quality management as per EN ISO 9001 and EN ISO 14001



Climatic chambers simulate all possible operating conditions



Optimisation of components in the acoustic lab

Renewable service and technical enquiries

For technical assistance:

Telephone: 0330 100 3540

Email: aftersales@vaillant.co.uk

General enquiries

If you have a general enquiry our friendly reception staff will happily point you in the right direction:

Telephone: 0345 602 2922

Training enquiries

Vaillant provides many different training courses. For more information:

Telephone: 0345 601 8885

Email: training@vaillant.co.uk



Heating



Hot water



Renewables

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