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Bradley Ross Holdings Limited

Sevenoaks, 101a High Street

Energy and Sustainability Statement

Final

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ABOUT HODKINSON CONSULTANCY

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

Executive Summary

The purpose of this Energy and Sustainability Statement is to demonstrate that the proposed development at Sevenoaks by Bradley Ross Holdings Limited in the London Borough of Richmond is considered sustainable, as measured against relevant local, regional and national planning policies.

The proposed development will comprise demolition of the existing house and outbuildings and erection of new eco family home, alongside associated works including driveway alterations and landscaping.

Through the incorporation of sustainable design and construction methods, energy and water saving measures, sustainable transport methods, waste reduction techniques and measures to enhance the ecological value of the site, a good quality and sustainable development is proposed.

The key sustainability features outlined in this Sustainability Statement are listed below:

- **Energy efficiency:** A net zero energy strategy has been devised using heat pumps, PV panels and battery storage, demonstrating an exemplar commitment to sustainability. This delivers a 100% reduction in regulated operational emissions without the need for offsetting, significantly exceeding the requirements of both adopted and incoming planning policy.

- **Overheating:** The scheme has been designed to ensure overheating risk is reduced to acceptable levels in accordance with CIBSE TM52 and TM59:2017 requirements.

- **Water efficiency:** Water meters and water efficient fixtures and fittings will be installed in the dwelling to target a maximum internal daily water consumption of 110 litres/person/day.

- **Waste and recycling:** Adequate facilities will be provided for domestic, and construction related waste, including segregated bins for refuse and recycling.

- **Circular Economy:** The principles of a circular economy shall be incorporated into the development, where possible.

- **Materials:** A Whole Life Carbon Assessment has been undertaken to assess and reduce the environmental impact of the development. Where practical, new building materials will be sourced locally to reduce transportation pollution and support the local economy. New materials will be selected based on their environmental impact and responsible suppliers will be used where possible.

- **Pollution:** Suitable measures have been defined to mitigate against any potential impact associated with construction traffic, dust, noise, vibration, contaminations and other environmental considerations.

- **Flood Risk and Sustainable Urban Drainage Systems (SuDS):** The proposed development site lies in a low flood risk zone and will benefit from SuDS such as living roof.

- **Security:** The security and accessibility of the dwelling is not expected to change, with this already sufficient. The sound insulation will be improved with façade and window improvements.

- **Inclusive Access:** The dwelling has been designed to be easy to access and to adapt to suit future needs of the occupants. The design is fully compliant with Part M4(2).

- **Sustainable transport:** The site will benefit from a good existing public transport network and sustainable modes will be encouraged through the provision of an electric vehicle charging point.

- **Biodiversity and ecology:** The proposed development includes significant building integrated landscaping/ greening with facades and canopies capable of receiving climbing plants and intensive green roofs.

- **Sustainable construction:** The site will aim to achieve a Very Good score with the Considerate Constructors Scheme and will closely monitor construction site impacts.

CONTENTS

1. INTRODUCTION

1.1 This Energy and Sustainability Statement has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, appointed by Bradley Ross Holdings Limited.

1.2 This Statement and the Sustainability Checklist in **Appendix A** sets out the sustainable design and construction measures included in the planning application for the proposed development at Sevenoaks in the London Borough of Richmond.

Energy and Sustainability Statement Structure and Methodology

1.3 The formulation of the Sustainability Strategy for the proposed development has taken into account several important objectives, including:

> To conform to the agreed level of sustainability set out within the masterplan for the development;

> To address all national, regional and local planning policies and requirements;

> To achieve a viable reduction in CO_2 emissions with an affordable, deliverable and technically appropriate strategy;

> To provide a high quality development that is adaptable to future changes in climate;

> To minimise the negative impact of the proposed development on both the local and wider climate and environment;

> To achieve the highest viable levels of sustainable design and construction;

> To minimise emissions of pollutants such as oxides of nitrogen and particulate matter; and

> To create a pleasant, safe and friendly working and living environment that will be flexible to its occupants' needs.

1.4 This Sustainability Statement does not duplicate the work of the technical reports prepared in support of the application but presents the findings in the overall context of sustainability.

1.5 **Chapter 2** provides an introduction to the site and the proposed development.

1.6 **Chapter 3** sets out the relevant national, regional and local policy documents which have been used to guide and inform the sustainability strategy for the proposed development.

1.7 **Chapters 4 to 14** outline the sustainability strategy of the proposed development in relation to the policy documents listed in Chapter 3.

1.8 **Chapter 15** provides a summary of the key sustainability features associated with the proposed development.

2. DEVELOPMENT OVERVIEW

Site Location

2.1 The proposed development site at Sevenoaks is a family home located in the London Borough of Richmond. The location, 101a High Street, Hampton, London, TW12 2SX, is shown in Figure 1 below.

Figure 1: Site Location – Map data © 2024 Google

2.2 The site is currently occupied by an Arts and Crafts style Tudor Home. Sevenoaks is in a conservation area in Hampton, adjacent to a number of Grade II listed buildings. The site has a large front and rear garden with brick boundary walls.

Proposed Development

2.3 The proposed development is described as follows:

"Demolition of existing house and outbuildings and erection of new eco family home, alongside associated works including driveway alterations and landscaping."

2.4 Figure 2 below illustrates the proposed ground floor layout.

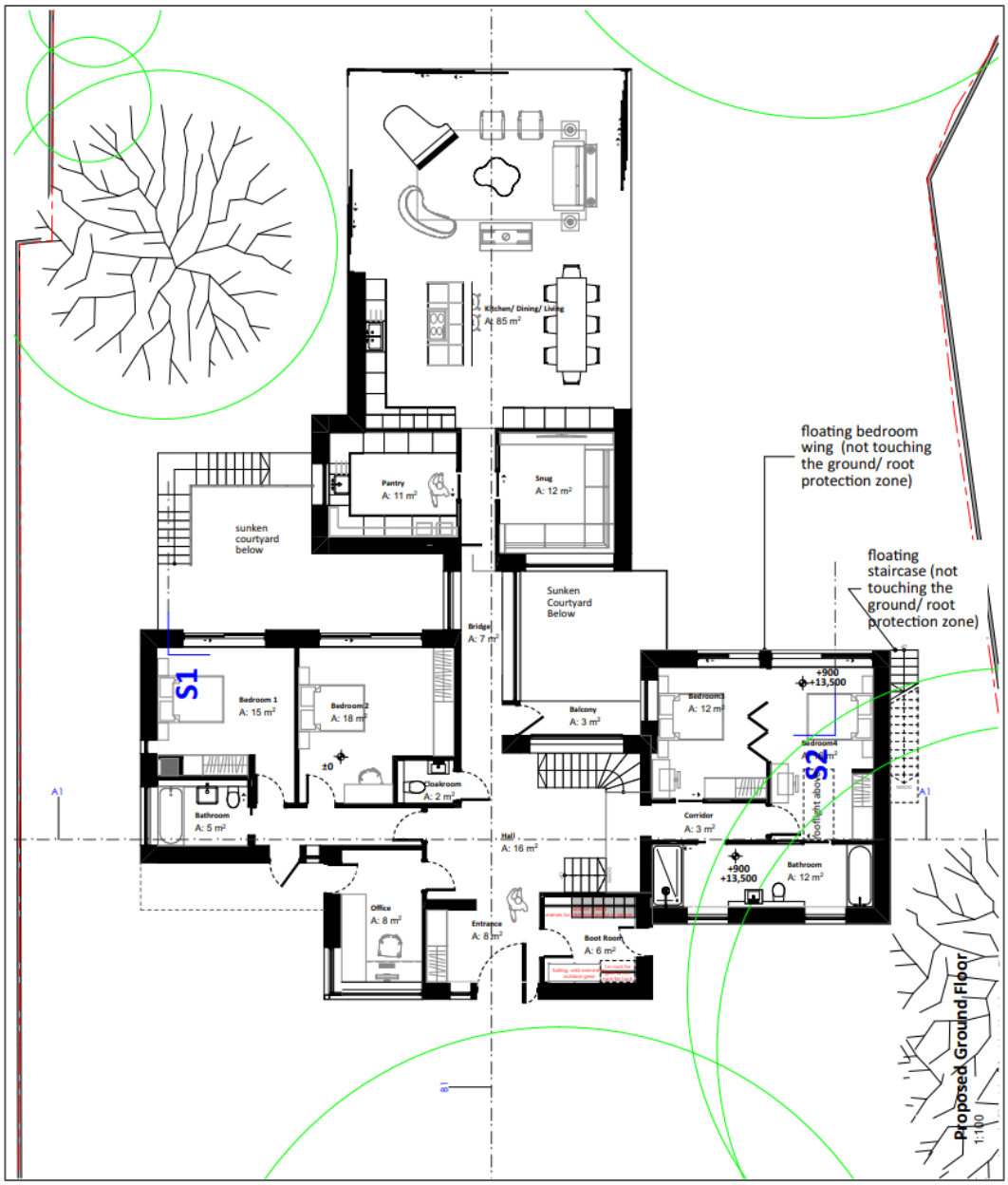


Figure 2: Proposed Ground Floor Layout – Holland Green (September 2024)

3. RELEVANT PLANNING POLICY

3.1 The following planning policies and requirements have informed the sustainable design of the proposed development.

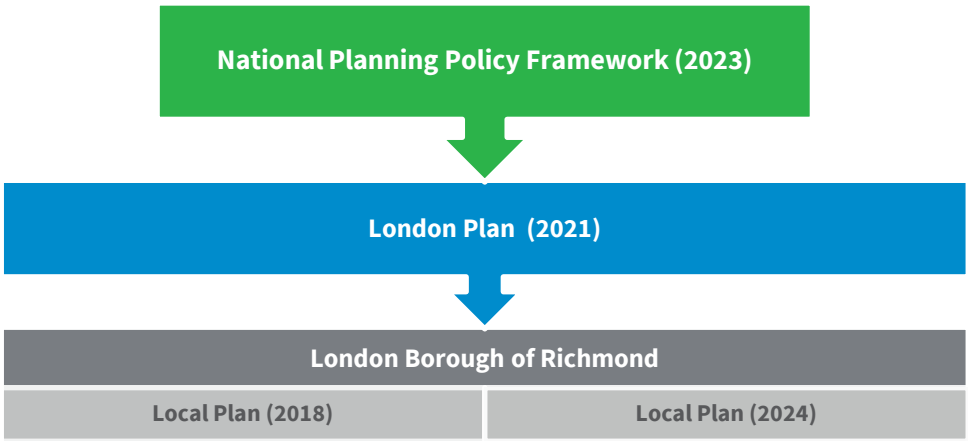


Figure 3: Relevant Planning Policy Documents

National Policy: NPPF

3.2 The revised National Planning Policy Framework (NPPF) was published on the 20th December 2023 and sets out the Government's planning policies for England.

3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Resolution 42/187 of the United Nations General Assembly). These address social progress, economic well-being and environmental protection. At the heart of the framework is a **presumption in favour of sustainable development**.

3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:

a) **An economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

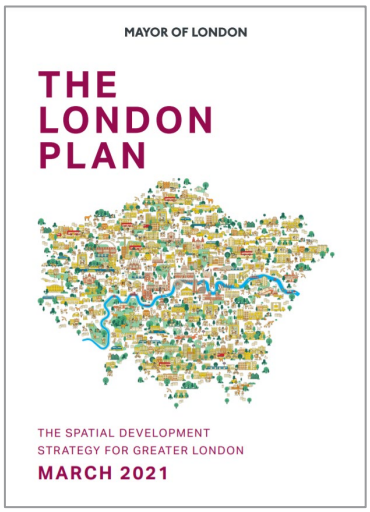
b) **A social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed, beautiful and safe places, with

accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c) **An environmental objective** – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Regional Policy: The London Plan

The London Plan (2021)



3.5 The London Plan sets out an integrated economic, environmental, transport and social framework for the development of London. The following policies are considered relevant to the proposed development and this Statement:

3.6 **Policy G5 Urban Greening** states that urban greening should be included as a fundamental element of site and building design by incorporating measures such as landscaping, green roofs, green walls and nature-based sustainable drainage. Boroughs should develop an Urban Greening Factor and in the interim, the Mayor recommends a target score of 0.4 for residential developments.

3.7 **Policy SI1 Improving Air Quality** states that development should seek opportunities to identify and deliver further improvements to air quality. Where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site.

3.8 **Policy SI2 Minimising Greenhouse Gas Emissions** states that major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand.

3.9 **Policy SI3 Energy Infrastructure** states that energy masterplans should be developed for large-scale development locations which establish the most effective energy supply options.

3.10 **Policy SI4 Managing Heat Risk** states that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the cooling hierarchy.

3.11 **Policy SI5 Water Infrastructure** states that in order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner. Development proposals should minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development) achieving mains water consumption of 105 litres or

less per head per day (excluding allowance of up to five litres for external water consumption). Commercial development should achieve at least the BREEAM excellent standard for the 'Wat 01' category.

3.12 **Policy SI7 Reducing Waste and Supporting the Circular Economy** states that referable applications should promote circular economy outcomes and aim to be net zero-waste.

3.13 **Policy T2 Healthy Streets** states that development should deliver patterns of land that facilitate residents making shorter, regular trips by walking or cycling. Development Plans should demonstrate the application of the Mayors Healthy Streets Approach.

Local Policy: London Borough of Richmond Upon Thames Local Plan 2018

3.14 The London Borough of Richmond Upon Thames' Local Plan was adopted in July 2018, which replaced the previous policies within the Core Strategy and Development Management Plan. The Plan sets out policies and guidance for the development of the borough until July 2033. The following policies are considered relevant to this Statement:

3.15 **Policy LP8, Amenity and Living Conditions** outlines the requirement for developments to ensure the design and layout of buildings enables good standards of daylight and sunlight to be achieved in new development and in existing properties affected by new development; where existing daylight and sunlight conditions are already substandard, they should be improved where possible.

3.16 **Policy LP 10, Local Environmental Impacts, Pollution and Land Contamination**, states the Council will seek to ensure that local environmental impacts of all development proposals do not lead to detrimental effects on the health, safety and the amenity of existing and new users or occupiers of the development site, or the surrounding land. These potential impacts can include, air pollution, noise and vibration, light pollution, odours and fumes, solar glare and solar dazzle as well as land contamination.

3.17 **Policy LP 17 Green Roofs and Walls** outlies the requirement for developments to incorporate green roofs and/or brown roofs into new major developments with roof plate areas of 100sqm or more where technically feasible and subject to considerations of visual impact. The aim should be to use at least 70% of any potential roof plate area as a green / brown roof.

3.18 **Policy LP 20, Climate Change Adaption** requires developments to minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy through their layout, design, construction, materials, landscaping and operation.

3.19 All developments should avoid, or minimise, contributing to all sources of flooding, including fluvial, tidal, surface water, groundwater and flooding from sewers, taking account of climate change and without increasing flood risk elsewhere as noted in **Policy LP 21, Flood Risk and Sustainable Drainage.**

3.20 Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change in accordance **with Policy LP 22, Sustainable Design and Construction**. This will also require developments that results in a new residential dwelling, including conversions, to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes. Non-residential buildings over 100sqm are also required to meet BREEAM 'Excellent' standard.

3.21 The Council will ensure that waste is managed in accordance with the waste hierarchy in line with **Policy LP 24 Waste Management**. The Council will require the following:

> Provision of adequate refuse and recycling storage space and facilities, which allows for ease of collection and which residents and occupiers can easily access, in line with the guidance and advice set out in the Council's SPD on Refuse and Recycling Storage Requirements.

> The location and design of refuse and recycling facilities is sensitively integrated in the development design.

> The development to make use of the rail and the waterway network for the transportation of construction, demolition and other waste.

> Developments that are likely to generate large amounts of waste, are required to produce site waste management plans to arrange for the efficient handling of construction, excavation and demolition waste and materials.

3.22 The London Borough of Richmond upon Thames mandates that the **Sustainable Construction Checklist** is completed, which forms part of the assessment for planning applications for new build, conversion and retrofit properties. This can be found in **Appendix A**.

Local Policy: London Borough of Richmond Upon Thames Local Plan 2024

3.23 The new Local Plan is anticipated to be adopted in 2024/2025, at which point it will supersede the existing Local Plan (2018) and the Twickenham Area Action Plan (2013).

3.24 Whilst the emerging plan is a material consideration, only limited weight can be given to the plan prior to modification and adoption stages. The below policies have been considered in this statement:

3.25 **Policy 4. Minimising Greenhouse Gas Emissions and Promoting Energy Efficiency (Strategic Policy)** requires new-build residential development of 1 or more dwellings to achieve net-zero carbon with a minimum 60% on-site reduction.

3.26 **Policy 5. Energy Infrastructure** requires developments to prepare an Energy Strategy in accordance with the Mayor's Energy Planning Guidance. All developments should maximise opportunities for on-site electricity and heat production from renewable energy sources.

3.27 **Policy 6. Sustainable Construction Standards** requires developments to complete the Sustainable Construction Checklist SPD, achieve a four-star rating (as a minimum) under the BRE Home Quality Mark scheme and incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).

3.28 **Policy 7. Waste and the Circular Economy** requires all developments, including conversions and changes of use are required to provide adequate refuse and recycling storage space and facilities for the separate collection of dry recyclables (card, paper, mixed plastics, metals, glass) and food, which allows for ease of collection and which residents and occupiers can easily access, in line with the guidance and advice set out in the Council's SPD on Refuse and Recycling Storage Requirements. Furthermore, all development proposals are required to adopt a circular economy approach to building design and construction to reduce waste, to keep materials and products in use for as long as possible, and to minimise embodied carbon.

3.29 **Policy 8. Flood Risk and Sustainable Drainage** outlines the Council requirement for the use of Sustainable Drainage Systems (SuDS) in all development proposals to manage surface water runoff as close to its source as possible, using the most sustainable solutions to reduce runoff volumes and rates. Ideally, all surface water should be managed on site. The development must not increase flood risk elsewhere and where possible reduce flood risk overall.

3.30 **Policy 9. Water Resources and Infrastructure** outlines that developments must not pose a threat to the borough's rivers, surface water and groundwater quality and quantity. This includes pollution caused by water run-off from developments into waterways.

3.31 **Policy 16. Small Sites** requires small sites to have regard to the existing townscape character, as set out in the Urban Design Study 2021, with proposals reflecting the building typology and demonstrating how they accord with the broad strategy for planning and management set out in the design guidance for each character area.

3.32 **Policy 29. Designated Heritage Assets** requires developments to conserve and, where possible, take opportunities to make a positive contribution to, the historic environment of the borough. Development proposals likely to adversely affect the significance of heritage assets will be assessed against the requirement to seek to avoid harm and the justification for the proposal.

3.33 **Policy 34. Green and Blue Infrastructure** requires developments to enhance the existing blue and green infrastructure network, including open spaces and green corridors, providing habitats for biodiversity to flourish and expand. Furthermore, developments are expected to incorporate and maintain appropriate elements of green infrastructure which make a positive contribution to the wider network of open spaces.

3.34 **Policy 38. Urban Greening** outlines all development proposals should integrate green infrastructure and provide for urban greening. At least 70% of any potential roof plate area should be used as biodiversity-based extensive green roof.

3.35 **Policy 39. Biodiversity and Geodiversity** requires developments to deliver robust and measurable net gains for biodiversity by incorporating and/or creating new habitats or biodiversity features, such as expansion and improvement of habitats, green links or habitat restoration, incorporation of green roofs and 252 21 Increasing biodiversity and the quality of our green and blue spaces, and greening the borough walls, tree planting as well as micro-habitat features such as bird and bat bricks and boxes, hedgehog gates or wildlife ponds.

3.36 **Policy 42. Trees, Woodland and Landscape** requires all developments to minimise impacts on existing trees, hedges, shrubs and other significant vegetation on site and provide sufficient space for the crowns and root systems of existing and proposed trees and their future growth. Developments within proximity of existing trees are required to provide protection from any damage during development. The council will resist the loss of trees, including aged or veteran trees. The planning of new trees, shrubs and other vegetation should prioritise the use of appropriate native tree and shrub species to help support biodiversity and connect to the wider green infrastructure network.

3.37 **Policy 46. Amenity and Living Conditions** requires developments to ensure the design and layout of buildings enables good standards of daylight and sunlight to be achieved in new development. Furthermore, proposals must not be visually intrusive or have an overbearing impact as a result of their height, massing or siting, including through the sense of enclosure.

3.38 **Policy 48. Vehicular Parking Standards** requires planning applicants to provide off-street vehicular and cycle parking, including electric vehicle charging points. Moreover, all basement applications require a Construction Management Plan.

3.39 **Policy 53. Local Environmental Impacts** requires all developments to comply with the new London Plan 2021 Policy SI1 Improving Air Quality as well as all developments must be at least “Air Quality Neutral”. Regarding Noise and Vibration, The Council encourages good acoustic design to ensure occupiers of new and existing noise sensitive buildings are protected. Lastly, the Council will seek to manage and limit environmental disturbances during construction and demolition as well as during excavations and construction of basements and subterranean developments. To deliver this, the Council requires the submission of Construction Management Plans.

3.40 **Policy 54. Basements and Subterranean Developments** outlines basements and subterranean developments, including potentially those of more than one storey, can be constructed and used without adverse impacts on the living conditions and amenity of neighbours, provided that the proposal is appropriate for the character of the area and the site allows for appropriate access for plant and machinery to enable construction without adverse impacts. A Construction Management Plan that the development will be designed and constructed so as to minimise the impact during construction and occupation stages must be produced and the proposal must demonstrate the basement does not cause loss, damage or adverse impact to biodiversity, including trees, and amenity value.

4. ENERGY STRATEGY AND CO_2 REDUCTION

4.1 The Applicant has devised an ambitious net zero energy strategy which reduces operational regulated CO_2 emissions below zero. This is proposed to be delivered from the following measures:

> An exemplary standard of fabric efficiency and air tightness;

> No fossil fuels;

> Extensive application of renewables, including a heat pump, photovoltaic (PV) panels, and energy storage systems.

4.2 SAP calculations have been undertaken on the proposed dwelling. Approved Part L 2021 SAP software has been used.

Fabric Performance

4.3 The proposed fabric and air tightness specification is shown in Table 1, below. These targets go significantly beyond what would be required for a project subject to Part L 2021, the latest adopted policy standards, and the more strenuous 60% CO_2 reduction target within Policy 4 of the draft 2024 Local Plan.

Table 1: Fabric Strategy

Element	Performance Target
External Wall	0.11 W/m^{2}k
Roof	0.11 W/m^{2}k
All Floors (including basement)	0.11 W/m^{2}k
Glazing	0.8 W/m^{2}k to kitchen/living areas 1.1 W/m^{2}k to all other areas G-value of 0.40
Air Permeability	2.0 m^3/h.m^2
Thermal bridging	Bespoke psi value targets – calculated y-value of 0.066

4.4 The strategy has been coordinated with the overheating consultant (Holland Green) to ensure the g-value represents an optimal balance between minimising summer overheating risk and maximising desirable solar gain in the cooler months.

Services & Heating

4.5 A centralised mechanical ventilation with heat recovery (MVHR) system will provide controlled fresh supply air throughout the home and extract stail air from kitchens and bathrooms. The heat recovery function will enable heat within the extract air to be recycled by warming the fresh supply air, therefore reducing the load on the space heating system.

4.6 Space heating and how water will be supplied by an air source heat pump (ASHP). ASHPs generate heat via compression of a refrigerant which has extracted ambient heat from the external air. The compressive action raises the temperature of the refrigerant and allows it to provide heating. They run off grid electricity – a low carbon and continually decarbonising source - and are very efficient, typically delivering 3+ kWh's of heat from every kWh of electricity consumed.

4.7 Hot water, generated by the heat pump, will be stored in a highly efficient cylinder.

4.8 Connection to a heat network has been ruled out. No existing networks exist within the vicinity of the site, and at one dwelling it would be highly unlikely to be appropriate to do this even if there was.

4.9 All internal, external, and any security lighting will be energy efficient and adequately controlled. This will ensure the conservation of energy when the lighting is not in use. LED lighting will be adopted as it is highly efficient and consumes less electricity compared to traditional bulbs. LEDs also have a longer lifespan, decreasing the need for frequent replacements which reduces its embodied carbon impact.

Renewable Generation & Storage

4.10 Generation of zero carbon power is a key component of a net zero energy strategy. The size of this home and available roofspace presents an opportunity to install a very large installation of PV panels. The applicant has set aside 108m^2 of roofspace, set across three areas. This is shown in the roofplan in **Appendix C**.

4.11 Using this area, the applicant proposes to install 17.5kWp of PV capacity. Additionally, to ensure the maximum on site benefit of this generation is realised, this will be coupled with a battery installation. A 13.5kWh battery has been used in the SAP calculations, aligning with a Tesla Powerwall model. The exact capacity of this battery will be ultimately determined by specialists, to ensure it maximises the benefit from PV generation.

4.12 The combination of a large PV installation and battery storage will enable this property to reduce its operational emission to zero. Technically, as shown in the SAP calculation, the result is slightly below zero, enabling this dwelling to be carbon negative.

4.13 The services and renewables strategy is shown in Table 2.

Table 2: Services & Renewables Strategy

Element	Performance Target
Ventilation	Mechanical ventilation with heat recovery (MVHR) HR efficiency 90% SFP 0.85 W/l/s (for 5 wet rooms)
Heating/Hot Water	Air source heat pump + cylinder
Lighting	LEDs
Photovoltaics	17.5 kWp (roof-mounted)
Energy Storage	Battery storage ~13.5 kWh Hot water cylinder (sized to meet demand)

CO_2 Performance

4.14 CO_2 reductions at each stage of the energy hierarchy are presented in Table 3. It is shown the proposed energy strategy results in a home which is net zero in its own right, with no requirement for offsetting measures. This significantly exceeds all policy and Part L requirements.

Table 3:CO_2 Reductions at Energy Hierarchy

	DER ($kgCO_2/yr/m^2$)	% Reduction
Baseline (Part L 2021)	10.85	-
Be Lean	9.65	11.1%
Be Clean	-	-
Be Green	**-0.09**	**100.8%**

4.15 Note that the ***Be Lean*** reduction is based on a gas condensing boiler system, with all renewables introduced at the ***Be Green*** stage. SAP calculation are shown in **Appendix D**.

Lighting

4.16 All internal, external, and any security lighting will be energy efficient and adequately controlled. This will ensure the conservation of energy when the lighting is not in use. LED lighting will be adopted as it is highly efficient and consumes less electricity compared to traditional bulbs. LEDs also have a longer lifespan, decreasing the need for frequent replacements which reduces its embodied carbon impact.

Energy Monitoring

4.17 Energy display devices, which can monitor electricity and primary heating fuel consumption, will be installed in the home. This will empower the occupants to be more aware of their usage and therefore make energy and cost savings, where possible.

5. WATER REDUCTION

Internal Water Efficiency

5.1 Increased frequency of drought across Europe lines up with climate change projections and water companies in the UK capture much less rain for our use than people assume.

5.2 The Environment Agency updated their determination of areas of water stress in 2021[1]. The water stress method takes a long-term view of the availability and the demand for public water supply, rather than a snapshot of shorter or peak periods. It accounts for future population growth, climate change, environmental needs and increased resilience. As of 2021, 15 out of the 23 water companies operating in areas of England were classified as being under 'serious' stress, including Thames Water where the site is located. This indicates the need to

[1] https://www.gov.uk/government/publications/water-stressed-areas-2021-classification

reduce internal water use where possible and specify water efficient fixtures and fittings in new development.

5.3 Reducing water consumption will not only help to preserve our water sources but will also save energy. Approximately 15% of a typical gas-heated household's heating bill is from heating water for showers, baths and taps and the energy used to heat water for devices and appliances emits an average of 875 kg of CO_2 per household per year (Energy Saving Trust, 2013). As such, internal water consumption will be significantly reduced through the use of practical and hygienic water saving measures.

Water Use

5.4 The dwelling will target a minimum water efficiency standard of **110 litres/person/day** in accordance with Building Regulations Approved Document G requirement (110 litres/person/day). An indicative route to achieving this target has been provided in **Appendix B**.

External Water Efficiency

5.5 Rainwater butts will be installed where possible in the back garden to reduce the demand on potable water and promote effective use of water supplies. These will be appropriately sized and capable of harvesting rainwater for external irrigation and car washing for example.

5.6 Implementing grey water reuse is the intention for the development, however due to lack of space on the site this will have to be further studied. Nonetheless, grey water reuse will seek to be implemented, space allowing.

6. WASTE MANAGEMENT

6.1 Waste reduction and recycling is another key challenge of sustainable development and something which is strongly encouraged in the London Plan (Policy SI7). The waste hierarchy, illustrated in Figure 4 below, prioritises those waste management options which are best for the environment.

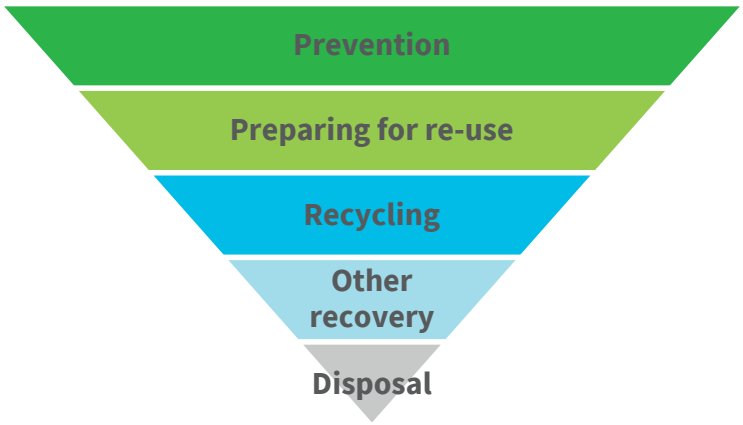


Figure 4: Waste Hierarchy

6.2 The waste hierarchy establishes waste management options according to what is best for the environment. It places great importance on preventing waste in the first place. When waste is created it prioritises preparing it for re-use, then recycling, recovery and lastly disposal (e.g. landfill).

Construction Waste

6.3 The reduction of construction waste not only minimises environmental impacts through ensuring the responsible use of resources and waste disposal but can also significantly reduce construction costs for the developer. The retention of the boundary brick wall and the re-use of bricks will help to minimise waste created during construction, also minimising the requirement for new materials.

6.4 Prior to construction, Bradley Ross Holdings Ltd will develop a Site Waste Management Plan which will establish ways of minimising waste at source, assess the use, reuse and recycling of materials on and off-site and prevent illegal waste activities. This plan will then be disseminated to all relevant personnel on and off-site.

6.5 The following waste minimisation actions will be considered:

> Consider opportunities for zero cut and fill to avoid waste from excavation or groundworks;

> Design for standardisation of components and the use of fewer materials;

> Design for off-site or modular build;

> Return packaging for reuse;

> Consider community reuse of surplus materials or offcuts; and

> Engage with supply chains and include waste minimisation initiatives and targets in tenders and contracts.

6.6 As part of their commitment to divert construction waste from landfill, Bradley Ross Holdings Ltd will regularly monitor and record the site's waste reduction performance. This will be compared against a target benchmark where at least 90% (by volume) of non-hazardous demolition and construction waste is to be diverted from landfill. The Applicant further commits to re-using at least 10% of the existing materials in the proposal.

Household Waste

6.7 Household waste will also be managed in line with the waste hierarchy, helping to reduce the amount of waste sent to landfill. As such, adequate waste storage is provided on the ground floor of the dwelling, where both recyclable and non-recyclable waste can be stored in accordance with Richmond's waste collection service.

6.8 In addition, space will be provided for segregated recycling waste bins within the kitchen areas. This will involve the installation of recycling bins underneath the kitchen sink, where waste can be segregated into paper, glass, cans, plastic and cardboard, if necessary.

6.9 The internal waste storage within the property will comprise of 23 litres for food waste, 40 litres for recyclables, and 40 litres for general waste. There will also be the provision of an additional two 44-litre recyclable storage spaces.

6.10 The food waste storage provided allows for residents to further reduce waste to landfill. Adequate internal and external food waste storage will be provided in accordance with the London Borough of Richmond's collection service.

6.11 Refuse storage for the dwelling has been provided at the front of the site, with bins in storage cupboards along the boundary wall of the property. On collection day, the refuse bins can be collected by the refuse collection operatives and returned to the store.

7. CIRCULAR ECONOMY

7.1 Current and future trends point toward the need for a fundamental shift in the way resources are consumed. A shift to a circular economy will provide considerable economic opportunities as a result.

7.2 In contrast to a linear economy (take, make, dispose), a circular economy keeps products and materials circulating through the system at their highest value for as long as possible, through re-use, recycling, refurbishment and remanufacturing. As 60% of total UK waste is generated from

construction, demolition and excavation (Defra and Government Statistical Service, 2019) this transition from linear to circular is essential.

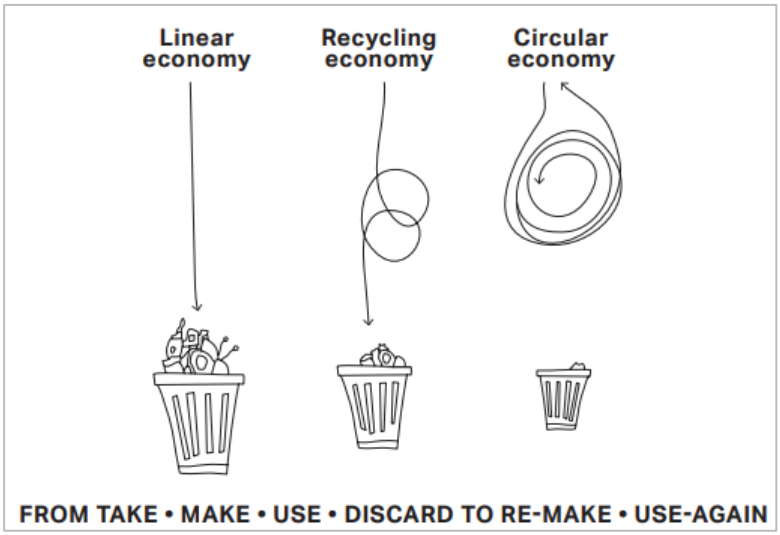


Figure 5: Linear, Recycling and Circular Economies (GLA, 2019)

7.3 The circular economy refers to a state whereby resources are kept in a continuous cycle of use so that:

> Virgin resources are no longer extracted;

> Existing products, once used, are reused or recycled to make new products without loss of value; and

> No resources are disposed of and no value is lost.

7.4 The end goal is to retain the value of materials and resources indefinitely, with no residual waste at all. This is possible but will require a fundamental change in the way that buildings are designed, built, operated, and deconstructed.

7.5 Applying circular economy thinking to the built environment is complex, with many overlapping issues and trade-offs to consider. However, there are some core guiding principles that promote a regenerative and restorative whole system approach that should be applied on every project. These are as follows:

> Building in layers – ensuring that different parts of the building are accessible and can be maintained and replaced where necessary.

- Designing out waste – ensuring that waste reduction is planned in from project inception to completion, including consideration of standardised components, modular build, and reuse of secondary products and materials.
- Designing for longevity.
- Designing for adaptability or flexibility.
- Designing for disassembly.
- Using systems, elements or materials that can be reused and recycled.

7.6 Bradley Ross Holdings Limited will adopt these six core principles to significantly reduce the amount of raw and new materials required for the development. They are already adopting a few of these measures in their design through the use of crushed demolition waste being used for backfilling (downcycling) whilst the retention of the 50m^2 existing brick wall minimises the requirement for new materials.

7.7 Alongside this, a reduction in vehicle movements, air pollution, noise and greenhouse gas emissions will also be beneficial.

8. MATERIALS

Environmental Impact

8.1 New building materials will be selected, where possible, to ensure that they minimise environmental impact and have low embodied energy – from manufacture, transportation and operational stages, through to eventual demolition and disposal.

8.2 All insulation materials will have an Ozone Depleting Potential (ODP) of zero and a Global Warming Potential (GWP) of less than 5. In addition, all decorative paints and varnishes will meet the relevant standards in order to reduce the emission levels of volatile organic compounds (VOCs).

8.3 The proposed materials for use at the development are as follows:

- Brickwork which picks up on the colour and variation in hue of the existing listed curtilage wall.
- A hybrid timber and steel frame which is the highest standard for ‘passive house’ type buildings.

> Timber is the predominant superstructure material, with steel used sparingly, where it is necessary. The timber is a lightweight, renewable and recyclable material, as opposed to blockwork that is heavy and can only downcycle to make hardcore or go to landfill.

> Rammed earth.

> Bronze cladding.

8.4 The above materials are sympathetic to the Conservation area and there is an opportunity to use eco-friendly materials such as rammed earth to provide thermal mass which will greatly assist in reducing embodied carbon and energy demand.

8.5 The materials selected for the new areas of landscaping will also tie in with the existing materials found in the Conservation area.

Local and Responsible Sourcing

8.6 Preference will be given to the use of locally sourced materials and local suppliers, where viable. This will benefit the local economy as well as having environmental benefits through reduced transportation.

8.7 The main building materials will be responsibly and legally sourced from manufacturers with environmental management systems and/or responsible sourcing credentials, such as BES 6001.

8.8 Timber used on site, including timber used in the construction phase, such as hoarding, fencing and scaffolding, will be sourced from sustainable forestry sources (e.g. PEFC and FSC) where possible.

Recycled Materials

8.9 Where feasible, Bradley Ross Holdings Ltd will commit to using materials that have been recycled. The use of recycled materials (e.g. crushed concrete from waste, used for hard-standing) has less embodied energy impact, other than that expended in their processing or transport.

Life Cycle Impacts

8.10 A full life cycle assessment has been produced to demonstrate that the Applicant has considered Whole Life Carbon in the design of the proposed development.

8.11 Whole Life Cycle Carbon Emissions (WLCCE) are the carbon emissions resulting from the construction and the use of a building over its entire life, through four stages described as life-cycle modules;

> Module A1 – A5 (product sourcing and construction);

> Module B1 – B7 (use);

> Module C1 – C4 (end of life);

> Module D (benefits and loads beyond the system boundary).

8.12 A full Whole Life Cycle Carbon Assessment has been undertaken for the planning application, please refer to the report by Hodkinson Consultancy (August 2024).

9. POLLUTION

Noise and Light Pollution

9.1 Bradley Ross Holdings Ltd are committed to reducing noise disturbance to internal and external areas of the dwelling to improve the health and wellbeing of the occupants and to help protect community cohesion.

9.2 As addressed in the Proposal's Response to Pre-Application Feedback, in response to Local Plan Policy LP39, the proposal results in no unacceptable impact on neighbours in terms of visual impact, noise or light from vehicular access or car parking.

Air Quality

9.3 Poor air quality is the greatest environmental risk to public health in the UK and is known to exacerbate the impact of pre-existing health conditions. It is not only a major risk to human health, but it also has significant damaging impacts on both plants and animals. Bradley Ross Holdings Ltd are committed to reducing the proposed development's negative impact on air quality during construction and operation.

9.4 Suitable measures have been defined in the Construction Management Plan prepared by RGP (August 2024) to mitigate against any potential impact associated with construction traffic, dust, noise, vibration, contaminations and other environmental considerations. These include:

> The Contractor is encouraged to make use of local suppliers, as far as reasonably possible, to reduce the distance travelled and associated vehicle emissions;

> Due to the small scale of development, a PM10 monitor is not considered necessary. The Contractor is nevertheless encouraged to install a monitoring device at the site boundary and devise an Action Plan for any unexpected high emissions;

> Use of a portable decibel reader / sound level meter to be used by the contractor to monitor noise levels generated during intensive phases of construction; and

> Protection plates and mobile screens will be used around those parts of the site likely to generate significant levels of noise. Such screens will have sufficient mass to be able to resist the passage of sound.

9.5 Please refer to the full report for further information.

10.FLOOD RISK & SURFACE WATER RUN-OFF

Flood Risk

10.1 Developments in low flood risk areas are promoted to not only protect homes and local communities and reduce the cost implications if flooding occurs, but to protect the environment from the transfer of pollutants during flooding events.

10.2 According to the Environment Agency's Flood Map shown in Figure 6 below, the proposed development lies in a low risk flood zone (Flood Zone 1).

Figure 6: Environment Agency Flood Map – https://flood-map-for-planning.service.gov.uk

Sustainable Drainage Systems

10.3 Sustainable drainage systems (SuDS) can deliver multiple benefits which broadly fit into four categories: water quantity, water quality, amenity and biodiversity, shown in Figure 7 below. The overarching principle of SuDS design is that surface water runoff should be managed for maximum benefit.

10.4 Long term environmental and social factors must be included in decisions regarding sustainable drainage. Sustainable drainage takes account of the quantity and quality of runoff, and the amenity and aesthetic value of surface water in the urban environment.

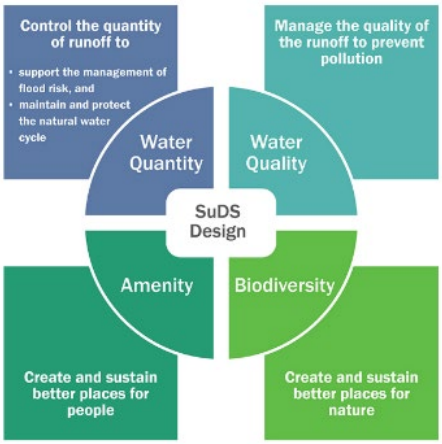


Figure 7: The four 'pillars' of SuDS – CIRIA SuDS Manual (2015)

10.5 The following listed SuDS are proposed. These will not only help to attenuate surface water but will provide the necessary water treatment.

> **Living roofs** will help to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.

11. BUILDING QUALITY

Security and Building Quality

11.1 The security and access of the site is expected to change within the proposed alterations. As such, it is assumed that the building remains both secure, and accessible for the occupants.

11.2 The new façade and windows will ensure that the building has a higher quality sound insulation. This will prevent external noises from disturbing the occupants, promoting a healthier internal environment.

11.3 The promotion of good daylighting levels contributes to sustainability through improving the occupant's quality of life and reducing the building's energy consumption by minimising the need for artificial lighting.

11.4 All internal lighting will be designed to avoid flicker and stroboscopic effects and will be designed to provide an appropriate illuminance (lux) level. There is currently no external lighting associated with the dwelling, and this is not expected to change.

Inclusive Design

11.5 The design of the new dwelling meets the requirements set out in optional requirement M4(2), ensuring it is both accessible and adaptable for a diverse range of occupants.

11.6 The property features a step-free approach and entrance, providing smooth access from any nearby parking spaces and communal areas within the property boundary. Inside, step-free access continues throughout the entrance level, allowing easy movement to the WC, main living areas, and connected private outdoor spaces.

11.7 The design is tailored for older individuals and wheelchair users, incorporating features that enable easy navigation and use of sanitary facilities. Additionally, the layout is designed to support future adaptations, enhancing accessibility and functionality as needed.

11.8 Wall-mounted switches and controls will be positioned at accessible heights for those with limited reach, ensuring a comfortable and inclusive living environment for all residents and visitors.

11.9 An Inclusive Access Statement has been prepared. Please see the full report submitted alongside this application for further detail.

Daylight and Sunlight

11.10 The promotion of good daylighting levels contributes to sustainability through improving the occupant's quality of life and reducing the building's energy consumption by minimising the need for artificial lighting.

11.11 The re-zoning of the Proposed Development to increase sunlight throughout will ensure good levels of light into the dwelling as well as additional windows and glazing throughout.

Overheating

11.12 Minimising the risk of summer overheating and high uncontrollable temperatures is important so as to ensure that homes are comfortable for their occupants and remain comfortable in the future. Bradley Ross Holdings Limited commit to ensuring that the dwelling will not have a high risk of summer overheating and will adopt appropriate measures to ensure this is delivered.

11.13 The Overheating Assessment prepared by Holland Green (September 2024), demonstrates that the development can maintain suitable indoor temperature during the summer. This study influenced the architectural design, leading to iterations to enhance thermal performance of the development. The key design strategies are outlined below:

- Large overhangs to minimise solar gains.
- Vertical shading to further reduce solar gains.
- Cross ventilation in most spaces.
- Stack ventilation in the main staircase.
- Improved U-values for enhanced thermal performance.

11.14 The results show all internal bedrooms, living rooms and circulation spaces comply with CIBSE TM52 and TM59 standards. Please refer to the full report for further information.

12. TRANSPORT AND LOCAL AMENITIES

Sustainable Transport

12.1 Sustainable transport links are central to the sustainability debate. They provide a positive contribution to environmental, societal and economic sustainability of the places they serve.

12.2 Due to the size of the dwelling and the associated alterations, transport and travel plans have not been completed. The existing parking is to be retained, and not expanded. The travel habits of occupants are therefore not expected to change, and the existing transport links are expected to be appropriate.

12.3 The site's location within Hampton, London, means that it is well connected to existing transport services. These include:

- **Hampton Train Station** serving the South Western Railway line, providing national connections across the UK.
- **Hampton Bus Stops**, providing frequent trips in all directions. Bus routes include, but are not limited to the Holly Road (Stop HL) providing access to routes 285, R68 and R70 or the Hampton and Richmond Borough FC (Stop E) providing access to routes 111 and 216.

12.4 The Transport for London Public Transport Accessibility Level (PTAL) map for the site is presented in Figure 8 overleaf. The site's PTAL rating of 1b represents a low level of transport accessibility.

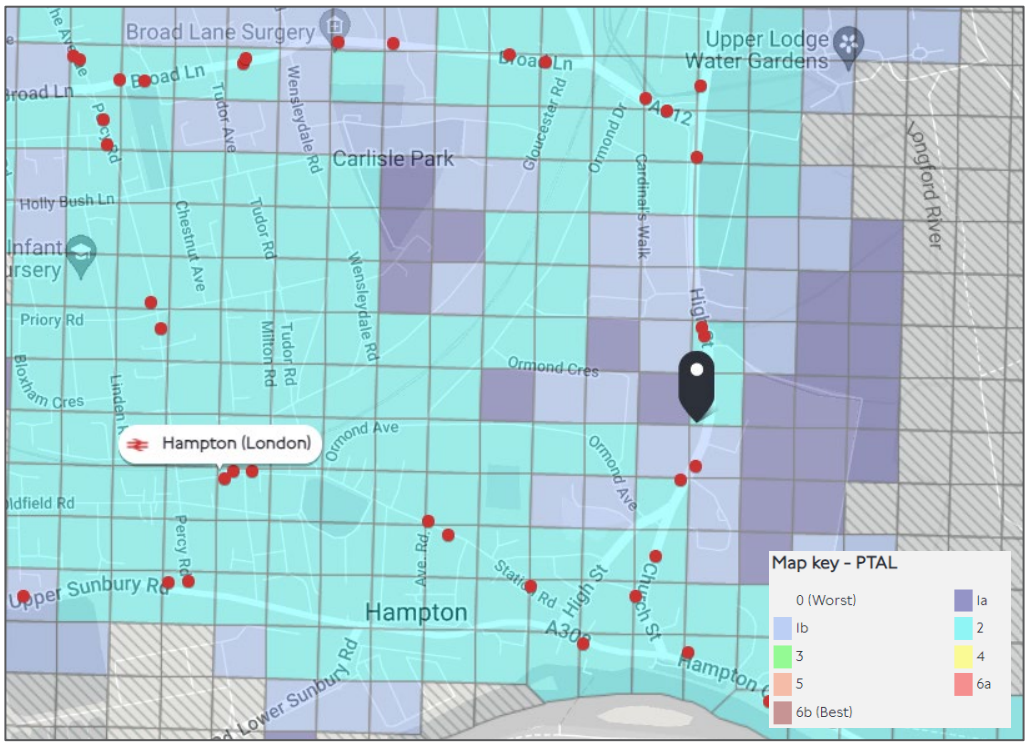


Figure 8: PTAL Map – www.tfl.gov.uk

Local Amenities

12.5 The proposed development has access to the following key amenities in the local area which will help to reduce dependency on private transport:

> **Administrative services** (Hampton Post Office located 14 minute walk from the site and ATM cash point on Oldfield Road located 18 minute walk from the site).

> **Health services** (Hampton Medical Centre located 22 minute walk or 5 minute drive from the site and Boots Pharmacy located on Station Approach 17 minute walk from the site);

> **Small/large scale retail services** (Hampton Hill Newsagents located 9 minute walk from the site alongside Tesco Express located 17 minute walk from the site on the High Street. A variety of restaurants located both North of the site on the High Street and South of the site approximately 15 minute walk in both directions.)

> **Recreation and leisure facilities** (Hampton Pool located less than 2 minute walk from the site alongside Hampton Sports and Fitness Centre located 5 minute drive from the site); and

> **Education facilities** (Tiny Thinkers Childcare located 2 minute walk from the site, Twickenham Prep School located 7 minute walk from the site, Hampton Secondary School located 22 minute walk from the site).

Electric Car Charging

12.6 Electric vehicles have the benefit of eliminating emissions, including carbon dioxide, oxides of nitrogen, carbon monoxide and particulates that normal cars emit. With road transport accounting for 66% of particulate emissions and 42% of NO_x emissions in London, measures such as electric vehicle charging points are strongly encouraged.

12.7 An electric vehicle charging point will be provided in line with Building Regulations Part S, which were adopted in June 2022. These updated standards require that an electric vehicle charging point must be provided at a ratio of 1:1 for the number of dwellings.

13. BIODIVERSITY AND ECOLOGYBROWNFIELD SITE

13.1 The site has been previously used for development which is predominantly covered in hard standing and is therefore considered 'brownfield'. Redeveloping and revitalising vacant and under-used sites is supported by the NPPF.

Protection of Ecological Value

13.2 To protect existing biodiversity, a series of measures will be implemented to reduce any impact on local wildlife. These include the following:

> All site operatives to be made aware of current legislation, including the protection of certain species;

> Site clearance works to be timed to avoid the main bird nesting season. If this is not possible, a check should be carried out prior to the works to determine the presence of any active nests;

> Suitable fencing should be erected to reduce the possibility of any damage to established vegetation; and

> Native species, or species of known wildlife value, should be used for the proposed new planting.

Enhancement of Ecological Value

13.3 Enhancing a site's ecological value not only helps to reduce a development's environmental impact but improves the health and wellbeing of the occupants through their interaction with the natural environment.

13.4 The proposed landscaping strategy incorporates significant building integrated landscaping/ greening with facades and canopies capable of receiving climbing plants and intensive green roofs.

13.5 The oak tree lost to represent Sevenoaks will also be reinstated.

13.6 The lower profile of the proposed development facilitates a seamless integration with the local environment. Moreover, a lower-profile structure enhances energy efficiency by reducing wind exposure and maximizing natural light, contributing to a more sustainable living space. This approach blends the existing landscape and community, reinforcing values of conservation.

13.7 The strategy for the new planting will include the following where possible:

> Promote local ecology through the use of native seed and fruit bearing species;

> Attract pollinators such as bees and butterflies through the use of flowering, nectar rich species;

> Combine natural and ornamental species to enrich the planting mix and promote local biodiversity;

> Create new habitats to attract local fauna; and

> Interconnect existing and proposed habitats of the site and its surroundings where possible.

Living Roof

13.8 105m^2 of living roof is to be provided in order to meet Policy G5 of the London Plan. Living roofs have demonstrable sustainability benefits, including:

> Reduction in urban heat island effect (localised cooling through increased evaporation);

> Provision of ecological habitats for fauna and flora, particularly where these roofs can replicate pre-existing ecological conditions; and

> Reduction in surface water run-off.

14.SUSTAINABLE CONSTRUCTION

14.1 Sustainable construction involves the prudent use of existing and new resources and the efficient management of the construction process. This includes the following measures:

> Reducing waste during construction and demolition and sorting waste on site where practical;

> Reducing the risk of statutory nuisance to neighbouring properties as much as possible through effective site management;

> Controlling dust and emissions from demolition and construction; and

> Complying with protected species legislation.

Considerate Constructors Scheme

14.2 The development site will be registered with the Considerate Constructors Scheme. This is designed to encourage environmentally and socially considerate ways of working, to reduce any adverse impacts arising from the construction process. As commonly known, the Considerate Constructors Scheme aims are as follows:

> Respecting the community (includes appearance)

> Care for the environment;

> Value their workforce (includes site safety).

14.3 The site will target a Very Good score of at least 33 out of 45, with all three sections scoring at least eleven points.

Monitoring Construction Site Impacts

14.4 During the construction processes, control procedures will be put in place to minimise noise and dust pollution and roads will be kept clean. The management systems will generally comprise procedures and working methods that are approved by the development team together with commercial arrangements to ensure compliance.

14.5 Further to the above, additional measures will be adopted to minimise the impact on the local area during construction. This will include the limiting of air and water pollution in accordance with best practice principles, as well as the recording, monitoring and displaying of energy and water use from site activities during construction.

14.6 In terms of construction traffic, this will be minimised by restricting deliveries and arrival times in order to manage potential impacts on existing and future occupants. Work will be limited to appropriate hours to be agreed with the Council, and suppressors will be used to reduce noise from machinery.

14.7 As outlined in the Construction Method Statement and Management Plan prepared by RGP (August 2024), all works can be carried out safely and efficiently within the curtilage of the worksite, resulting in minimal impact on neighbouring properties and the operation of the public highway.

14.8 Suitable measures have been defined to mitigate against any potential impact associated with construction traffic, dust, noise, vibration, contaminations and other environmental considerations. Key hazards and risks have been identified and appropriately assessed in the preparation of the report to maintain the safety of appointed operatives and members of the public. Please refer to the full report for further information.

15.CONCLUSION

15.1 The issue of sustainable development has been considered throughout the design of the proposed development at Sevenoaks by Bradley Ross Holdings Limited in the London Borough of Richmond. In particular, the incorporation of sustainable design and construction methods, energy and water saving measures, waste reduction techniques as well as measures to enhance the ecological value of the site, a good quality and sustainable development is proposed.

15.2 The key sustainability features outlined in this Sustainability Statement are listed below:

> **Energy efficiency:** A net zero energy strategy has been devised using heat pumps, PV panels and battery storage, demonstrating an exemplar commitment to sustainability. This delivers a 100% reduction in regulated operational emissions without the need for offsetting, significantly exceeding the requirements of both adopted and incoming planning policy.

> **Overheating:** The scheme has been designed to ensure overheating risk is reduced to acceptable levels in accordance with CIBSE TM52 and TM59:2017 requirements.

> **Water efficiency:** Water meters and water efficient fixtures and fittings will be installed in the dwelling to target a maximum internal daily water consumption of 110 litres/person/day.

> **Waste and recycling:** Adequate facilities will be provided for domestic, and construction related waste, including segregated bins for refuse and recycling.

> **Circular Economy:** The principles of a circular economy shall be incorporated into the development, where possible.

> **Materials:** A Whole Life Carbon Assessment has been undertaken to assess and reduce the environmental impact of the development. Where practical, new building materials will be sourced locally to reduce transportation pollution and support the local economy. New materials will be selected based on their environmental impact and responsible suppliers will be used where possible.

> **Pollution:** Suitable measures have been defined to mitigate against any potential impact associated with construction traffic, dust, noise, vibration, contaminations and other environmental considerations.

> **Flood Risk and Sustainable Urban Drainage Systems (SuDS):** The proposed development site lies in a low flood risk zone and will benefit from SuDS such as living roof.

> **Security:** The security and accessibility of the dwelling is not expected to change, with this already sufficient. The sound insulation will be improved with façade and window improvements.

- **Inclusive Access:** The dwelling has been designed to be easy to access and to adapt to suit future needs of the occupants. The design is fully compliant with Part M4(2).

- **Sustainable transport:** The site will benefit from a good existing public transport network and sustainable modes will be encouraged through the provision of an electric vehicle charging point.

- **Biodiversity and ecology:** The proposed development includes significant building integrated landscaping/ greening with facades and canopies capable of receiving climbing plants and intensive green roofs.

- **Sustainable construction:** The site will aim to achieve a Very Good score with the Considerate Constructors Scheme and will closely monitor construction site impacts.

APPENDICIES

Appendix A
Sustainable Construction Checklist

Appendix B
Water Efficiency Calculator

Appendix C
Roofplan (for PV)

Appendix D
SAP Calculations

HODKINSON

Appendix A

Sustainable Construction Checklist

LBRUT Sustainable Construction Checklist - June 2020

This document forms part of the Sustainable Construction Checklist SPD. This document **must** be filled out as part of the planning application for the following developments: all residential development providing **one or more new residential units (including conversions leading to one or more new units)**, and all other forms of development providing **100sqm or more of non-residential floor space**. Developments including new non-residential development of less than 100sqm floor space, extensions less than 100sqm, and other conversions are strongly encouraged to comply with this checklist. Where further information is requested, please either fill in the relevant section, or refer to the document where this information may be found in detail, e.g. Flood Risk Assessment or similar. **Further guidance** on completing the Checklist may be found in the Justification and Guidance section of this SPD.

Property Name (if relevant): Sevenoaks, 101a High Street

Application No. (if known):

Address (include. postcode): 101a High Street, Hampton, London, TW12 2SX

Completed by: R Durrant, J Peck - Hodkinson Consultancy

For Non-Residential
Size of development (m2):

For Residential
Number of dwellings: 1

1 MINIMUM COMPLIANCE (RESIDENTIAL AND NON-RESIDENTIAL)

Energy Assessment

Has an energy assessment been submitted that demonstrates the expected energy and carbon dioxide emissions saving from energy efficiency and renewable energy measures, including the feasibility of CHP/CCHP and community heating systems? If yes, please select TRUE. **TRUE**

Carbon Dioxide emissions reduction

What is the on site carbon dioxide emissions reduction against a Building Regulations Part L (2013) baseline: 100.8 % Over Part L 2021

Policy LP 22 B. and Draft London Plan Policy 9.2.5 require a 35% onsite reduction in CO_2 emissions beyond Building Regulations 2013.

What is the percentage reduction from efficiency measures alone: 11 %

Policy LP 22 C. and Draft London Plan Policy 9.2.6 require a 10% onsite reduction in CO2 emissions beyond Building Regulations 2013 from efficiency measures for residential and 15% for non-residential.

Percentage of **total** site CO2 emissions saved through renewable energy installation? 89.7 %

What is the total remaining carbon to be offset: 0 Tonne

Policy LP 22 B. and Draft London Plan Policy 9.2.4 require Major developments to achieve Zero Carbon after offsetting.

Are remaining emissions going to be offset through offset fund payment in accordance with current guidelines issued for the cost per tonne of CO2? **FALSE**

What is the total predicted cost of offset? £

The London Plan sets this as £95/tonne per year over 30 years, this should be updated based on As Build calculations.

1A MINIMUM POLICY COMPLIANCE (NON-RESIDENTIAL AND DOMESTIC REFURBISHMENT)

Please check the Guidance Section of this SPD for the policy requirements

Environmental Rating of development:

Non-Residential new-build (100sqm or more)
BREEAM Level: **Please Select** — Have you attached a pre-assessment to support this? **Please Select:**
Excellent required under Policy LP22 A 3

Extensions and conversions for residential dwellings
BREEAM Domestic Refurbishment: **Please Select** — Have you attached a pre-assessment to support this? **Please Select:**
Excellent required under Policy LP22 A 4

Extensions and conversions for non-residential buildings
BREEAM Level: **Please Select** — Have you attached a pre-assessment to support this? **Please Select:**
Excellent required under Policy LP 22

Score awarded for Environmental Rating:
BREEAM: Good = *0*, Very Good = 4, Excellent = *8*, Outstanding = *16*

Subtotal 0

1B MINIMUM POLICY COMPLIANCE (RESIDENTIAL)

Water Usage

	Score	
Internal water usage after gray/rainwater systems limited to 105 litres person per day. (Excluding an allowance 5 litres per person per day for external water consumption). Calculations using the water efficiency calculator for new dwellings have been submitted. *110l/p/d Required for new dwellings under Policy LP22 A 2 105l/p/d required under Draft London Plan Policy SI5*	*1*	**TRUE**

Subtotal 1

2. ENERGY USE AND POLLUTION

2.1 Need for Cooling

		Score	
a.	How does the development incorporate cooling measures? Tick all that apply:		
	Energy efficient design incorporating specific heat demand to less than or equal to 15 kWh/sqm	6	FALSE
	Reduce heat entering a building through providing/improving insulation and living roofs and walls	2	TRUE
	Reduce heat entering a building through shading	3	TRUE
	Exposed thermal mass and high ceilings	4	TRUE
	Passive ventilation	3	TRUE
	Mechanical ventilation with heat recovery	1	TRUE
	Active cooling systems, i.e. Air Conditioning Unit	0	FALSE
	See Draft London Plan SI4		

2.2 Heat Generation

		Score	
b.	How have the heating and cooling systems, with preference to the heating system hierarchy, been selected (defined in London Plan policy **SI3)** Tick all heating and cooling systems that will be used in the development:		
	Connection to existing heating or cooling networks powered by renewable energy	6	FALSE
	Connection to existing heating or cooling networks powered by gas or electricity	5	FALSE
	Site wide CHP network powered by renewable energy	4	FALSE
	Site wide CHP network powered by gas	3	FALSE
	Communal heating and cooling powered by renewable energy	2	FALSE
	Communal heating and cooling powered by gas or electricity	1	FALSE
	Individual heating and cooling	0	TRUE
	See Draft London Plan SI3		

2.3 Pollution: Air, Noise and Light

a.	Does the development plan to implement reduction strategies for dust emissions from construction sites?	2	TRUE
b.	Does the development plan to include a biomass boiler?		FALSE
	If yes, please refer to the biomass guidelines for the Borough of Richmond, please see guidance for supplementary information. If the proposed boiler is of a qualifying size, you may need to complete the information request form found on the Richmond website.		
c.	Has an air quality impact assessment been provided		FALSE
	If yes, has 'Emissions Neutral' been achieved	1	Please Select:
	If yes, have occupants of new development been protected from existing pollution	1	Please Select:
	If no to any of the above are there any sensitive receptors as defined in Policy LP 10 present?	-1	Please Select:
	see Policy LP 10		
d.	Please tick only one option below		
	Has the development taken measures to reduce existing noise and enhance the existing soundscape of the site?	3	Please Select:
	Has the development taken care to not create any new noise generation/transmission issues in its intended operation?	1	TRUE
	see Policy LP 10		
e.	Has the development taken measures to reduce light pollution impacts on character, residential amenity and biodiversity?	3	TRUE
	see Policy LP 10		
f.	Have you attached a Lighting Pollution Report?	-	

Subtotal 19

Please give any additional relevant comments to the Energy Use and Pollution Section below

All internal, external, and any security lighting will be energy efficient and adequately controlled. This will ensure the conservation of energy when the lighting is not in use. LED lighting will be adopted as it is highly efficient and consumes less electricity compared to traditional bulbs. LEDs also have a longer lifespan, decreasing the need for frequent replacements which reduces its embodied carbon impact.

3. TRANSPORT

3.1 Provision for the safe efficient and sustainable movement of people and goods

a.	Does your development provide opportunities for occupants to use innovative travel technologies?		TRUE

Please explain:

Inclusion of an electric vehicle charging point (in line with Building Regulations requirements of 1 active EVC space per new dwelling) to allow for electric car use and provison of 10 cycle storage spaces.

		Score	
b.	Does your development provide for 100% active provision for electric vehicle charging point(s) and have you successfully demonstrated that it would be able to operate satisfactorily in the future expectation of all vehicles being electrically powered?	2	TRUE
c.	**For major developments ONLY**: Has a Transport Assessment been produced for your development based on TfL's Best Practice Guidance?		
	If you have provided a Transport Assessment as part of your planning application, please tick here and move to Section 3 of this Checklist.	5	Please Select:
	See policy LP44		
d.	**For smaller developments ONLY**: Have you provided a Transport Statement?	5	FALSE
e.	Does your development provide cycle storage? (Standard space requirements are set out in the Council's Parking Standards - Local Plan Appendix 3)	2	TRUE
	If so, for how many bicycles?	10	
	Is this shown on the site plans?		TRUE
	See Local Plan Appendix 3		
f.	Will the development create or improve links with local and wider transport networks? If yes, please provide details.	2	FALSE
		Subtotal	4

Please give any additional relevant comments to the Transport Section below

Currently there is 0 existing cycle storage built into the property, but up to 10 cycle spaces in the proposal which can be hung on a rack system in the boot room. This will encourage the use of bikes and sustainable transport options.

4 BIODIVERSITY

4.1 Minimising the threat to biodiversity from new buildings, lighting, hard surfacing and people

a.	Does your development involve the loss of an ecological feature or habitat, including a loss of garden or other green space? (Indicate if yes)				-2	FALSE
	If so, please state how much in sqm?				sqm	
b.	Does your development involve the removal of any tree(s)? (Indicate if yes)					TRUE
	If so, has a tree report been provided in support of your application? (Indicate if yes)					TRUE
c.	Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes)					TRUE
d.	Please indicate which features and/or habitats that your development will incorporate to improve on site biodiversity:					
	Pond, reedbed or extensive native planting	*6*	Area provided:	35	sqm	TRUE
	An extensive green roof	*5*	Area provided:		sqm	FALSE
	An intensive green roof	*4*	Area provided:	105	sqm	TRUE
	Garden space	*4*	Area provided:	65	sqm	TRUE
	Additional native and/or wildlife friendly planting to peripheral areas	*3*	Area provided:	583	sqm	TRUE
	Additional planting to peripheral areas	*2*	Area provided:	98.5	sqm	TRUE
	A living wall	*2*	Area provided:		sqm	FALSE
	Bat boxes	*0.5*				FALSE
	Bird boxes	*0.5*				FALSE
	Swift boxes	*0.5*				FALSE
	Other	*0.5*				TRUE
e.	Does your development use at least 70% of available roof plate as green/brown roof *Policy LP 17 requires 70%*				1	FALSE
					Subtotal	**19.5**

Please give any additional relevant comments to the Biodiversity Section below

Please see list of features included for the proposed development and the percentage of green roof:
- Pond 35m2
- Intensive green roof 105m2
- Seating areas and paths 258m2
- Driveway and parking 350m2
- Lawn 65m2
- Meadow/grassland 769m2
- Reinforced grass/SUDs 27m2
- Wildlife friendly Planting 583m2
- Hedging 98.5 lin m

Percentage of green roof in line with the total roof area is 35% (excluding overhangs).

5 FLOODING AND DRAINAGE

5.1 Mitigating the risks of flooding and other impacts of climate change in the borough

a.	Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes)		-2	FALSE
	Have you submitted a Flood Risk Assessment? (Indicate if yes)			FALSE
b.	Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick all that apply)			
	Store rainwater for later use		5	TRUE
	Use of infiltration techniques such as porous surfacing materials to allow drainage on-site		3	FALSE
	Attenuate rainwater in ponds or open water features		4	FALSE
	Store rainwater in tanks for gradual release to a watercourse		3	TRUE
	Discharge rainwater directly to watercourse		2	FALSE
	Discharge rainwater to surface water drain		1	TRUE
	Discharge rainwater to combined sewer		0	FALSE
	Have you submitted a Drainage Statement (Indicate if yes)			FALSE
	See Policy LP 21 and Draft London Plan SL 13			
c.	Please give the change in area of permeable surfacing which will result from your development proposal:	441.6	sqm	
	Please provide details of the permeable surfacing below	*please represent a loss in permeable area as a negative number*		
			Subtotal	**9**

Please give any additional relevant comments to the Flooding and Drainage Section below

The current house at 193.7m2 and the proposed development is 576.9m2. This is an increase of 383.2 m2 in building size. The proposed terrace at the rear is 58.4m2. This is an increase of 441.6m2 of drained areas on the site.

Driveway excluded as this is not changing in our calculations and this is tarmac according to the topographic survey.

As all pathways in the garden have been deemed that they will drain off into the permeable landscaping beside the pathways. This is because the CIRIA SuDS Manual has a caveat for small areas of hard standing in a permeable setting.

6 IMPROVING RESOURCE EFFICIENCY

6.1 Reduce waste generated and amount disposed of by landfill though increasing level of re-use and recycling

a.	Will demolition be required on your site prior to construction? *[Points will only be awarded if 10% or greater of demolition waste is reused/recycled]*		1	TRUE
	If so, what percentage of demolition waste will be reused in the new development?	10	%	
	What percentage of demolition waste will be recycled?	90	%	
b.	Does your site have any contaminated land?		1	FALSE
	Have you submitted an assessment of the site contamination?		2	FALSE
	Are plans in place to remediate the contamination?		2	FALSE
	Have you submitted a remediation plan?		1	FALSE
	Are plans in place to include composting on site?		1	TRUE
c.	Will a waste management plan and facilities be in place in line with Policy LP24	Yes		

6.2 Reducing levels of water waste

a.	Will the following measures of water conservation be incorporated into the development? (Please tick all that apply):			
	Fitting of water efficient taps, shower heads etc		1	TRUE
	Use of water efficient A or B rated appliances		1	TRUE
	Rainwater harvesting for internal use		4	FALSE
	Greywater systems		4	FALSE
	Fit a water meter		1	TRUE
			Subtotal	**4**

Please give any additional relevant comments to the Improving Resource Efficiency Section below

Implementing grey water reuse is the intention for the development, however due to lack of space on the site this will have to be further studied. Nonetheless, grey water reuse will seek to be implemented, space allowing.

7 ACCESSIBILITY

7.1 Ensure flexible adaptable and long-term use of structures

a. **If the development is residential,** will it meet the requirements of the nationally described space standard for internal space and layout? *1* **TRUE**

If the standards are not met, in the space below, please provide details of the functionality of the internal space and layout

AND

b. **If the development is residential**, will it meet Building Regulation Requirement M4 (2) 'accessible and adaptable dwellings'? *2* **TRUE**

If this is not met, in the space below, please provide details of any accessibility measures included in the development.

For major residential developments, are 10% or more of the units in the development to Building Regulation Requirement M4 (3) 'wheelchair user dwellings'? *1* **Please Select:**

OR

c. **If the development is non-residential,** does it comply with requirements included in Richmond's Local Plan LP1, LP28.B, LP30 & LP45 *2* **Please Select:**

Please provide details of the accessibility measures specified in the Local Plan that will be included in the development

Subtotal 3

Please give any additional relevant comments to the Design Standards and Accessibility Section below

The property features a step-free approach and entrance, providing smooth access from any nearby parking spaces and communal areas within the property boundary. Inside, step-free access continues throughout the entrance level, allowing easy movement to the WC, main living areas, and connected private outdoor spaces.
The design is tailored for older individuals and wheelchair users, incorporating features that enable easy navigation and use of sanitary facilities. Additionally, the layout is designed to support future adaptations, enhancing accessibility and functionality as needed.
Wall-mounted switches and controls will be positioned at accessible heights for those with limited reach, ensuring a comfortable and inclusive living environment for all residents and visitors.
An Inclusive Access Statement has been prepared. Please see the full report submitted alongside this application for further detail.

LBRUT Sustainable Construction Checklist- Scoring Matrix for *New Construction* **(Non-Residential and domestic refurb)**

TOTAL ***59.5***

Score	Rating	Significance
84 or more	*A+*	Project strives to achieve highest standard in energy efficient sustainable development
75-83	*A*	Makes a major contribution towards achieving sustainable development in Richmond
56-74	*B*	Helps to significantly improve the Borough's stock of sustainable developments
40-55	*C*	Minimal effort to increase sustainability beyond general compliance
39 or less	*FAIL*	Does not comply with SPD Policy

LBRUT Sustainable Construction Checklist- Scoring Matrix for New Construction **Residential new-build**

Score	Rating	Significance
85 or more	A++	Project strives to achieve highest standard in energy efficient sustainable development
68-84	*A+*	Project strives to achieve higher standard in energy efficient sustainable development
59-67	*A*	Makes a major contribution towards achieving sustainable development in Richmond
39-58	*B*	Helps to significantly improve the Borough's stock of sustainable developments
24-38	*C*	Minimal effort to increase sustainability beyond general compliance
23 or less	*FAIL*	Does not comply with SPD Policy

Authorisation:

I herewith declare that I have filled in this form to the best of my knowledge

Signature R Durrant **Date** 09/09/24

HODKINSON

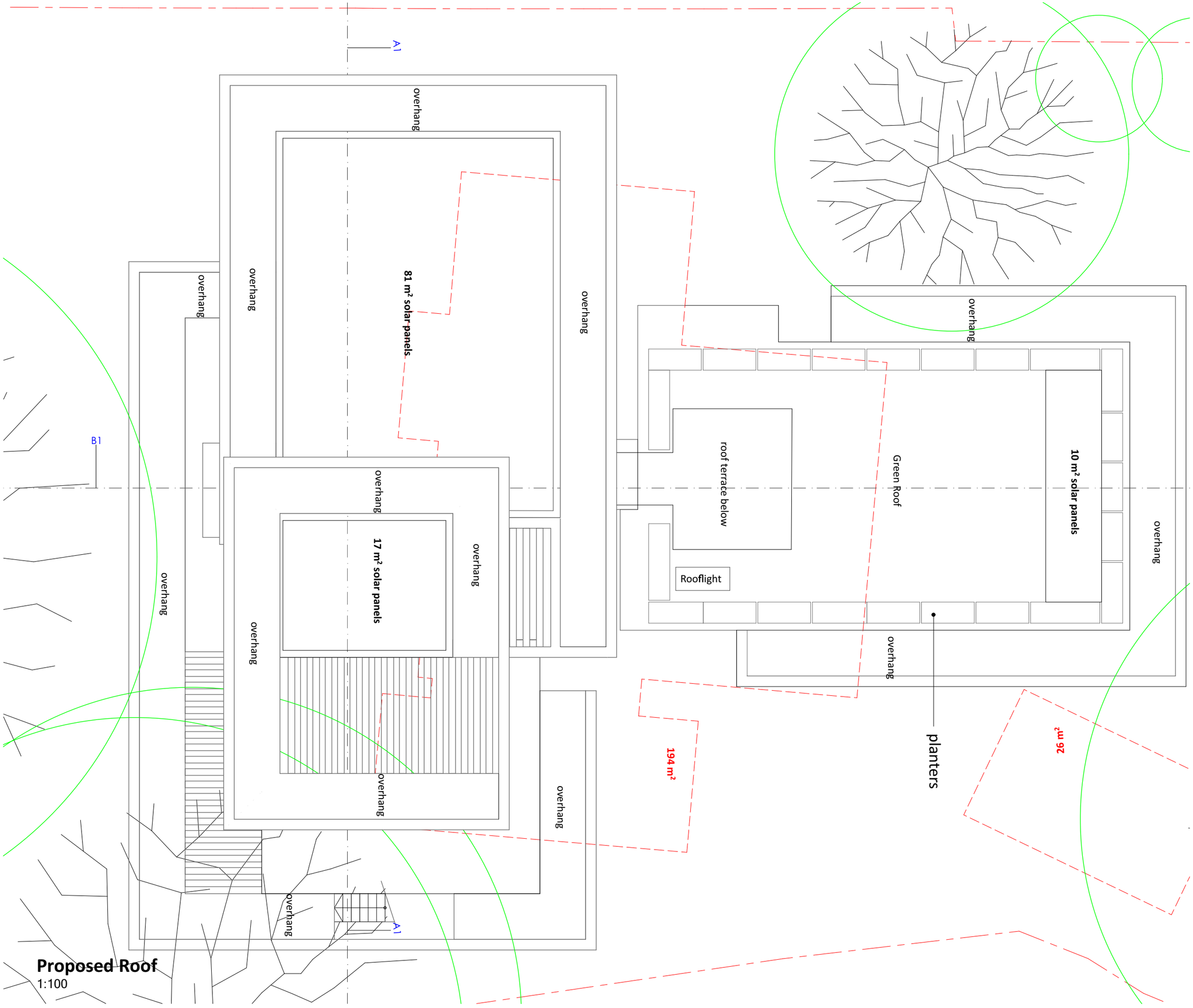
Appendix B

Water Efficiency Calculator

Water Efficiency Calculator
Sevenoaks, 101a High Street

	Internal Water Consumption			
Installation Type	**Unit of Measure**	**Capacity / Flow Rate**	**Litres/person/day**	**Notes**
WC	Full Flush Volume (Litres)	**6**	8.76	Low flush WCs will be installed to reduce the volume of water consumed during flushing. All WCs will have dual flush cisterns which will provide both part (4L) and full (6L) flushes.
	Part Flush Volume (Litres)	**4**	11.84	
Basin Tap	Flow Rate (Litres/minute)	**4**	7.90	All taps (excluding kitchen taps) will be reduced to 4 litres/minute using flow restrictors. Where multiple taps are to be provided the average flow rate will be used.
Bath	Capacity (Litres to overflow)	**160**	17.60	All baths will have reduced capacities of 160 litres (excluding displacement). The bath taps are not included in this calculation as they are already incorporated into the use factor for the baths.
Shower	Flow Rate (Litres/minute)	**8**	34.96	Shower flow rates will be reduced to a maximum of 8 litres/minute using flow restrictors fixed to the shower heads. These contain precision-made holes or filters to restrict water flow and reduce the outlet flow and pressure.
Kitchen Tap	Flow Rate (Litres/minute)	**5**	12.56	Kitchen taps will be reduced to 5 litres/minute using flow restrictors which will be fitted within the console of the tap or in the pipework.
Washing Machine	Water Consumption (Litres/kg)	**8.17**	17.16	Water efficient washing machines or washer-dryers will be specified. The make and model numbers of the appliances are unknown at this stage therefore a default figure of 8.17 litres/kg has been assumed.
Dishwasher	Water Consumption (Litres/place setting)	**1.25**	4.50	All dishwashers will be water efficient. The make and models numbers are unknown therefore a default figure of 1.25 litres/place setting has been assumed at this stage.
		Net Internal Water Consumption (Litres/person/day)	**115.3**	
		Normalisation Factor	**0.91**	
		Total Internal Water Consumption (Litres/person/day)	**104.9**	The total *internal* water consumption target of ≤105 litres/person/day will be achieved in accordance with Regulation 36 para (2)b optional requirement Approved Document G.
		Allowance for External Water Consumption (Litres/person/day)	**5**	
		Total Water Consumption (Litres/person/day)	**109.9**	The *total* water consumption target of ≤110 litres/person/day will be achieved in accordance with Regulation 36 para (2)b optional requirement of Approved Document G.

Appendix C
Roofplan (for PV)



Proposed Roof
1:100

NOTES

ALL DRAWINGS TO BE PRINTED AT 100% SCALE. DO NOT FIT TO PRINTER MARGINS WHEN PRINTING. DO NOT SCALE DIMENSIONS FROM THE DRAWING. USE FIGURED DIMENSIONS ONLY.

1. This drawing is copyright of HollandGreen Ltd. Reproduction is only to take place with written authority.
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3. Any structural work where mentioned on this drawing is subject to a qualified structural and civil engineer calculations before building work commences.
4. All boundaries are assumed. To be confirmed on site before building work commences.
5. Any discrepancies are to be brought to the attention of HollandGreen Ltd for rectification. If in doubt, ASK.
6. Only drawings marked as CONSTRUCTION status can be used to build or manufacture from.
7. All windows and doors shown on schedules and drawings are indicative only and no manufacturing should be carried out until a site survey has been conducted by manufacturer.
8. The survey information shown on this drawing is based on a survey prepared by a third party. HollandGreen accept no responsibility for the accuracy or completeness of the survey.

1:100
0 2 4m

N

Stage: **PLANNING**

Drawing: Proposed Roof

Revision	Date	Details
PL-3	03/09/2024	Issued to Consultants

Project
Ross - Sevenoaks

Project Address
Sevenoaks, 101a High Street
Hampton Middlesex London
TW12 2SX

Project Number
1553

Project Leader
Laira Piccinato

Scale
1:100 @ A3

Date
04 September 2024

Drawing Number
051-110

Revision
PL-3

The Old Grammar School
Church Road
Thame
OX9 3AJ

hello@hollandgreen.co.uk
hollandgreen.co.uk

HOLLAND GREEN™

Appendix D
SAP Calculations

Full SAP Calculation Printout

Property Reference	Proposed House	**Issued on Date**	06/09/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	100 A	**DER**	-0.09	**TER**	10.85
Environmental	100 A	**% DER < TER**			100.83
CO_2 Emissions (t/year)	-0.32	**DFEE**	48.10	**TFEE**	55.48
Compliance Check	See BREL	**% DFEE < TFEE**			13.30
% DPER < TPER	94.18	**DPER**	3.36	**TPER**	57.66

Assessor Details	Miss Eleanor Ballinger	**Assessor ID**	M976-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	160.5800 (1a)	x	2.5000 (2a)	=	401.4500	(1a) - (3a)
Ground floor	254.7200 (1b)	x	3.0000 (2b)	=	764.1600	(1b) - (3b)
First floor	86.5500 (1c)	x	3.0000 (2c)	=	259.6500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	501.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1425.2600	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1000	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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)
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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(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	0.2225	0.2200	0.2175	0.2050	0.2025	0.1900	0.1900	0.1875	0.1950	0.2025	0.2075	0.2125	(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	
Window (Uw = 1.10)			98.3500	1.0536	103.6255			(27)
Kitchen Window (Uw = 0.80)			61.9900	0.7752	48.0543			(27)
Door			18.7000	1.0000	18.7000			(26)
Rooflight			6.9400	1.0536	7.3123			(27a)
Heatloss Floor 1			160.5800	0.1100	17.6638	20.0000	3211.6000	(28)
Heatloss Floor 2			150.7800	0.1100	16.5858	110.0000	16585.8000	(28a)
Heatloss Floor 3			17.2700	0.1100	1.8997			(28b)
External Wall 1	612.5500	179.0400	433.5100	0.1100	47.6861	60.0000	26010.6000	(29a)
External Roof 1	329.8200	6.9400	322.8800	0.1100	35.5168	9.0000	2905.9200	(30)
Total net area of external elements Aum(A, m2)			1271.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		297.0442			(33)
Internal Wall 1			738.1300			9.0000	6643.1700	(32c)
Internal Floor 1			103.9400			18.0000	1870.9200	(32d)

Internal Floor 2	69.2800	18.0000	1247.0400	(32d)
Internal Ceiling 1	103.8500	9.0000	934.6500	(32e)
Internal Ceiling 2	68.1800	9.0000	613.6200	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 60023.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 119.6041 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	74.3100	0.0400	2.9724
E3 Sill	67.1300	0.0400	2.6852
E4 Jamb	142.5000	0.0500	7.1250
E5 Ground floor (normal)	67.7600	0.0600	4.0656
E15 Flat roof with parapet	126.2100	0.3000	37.8630
E14 Flat roof	27.4400	0.1600	4.3904
E16 Corner (normal)	71.0000	0.0400	2.8400
E17 Corner (inverted - internal area greater than external area)	37.0000	-0.0800	-2.9600
E22 Basement floor	58.8500	0.2200	12.9470
E20 Exposed floor (normal)	15.4200	0.2000	3.0840
E21 Exposed floor (inverted)	21.0300	0.2000	4.2060
E24 Eaves (insulation at ceiling level - inverted)	31.5300	0.1500	4.7295

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 83.9481 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 380.9923 (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	104.6497	103.4739	102.2980	96.4188	95.2430	89.3638	89.3638	88.1880	91.7155	95.2430	97.5947	99.9464	(38)
Heat transfer coeff	485.6420	484.4662	483.2903	477.4111	476.2353	470.3561	470.3561	469.1803	472.7078	476.2353	478.5870	480.9387	(39)
Average = Sum(39)m / 12 =												477.1172	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9677	0.9654	0.9630	0.9513	0.9490	0.9372	0.9372	0.9349	0.9419	0.9490	0.9536	0.9583	(40)
HLP (average)												0.9507	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---
4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3943 (42)
Hot water usage for mixer showers

81.1318	79.9126	78.1359	74.7365	72.2278	69.4302	67.8400	69.6033	71.5361	74.5399	78.0123	80.8210	(42a)

Hot water usage for baths

35.0126	34.4926	33.7603	32.4102	31.3992	30.2782	29.6727	30.3998	31.1915	32.3911	33.7690	34.8942	(42b)

Hot water usage for other uses

49.3914	47.5953	45.7993	44.0032	42.2072	40.4111	40.4111	42.2072	44.0032	45.7993	47.5953	49.3914	(42c)

Average daily hot water use (litres/day) 152.1642 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.5358	162.0005	157.6955	151.1499	145.8342	140.1196	137.9239	142.2103	146.7309	152.7303	159.3766	165.1065	(44)
Energy conte	262.1682	230.6865	242.3721	206.9167	196.3209	172.2933	166.8070	176.0861	180.9339	207.2535	227.0613	258.5169	(45)
Energy content (annual)											Total = Sum(45)m =	2527.4163	
Distribution loss (46)m = 0.15 x (45)m	39.3252	34.6030	36.3558	31.0375	29.4481	25.8440	25.0210	26.4129	27.1401	31.0880	34.0592	38.7775	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0260 (55)
Total storage loss

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)

If cylinder contains dedicated solar storage

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(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

317.2366	280.4257	297.4405	260.2087	251.3893	225.5853	221.8754	231.1545	234.2259	262.3219	280.3533	313.5853	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
317.2366	280.4257	297.4405	260.2087	251.3893	225.5853	221.8754	231.1545	234.2259	262.3219	280.3533	313.5853	(64)
									Total per year (kWh/year) = Sum(64)m =		3175.8023	(64)
12Total per year (kWh/year)												3176	(64)

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

131.2256	116.4946	124.6434	111.4334	109.3314	99.9211	99.5180	102.6033	102.7941	112.9665	118.1315	130.0116	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	305.9751	338.7582	305.9751	316.1743	305.9751	316.1743	305.9751	305.9751	316.1743	305.9751	316.1743	305.9751	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	606.6299	612.9248	597.0618	563.2914	520.6622	480.5969	453.8308	447.5358	463.3988	497.1693	539.7984	579.8637	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	(71)
Water heating gains (Table 5)	176.3785	173.3551	167.5315	154.7686	146.9508	138.7794	133.7608	137.9077	142.7696	151.8367	164.0715	174.7468	(72)
Total internal gains	1162.8985	1198.9531	1144.4834	1108.1493	1047.5032	1009.4655	967.4817	965.3337	996.2577	1028.8961	1093.9592	1134.5007	(73)

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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	21.4700	10.6334	0.4000	0.7500	0.7700	47.4633	(74)
East	11.1700	19.6403	0.4000	0.7500	0.7700	45.6095	(76)
South	51.0800	46.7521	0.4000	0.7500	0.7700	496.4851	(78)
West	14.6300	19.6403	0.4000	0.7500	0.7700	59.7374	(80)
East	17.0700	19.6403	0.4000	0.7500	0.7700	69.7004	(76)
South	23.8100	46.7521	0.4000	0.7500	0.7700	231.4274	(78)
West	21.1100	19.6403	0.4000	0.7500	0.7700	86.1966	(80)
North	6.9400	26.0000	0.4000	0.7500	1.0000	48.7188	(82)

Solar gains	1085.3384	1895.0714	2694.2043	3472.4092	3986.0680	3992.8867	3835.2428	3451.1337	2965.9656	2123.8723	1308.9523	922.7351	(83)
Total gains	2248.2369	3094.0244	3838.6877	4580.5585	5033.5712	5002.3523	4802.7245	4416.4674	3962.2234	3152.7684	2402.9115	2057.2358	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3322	34.4155	34.4992	34.9241	35.0103	35.4479	35.4479	35.5368	35.2716	35.0103	34.8383	34.6679	
alpha	3.2888	3.2944	3.2999	3.3283	3.3340	3.3632	3.3632	3.3691	3.3514	3.3340	3.3226	3.3112	
util living area	0.9893	0.9708	0.9329	0.8490	0.7178	0.5530	0.4161	0.4653	0.6904	0.9061	0.9781	0.9919	(86)
Living	19.2058	19.5197	19.9152	20.3592	20.6706	20.8373	20.8877	20.8784	20.7549	20.2983	19.6586	19.1568	
Non living	17.9667	18.3668	18.8656	19.4171	19.7797	19.9633	20.0069	20.0027	19.8838	19.3570	18.5534	17.9097	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1103	20.1123	20.1143	20.1241	20.1261	20.1360	20.1360	20.1379	20.1320	20.1261	20.1221	20.1182	(88)
util rest of house	0.9875	0.9659	0.9219	0.8252	0.6758	0.4911	0.3398	0.3862	0.6316	0.8857	0.9737	0.9905	(89)
MIT 2	20.1103	20.1123	20.1143	20.1241	20.1261	20.1360	20.1360	20.1379	20.1320	20.1261	20.1221	20.1182	(90)
Living area fraction									fLA = Living area / (4) =			0.1652	(91)
MIT	20.2573	20.2589	20.2606	20.2688	20.2704	20.2787	20.2787	20.2803	20.2754	20.2704	20.2672	20.2639	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2573	20.2589	20.2606	20.2688	20.2704	20.2787	20.2787	20.2803	20.2754	20.2704	20.2672	20.2639	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9878	0.9668	0.9239	0.8294	0.6832	0.5017	0.3527	0.3997	0.6420	0.8894	0.9745	0.9908	(94)
Useful gains	2220.8419	2991.2857	3546.4963	3799.3256	3438.7026	2509.6825	1694.1473	1765.3833	2543.7913	2804.2000	2341.5657	2038.2921	(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	7749.5338	7440.8859	6650.3551	5427.5914	4081.5486	2671.0055	1730.2933	1820.5784	2919.1543	4605.4075	6301.6283	7725.7337	(97)
Space heating kWh	4113.3468	2990.1313	2309.2709	1172.3513	478.2774	0.0000	0.0000	0.0000	0.0000	1340.0983	2851.2451	4231.4566	(98a)
Space heating requirement - total per year (kWh/year)												19486.1778	
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	4113.3468	2990.1313	2309.2709	1172.3513	478.2774	0.0000	0.0000	0.0000	0.0000	1340.0983	2851.2451	4231.4566	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												19486.1778	
Space heating per m2											(98c) / (4) =	38.8287	(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 %)	333.7903	(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	4113.3468	2990.1313	2309.2709	1172.3513	478.2774	0.0000	0.0000	0.0000	0.0000	1340.0983	2851.2451	4231.4566	(98)
Space heating efficiency (main heating system 1)	333.7903	333.7903	333.7903	333.7903	333.7903	0.0000	0.0000	0.0000	0.0000	333.7903	333.7903	333.7903	(210)
Space heating fuel (main heating system)	1232.3148	895.8114	691.8329	351.2240	143.2868	0.0000	0.0000	0.0000	0.0000	401.4792	854.2026	1267.6992	(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	317.2366	280.4257	297.4405	260.2087	251.3893	225.5853	221.8754	231.1545	234.2259	262.3219	280.3533	313.5853	(64)
Efficiency of water heater												114.8400	(216)
(217)m	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(217)
Fuel for water heating, kWh/month	276.2422	244.1882	259.0042	226.5837	218.9040	196.4345	193.2039	201.2839	203.9584	228.4238	244.1251	273.0628	(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	138.0811	124.7185	138.0811	133.6269	138.0811	133.6269	138.0811	138.0811	133.6269	138.0811	133.6269	138.0811	(231)
Lighting	85.1900	68.3426	61.5349	45.0831	34.8235	28.4511	31.7672	41.2921	53.6344	70.3713	79.4842	87.5577	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-270.5336	-505.8660	-985.0633	-1380.9997	-1133.0562	-894.1289	-886.8001	-897.4149	-908.3547	-678.9790	-331.9090	-218.5772	(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	-0.2824	-2.1660	-14.8727	-131.0003	-866.8158	-1121.8711	-1081.8239	-737.8971	-250.8453	-8.4770	-0.7310	-0.1588	(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	5837.8510	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	114.8400	
Water heating fuel used	2765.4147	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.9350)		
mechanical ventilation fans (SFP = 0.9350)	1625.7941	(230a)
Total electricity for the above, kWh/year	1625.7941	(231)
Electricity for lighting (calculated in Appendix L)	687.5320	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-13308.6240	(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	-2392.0322	(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	5837.8510	0.1558	909.4072	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2765.4147	0.1410	389.9043	(264)
Space and water heating			1299.3115	(265)
Pumps, fans and electric keep-hot	1625.7941	0.1387	225.5177	(267)
Energy for lighting	687.5320	0.1443	99.2321	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-9091.6829	0.1340	-1217.9441	
PV Unit electricity exported	-4216.9411	0.1069	-450.9201	
Total			-1668.8642	(269)
Total CO2, kg/year			-44.8029	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.0900	(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	5837.8510	1.5767	9204.4921	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2765.4147	1.5213	4207.1523	(278)
Space and water heating			13411.6443	(279)
Pumps, fans and electric keep-hot	1625.7941	1.5128	2459.5013	(281)
Energy for lighting	687.5320	1.5338	1054.5595	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-9091.6829	1.4952	-13593.5807	
PV Unit electricity exported	-4216.9411	0.3908	-1647.7731	
Total			-15241.3538	(283)
Total Primary energy kWh/year			1684.3513	(286)
Dwelling Primary energy Rate (DPER)			3.3600	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	160.5800 (1a)	x	2.5000 (2a)	=	401.4500 (1a) - (3a)	
Ground floor	254.7200 (1b)	x	3.0000 (2b)	=	764.1600 (1b) - (3b)	
First floor	86.5500 (1c)	x	3.0000 (2c)	=	259.6500 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	501.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1425.2600	(5)

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2. Ventilation rate

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		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)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0281	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2781	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2781	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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)
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	0.3545	0.3476	0.3406	0.3059	0.2989	0.2642	0.2642	0.2572	0.2781	0.2989	0.3128	0.3267	(22b)
Effective ac	0.5628	0.5604	0.5580	0.5468	0.5447	0.5349	0.5349	0.5331	0.5387	0.5447	0.5489	0.5534	(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	
TER Opaque door			18.7000	1.0000	18.7000			(26)
TER Opening Type (Uw = 1.20)			102.3200	1.1450	117.1603			(27)
Rooflight			4.4300	2.0221	8.9577			(27a)
Heatloss Floor 1			160.5800	0.1300	20.8754			(28)
Heatloss Floor 2			150.7800	0.1300	19.6014			(28a)
Heatloss Floor 3			17.2700	0.1300	2.2451			(28b)
External Wall 1	612.5500	121.0200	491.5300	0.1800	88.4754			(29a)
External Roof 1	329.8200	4.4300	325.3900	0.1100	35.7929			(30)
Total net area of external elements Aum(A, m2)			1271.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		311.8082			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 119.6041 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	74.3100	0.0500	3.7155
E3	Sill	67.1300	0.0500	3.3565
E4	Jamb	142.5000	0.0500	7.1250
E5	Ground floor (normal)	67.7600	0.1600	10.8416
E15	Flat roof with parapet	126.2100	0.5600	70.6776
E14	Flat roof	27.4400	0.0800	2.1952
E16	Corner (normal)	71.0000	0.0900	6.3900
E17	Corner (inverted - internal area greater than external area)	37.0000	-0.0900	-3.3300
E22	Basement floor	58.8500	0.0700	4.1195
E20	Exposed floor (normal)	15.4200	0.3200	4.9344
E21	Exposed floor (inverted)	21.0300	0.3200	6.7296
E24	Eaves (insulation at ceiling level - inverted)	31.5300	0.2400	7.5672

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		124.3221 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	436.1303 (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	264.7270	263.5792	262.4541	257.1696	256.1809	251.5783	251.5783	250.7259	253.3511	256.1809	258.1810	260.2721	(38)
Heat transfer coeff	700.8573	699.7095	698.5844	693.2999	692.3112	687.7086	687.7086	686.8562	689.4814	692.3112	694.3114	696.4024	(39)
Average = Sum(39)m / 12 =												693.2952	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3965	1.3943	1.3920	1.3815	1.3795	1.3703	1.3703	1.3686	1.3739	1.3795	1.3835	1.3877	(40)
HLP (average)												1.3815	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.3943 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	81.1318	79.9126	78.1359	74.7365	72.2278	69.4302	67.8400	69.6033	71.5361	74.5399	78.0123	80.8210	(42a)
Hot water usage for baths	35.0126	34.4926	33.7603	32.4102	31.3992	30.2782	29.6727	30.3998	31.1915	32.3911	33.7690	34.8942	(42b)
Hot water usage for other uses	49.3914	47.5953	45.7993	44.0032	42.2072	40.4111	40.4111	42.2072	44.0032	45.7993	47.5953	49.3914	(42c)
Average daily hot water use (litres/day)												152.1642	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.5358	162.0005	157.6955	151.1499	145.8342	140.1196	137.9239	142.2103	146.7309	152.7303	159.3766	165.1065	(44)
Energy conte	262.1682	230.6865	242.3721	206.9167	196.3209	172.2933	166.8070	176.0861	180.9339	207.2535	227.0613	258.5169	(45)
Energy content (annual)										Total = Sum(45)m =		2527.4163	
Distribution loss (46)m = 0.15 x (45)m	39.3252	34.6030	36.3558	31.0375	29.4481	25.8440	25.0210	26.4129	27.1401	31.0880	34.0592	38.7775	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	313.9148	277.4254	294.1187	256.9940	248.0675	222.3707	218.5536	227.8326	231.0112	259.0001	277.1386	310.2635	(62)
WWHRS	-37.0901	-32.8028	-34.3492	-28.4425	-26.5074	-22.6825	-21.2613	-22.6092	-23.4682	-27.6665	-31.3427	-36.4032	(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	276.8247	244.6226	259.7695	228.5515	221.5601	199.6882	197.2923	205.2234	207.5430	231.3337	245.7959	273.8603	(64)
										Total per year (kWh/year) = Sum(64)m =		2792.0651	(64)
12Total per year (kWh/year)												2792	(64)
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	128.5682	114.0943	121.9860	108.8617	106.6740	97.3494	96.8606	99.9459	100.2224	110.3091	115.5597	127.3542	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	306.4104	339.2401	306.4104	316.6241	306.4104	316.6241	306.4104	306.4104	316.6241	306.4104	316.6241	306.4104	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	606.6299	612.9248	597.0618	563.2914	520.6622	480.5969	453.8308	447.5358	463.3988	497.1693	539.7984	579.8637	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	(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)	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	(71)
Water heating gains (Table 5)	172.8067	169.7833	163.9597	151.1968	143.3790	135.2075	130.1890	134.3359	139.1978	148.2649	160.4996	171.1749	(72)
Total internal gains	1162.7620	1198.8632	1144.3469	1108.0273	1047.3667	1006.3436	964.3452	962.1972	993.1358	1028.7596	1093.8372	1134.3642	(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	13.7000	10.6334	0.6300	0.7000	0.7700	44.5209	(74)
East	18.0100	19.6403	0.6300	0.7000	0.7700	108.1018	(76)
South	47.8000	46.7521	0.6300	0.7000	0.7700	682.9683	(78)
West	22.8100	19.6403	0.6300	0.7000	0.7700	136.9129	(80)
North	4.4300	26.0000	0.6300	0.7000	1.0000	45.7149	(82)

Solar gains	1018.2188	1777.8549	2527.5121	3257.5070	3739.3311	3745.7107	3597.8324	3237.5300	2782.4372	1992.4903	1227.9999	865.6741	(83)
Total gains	2180.9809	2976.7181	3671.8590	4365.5343	4786.6978	4752.0543	4562.1776	4199.7272	3775.5730	3021.2499	2321.8371	2000.0382	(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, ni1,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.7896	23.8287	23.8670	24.0490	24.0833	24.2445	24.2445	24.2746	24.1822	24.0833	24.0139	23.9418	
alpha	2.5860	2.5886	2.5911	2.6033	2.6056	2.6163	2.6163	2.6183	2.6121	2.6056	2.6009	2.5961	
util living area	0.9894	0.9763	0.9528	0.9032	0.8195	0.6952	0.5646	0.6147	0.8007	0.9368	0.9812	0.9915	(86)
MIT	17.7764	18.1755	18.7580	19.4922	20.1463	20.6265	20.8469	20.8033	20.4105	19.5172	18.5010	17.7106	(87)
Th 2	19.7660	19.7677	19.7695	19.7776	19.7791	19.7861	19.7861	19.7875	19.7834	19.7791	19.7760	19.7728	(88)
util rest of house	0.9873	0.9717	0.9431	0.8821	0.7763	0.6137	0.4409	0.4943	0.7365	0.9189	0.9768	0.9899	(89)
MIT 2	16.0023	16.5112	17.2501	18.1714	18.9616	19.5022	19.7076	19.6780	19.2871	18.2208	16.9345	15.9217	(90)
Living area fraction										fLA = Living area / (4) =		0.1652	(91)
MIT	16.2954	16.7862	17.4992	18.3896	19.1573	19.6879	19.8958	19.8639	19.4726	18.4350	17.1933	16.2172	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.2954	16.7862	17.4992	18.3896	19.1573	19.6879	19.8958	19.8639	19.4726	18.4350	17.1933	16.2172	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9772	0.9539	0.9171	0.8502	0.7494	0.6061	0.4533	0.5029	0.7162	0.8903	0.9615	0.9814	(94)
Useful gains	2131.2856	2839.5459	3367.4425	3711.3669	3587.1186	2880.2545	2067.8105	2112.0720	2704.1944	2689.7193	2232.4140	1962.7862	(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	8407.0402	8316.8631	7683.8733	6579.1424	5162.7851	3499.0226	2266.5631	2379.1766	3704.3380	5424.2243	7007.9014	8368.7999	(97)
Space heating kWh	4669.1615	3680.7572	3211.4245	2064.7984	1172.2959	0.0000	0.0000	0.0000	0.0000	2034.4717	3438.3509	4766.0742	(98a)
Space heating requirement - total per year (kWh/year)												25037.3342	
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	4669.1615	3680.7572	3211.4245	2064.7984	1172.2959	0.0000	0.0000	0.0000	0.0000	2034.4717	3438.3509	4766.0742	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												25037.3342	
Space heating per m2											(98c) / (4) =	49.8901	(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													
	4669.1615	3680.7572	3211.4245	2064.7984	1172.2959	0.0000	0.0000	0.0000	0.0000	2034.4717	3438.3509	4766.0742	(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)													
	5058.6798	3987.8192	3479.3331	2237.0513	1270.0931	0.0000	0.0000	0.0000	0.0000	2204.1947	3725.1906	5163.6773	(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													
	276.8247	244.6226	259.7695	228.5515	221.5601	199.6882	197.2923	205.2234	207.5430	231.3337	245.7959	273.8603	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.2430	88.1802	88.0568	87.8130	87.2361	79.8000	79.8000	79.8000	79.8000	87.7891	88.1368	88.2591	(217)
Fuel for water heating, kWh/month													
	313.7073	277.4120	295.0022	260.2707	253.9776	250.2358	247.2335	257.1722	260.0789	263.5106	278.8799	310.2912	(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)
Lighting	63.6660	51.0753	45.9876	33.6925	26.0251	21.2627	23.7409	30.8593	40.0832	52.5914	59.4018	65.4355	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-133.9885	-181.1801	-249.7113	-268.4974	-279.0954	-256.2410	-252.3840	-242.8138	-225.2047	-200.4491	-144.2255	-116.7031	(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	-101.1323	-209.1971	-409.6929	-606.9895	-795.0796	-796.7354	-787.9958	-671.1723	-496.8569	-297.1363	-134.2774	-80.3093	(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	27126.0392	(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	3267.7720	(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)	513.8214	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-7937.0688	(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	23056.5638	(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	27126.0392	0.2100	5696.4682	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3267.7720	0.2100	686.2321	(264)
Space and water heating			6382.7004	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	513.8214	0.1443	74.1603	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2550.4940	0.1356	-345.7659	
PV Unit electricity exported	-5386.5748	0.1263	-680.2418	
Total			-1026.0077	(269)
Total CO2, kg/year			5442.7823	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.8500	(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	27126.0392	1.1300	30652.4243	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3267.7720	1.1300	3692.5824	(278)
Space and water heating			34345.0067	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	513.8214	1.5338	788.1164	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2550.4940	1.5011	-3828.5256	
PV Unit electricity exported	-5386.5748	0.4636	-2497.0404	
Total			-6325.5660	(283)
Total Primary energy kWh/year			28937.6579	(286)
Target Primary Energy Rate (TPER)			57.6600	(287)

Full SAP Calculation Printout

Property Reference	Proposed House	**Issued on Date**	06/09/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	100 A	**DER**	-0.09	**TER**	10.85
Environmental	100 A	**% DER < TER**			100.83
CO_2 Emissions (t/year)	-0.32	**DFEE**	48.10	**TFEE**	55.48
Compliance Check	See BREL	**% DFEE < TFEE**			13.30
% DPER < TPER	94.18	**DPER**	3.36	**TPER**	57.66

Assessor Details	Miss Eleanor Ballinger	**Assessor ID**	M976-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	160.5800 (1a)	x	2.5000 (2a)	=	401.4500	(1a) - (3a)
Ground floor	254.7200 (1b)	x	3.0000 (2b)	=	764.1600	(1b) - (3b)
First floor	86.5500 (1c)	x	3.0000 (2c)	=	259.6500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	501.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1425.2600	(5)

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2. Ventilation rate

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			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)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.0281	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			2.0000	(17)
Infiltration rate			0.1281	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1281	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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)
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	0.1633	0.1601	0.1569	0.1409	0.1377	0.1217	0.1217	0.1185	0.1281	0.1377	0.1441	0.1505	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5133	0.5128	0.5123	0.5099	0.5095	0.5074	0.5074	0.5070	0.5082	0.5095	0.5104	0.5113	(25)

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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	
Window (Uw = 1.10)			98.3500	1.0536	103.6255			(27)
Kitchen Window (Uw = 0.80)			61.9900	0.7752	48.0543			(27)
Door			18.7000	1.0000	18.7000			(26)
Rooflight			6.9400	1.0536	7.3123			(27a)
Heatloss Floor 1			160.5800	0.1100	17.6638	20.0000	3211.6000	(28)
Heatloss Floor 2			150.7800	0.1100	16.5858	110.0000	16585.8000	(28a)
Heatloss Floor 3			17.2700	0.1100	1.8997			(28b)
External Wall 1	612.5500	179.0400	433.5100	0.1100	47.6861	60.0000	26010.6000	(29a)
External Roof 1	329.8200	6.9400	322.8800	0.1100	35.5168	9.0000	2905.9200	(30)
Total net area of external elements Aum(A, m2)			1271.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	297.0442			(33)
Internal Wall 1			738.1300			9.0000	6643.1700	(32c)
Internal Floor 1			103.9400			18.0000	1870.9200	(32d)
Internal Floor 2			69.2800			18.0000	1247.0400	(32d)
Internal Ceiling 1			103.8500			9.0000	934.6500	(32e)
Internal Ceiling 2			68.1800			9.0000	613.6200	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 60023.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 119.6041 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	74.3100	0.0400	2.9724
E3	Sill	67.1300	0.0400	2.6852
E4	Jamb	142.5000	0.0500	7.1250
E5	Ground floor (normal)	67.7600	0.0600	4.0656
E15	Flat roof with parapet	126.2100	0.3000	37.8630
E14	Flat roof	27.4400	0.1600	4.3904
E16	Corner (normal)	71.0000	0.0400	2.8400
E17	Corner (inverted - internal area greater than external area)	37.0000	-0.0800	-2.9600
E22	Basement floor	58.8500	0.2200	12.9470
E20	Exposed floor (normal)	15.4200	0.2000	3.0840
E21	Exposed floor (inverted)	21.0300	0.2000	4.2060
E24	Eaves (insulation at ceiling level - inverted)	31.5300	0.1500	4.7295

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 83.9481 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 380.9923 (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	241.4378	241.1943	240.9557	239.8348	239.6250	238.6488	238.6488	238.4680	239.0248	239.6250	240.0493	240.4928	(38)
Heat transfer coeff	622.4301	622.1866	621.9480	620.8271	620.6173	619.6411	619.6411	619.4603	620.0171	620.6173	621.0416	621.4851	(39)
Average = Sum(39)m / 12 =												620.8261	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2403	1.2398	1.2393	1.2371	1.2367	1.2347	1.2347	1.2344	1.2355	1.2367	1.2375	1.2384	(40)
HLP (average)												1.2371	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3943 (42)
Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

35.0126	34.4926	33.7603	32.4102	31.3992	30.2782	29.6727	30.3998	31.1915	32.3911	33.7690	34.8942	(42b)

Hot water usage for other uses

49.3914	47.5953	45.7993	44.0032	42.2072	40.4111	40.4111	42.2072	44.0032	45.7993	47.5953	49.3914	(42c)

Average daily hot water use (litres/day) 77.3634 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	84.4039	82.0879	79.5596	76.4134	73.6064	70.6894	70.0838	72.6070	75.1948	78.1903	81.3643	84.2856	(44)
Energy conte	133.6752	116.8921	122.2801	104.6061	99.0884	86.9208	84.7603	89.9027	92.7227	106.1035	115.9184	131.9708	(45)
Energy content (annual)										Total = Sum(45)m =		1284.8412	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	113.6239	99.3583	103.9381	88.9152	84.2251	73.8827	72.0463	76.4173	78.8143	90.1880	98.5306	112.1752	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	113.6239	99.3583	103.9381	88.9152	84.2251	73.8827	72.0463	76.4173	78.8143	90.1880	98.5306	112.1752	(64)
										Total per year (kWh/year) = Sum(64)m =		1092.1150	(64)
12Total per year (kWh/year)												1092	(64)
Electric shower(s)	64.9731	57.8915	63.2153	60.3256	61.4576	58.6246	60.5787	61.4576	60.3256	63.2153	62.0266	64.9731	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												739.0648	(64a)
Heat gains from water heating, kWh/month	44.6492	39.3124	41.7884	37.3102	36.4207	33.1268	33.1563	34.4687	34.7850	38.3508	40.1393	44.2871	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	305.9751	338.7582	305.9751	316.1743	305.9751	316.1743	305.9751	305.9751	316.1743	305.9751	316.1743	305.9751	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	606.6299	612.9248	597.0618	563.2914	520.6622	480.5969	453.8308	447.5358	463.3988	497.1693	539.7984	579.8637	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	(71)
Water heating gains (Table 5)	60.0124	58.5007	56.1672	51.8197	48.9525	46.0095	44.5649	46.3289	48.3125	51.5468	55.7491	59.5256	(72)
Total internal gains	1046.5324	1084.0986	1033.1191	1005.2004	949.5049	916.6957	878.2858	873.7549	901.8006	928.6062	985.6367	1019.2795	(73)

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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	21.4700	10.6334	0.4000	0.7500	0.7700	47.4633	(74)
East	11.1700	19.6403	0.4000	0.7500	0.7700	45.6095	(76)

South				51.0800	46.7521	0.4000	0.7500	0.7700				496.4851	(78)
West				14.6300	19.6403	0.4000	0.7500	0.7700				59.7374	(80)
East				17.0700	19.6403	0.4000	0.7500	0.7700				69.7004	(76)
South				23.8100	46.7521	0.4000	0.7500	0.7700				231.4274	(78)
West				21.1100	19.6403	0.4000	0.7500	0.7700				86.1966	(80)
North				6.9400	26.0000	0.4000	0.7500	1.0000				48.7188	(82)
Solar gains	1085.3384	1895.0714	2694.2043	3472.4092	3986.0680	3992.8867	3835.2428	3451.1337	2965.9656	2123.8723	1308.9523	922.7351	(83)
Total gains	2131.8708	2979.1700	3727.3234	4477.6096	4935.5729	4909.5824	4713.5285	4324.8886	3867.7663	3052.4785	2294.5891	1942.0146	(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	26.7872	26.7977	26.8079	26.8563	26.8654	26.9077	26.9077	26.9156	26.8914	26.8654	26.8471	26.8279	
alpha	2.7858	2.7865	2.7872	2.7904	2.7910	2.7938	2.7938	2.7944	2.7928	2.7910	2.7898	2.7885	
util living area	0.9903	0.9758	0.9482	0.8890	0.7908	0.6537	0.5180	0.5707	0.7723	0.9308	0.9817	0.9925	(86)
MIT	18.0712	18.4856	19.0604	19.7502	20.3386	20.7321	20.8992	20.8650	20.5428	19.7210	18.7423	17.9881	(87)
Th 2	19.8879	19.8883	19.8887	19.8905	19.8908	19.8923	19.8923	19.8926	19.8917	19.8908	19.8901	19.8894	(88)
util rest of house	0.9885	0.9713	0.9383	0.8669	0.7470	0.5763	0.4081	0.4614	0.7084	0.9124	0.9775	0.9911	(89)
MIT 2	17.2024	17.6138	18.1804	18.8494	19.3964	19.7329	19.8511	19.8330	19.5904	18.8356	17.8730	17.1207	(90)
Living area fraction										fLA = Living area / (4) =		0.1652	(91)
MIT	17.3459	17.7578	18.3258	18.9982	19.5521	19.8980	20.0242	20.0035	19.7477	18.9819	18.0166	17.2640	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3459	17.7578	18.3258	18.9982	19.5521	19.8980	20.0242	20.0035	19.7477	18.9819	18.0166	17.2640	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9821	0.9590	0.9197	0.8450	0.7315	0.5767	0.4222	0.4733	0.6987	0.8924	0.9673	0.9858	(94)
Useful gains	2093.7430	2857.0388	3428.0067	3783.5311	3610.4467	2831.4934	1989.9691	2047.0208	2702.5380	2724.0755	2219.4485	1914.5309	(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	8120.1881	7999.9486	7355.0306	6269.2469	4873.1358	3282.8586	2121.8052	2232.2209	3501.6982	5201.9343	6779.6331	8119.0546	(97)
Space heating kWh	4483.6752	3456.0353	2921.7058	1789.7153	939.4407	0.0000	0.0000	0.0000	0.0000	1843.5270	3283.3329	4616.1656	(98a)
Space heating requirement - total per year (kWh/year)												23333.5979	
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	4483.6752	3456.0353	2921.7058	1789.7153	939.4407	0.0000	0.0000	0.0000	0.0000	1843.5270	3283.3329	4616.1656	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												23333.5979	
Space heating per m2										(98c) / (4) =		46.4952	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	5824.6260	4585.3439	4707.8981	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7164	0.7872	0.7482	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	4172.5594	3609.7025	3522.6573	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5520.4762	5300.4590	4862.6660	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	970.5002	1257.9228	996.9665	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	242.6250	314.4807	249.2416	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												806.3474	(107)
Energy for space heating												46.4952	(99)
Energy for space cooling												1.6067	(108)
Total												48.1019	(109)
Fabric Energy Efficiency (DFEE)												48.1	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	160.5800	(1a)	x 2.5000	(2a) =	401.4500	(1a) - (3a)
Ground floor	254.7200	(1b)	x 3.0000	(2b) =	764.1600	(1b) - (3b)
First floor	86.5500	(1c)	x 3.0000	(2c) =	259.6500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	501.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		1425.2600	(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)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0281	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2781	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2781	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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)
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	0.3545	0.3476	0.3406	0.3059	0.2989	0.2642	0.2642	0.2572	0.2781	0.2989	0.3128	0.3267	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5628	0.5604	0.5580	0.5468	0.5447	0.5349	0.5349	0.5331	0.5387	0.5447	0.5489	0.5534	(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	
TER Opaque door			18.7000	1.0000	18.7000			(26)
TER Opening Type (Uw = 1.20)			102.3200	1.1450	117.1603			(27)
Rooflight			4.4300	2.0221	8.9577			(27a)
Heatloss Floor 1			160.5800	0.1300	20.8754			(28)
Heatloss Floor 2			150.7800	0.1300	19.6014			(28a)
Heatloss Floor 3			17.2700	0.1300	2.2451			(28b)
External Wall 1	612.5500	121.0200	491.5300	0.1800	88.4754			(29a)
External Roof 1	329.8200	4.4300	325.3900	0.1100	35.7929			(30)
Total net area of external elements Aum(A, m2)			1271.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		311.8082			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 119.6041 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	74.3100	0.0500	3.7155
E3 Sill	67.1300	0.0500	3.3565
E4 Jamb	142.5000	0.0500	7.1250
E5 Ground floor (normal)	67.7600	0.1600	10.8416
E15 Flat roof with parapet	126.2100	0.5600	70.6776
E14 Flat roof	27.4400	0.0800	2.1952
E16 Corner (normal)	71.0000	0.0900	6.3900
E17 Corner (inverted - internal area greater than external area)	37.0000	-0.0900	-3.3300
E22 Basement floor	58.8500	0.0700	4.1195
E20 Exposed floor (normal)	15.4200	0.3200	4.9344
E21 Exposed floor (inverted)	21.0300	0.3200	6.7296
E24 Eaves (insulation at ceiling level - inverted)	31.5300	0.2400	7.5672

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 124.3221 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 436.1303 (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	264.7270	263.5792	262.4541	257.1696	256.1809	251.5783	251.5783	250.7259	253.3511	256.1809	258.1810	260.2721	(38)
Heat transfer coeff	700.8573	699.7095	698.5844	693.2999	692.3112	687.7086	687.7086	686.8562	689.4814	692.3112	694.3114	696.4024	(39)

Average = Sum(39)m / 12 = 693.2952

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3965	1.3943	1.3920	1.3815	1.3795	1.3703	1.3703	1.3686	1.3739	1.3795	1.3835	1.3877	(40)
HLP (average)												1.3815	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3943 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

35.0126	34.4926	33.7603	32.4102	31.3992	30.2782	29.6727	30.3998	31.1915	32.3911	33.7690	34.8942	(42b)

Hot water usage for other uses

49.3914	47.5953	45.7993	44.0032	42.2072	40.4111	40.4111	42.2072	44.0032	45.7993	47.5953	49.3914	(42c)

Average daily hot water use (litres/day) 77.3634 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	84.4039	82.0879	79.5596	76.4134	73.6064	70.6894	70.0838	72.6070	75.1948	78.1903	81.3643	84.2856	(44)
Energy conte	133.6752	116.8921	122.2801	104.6061	99.0884	86.9208	84.7603	89.9027	92.7227	106.1035	115.9184	131.9708	(45)

Energy content (annual) Total = Sum(45)m = 1284.8412

Distribution loss (46)m = 0.15 x (45)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	(46)

Water storage loss:

Total storage 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	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

Primary 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	(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													
	113.6239	99.3583	103.9381	88.9152	84.2251	73.8827	72.0463	76.4173	78.8143	90.1880	98.5306	112.1752	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	113.6239	99.3583	103.9381	88.9152	84.2251	73.8827	72.0463	76.4173	78.8143	90.1880	98.5306	112.1752	(64)
											Total per year (kWh/year) = Sum(64)m =	1092.1150	(64)
12Total per year (kWh/year)												1092	(64)
Electric shower(s)													
	64.9731	57.8915	63.2153	60.3256	61.4576	58.6246	60.5787	61.4576	60.3256	63.2153	62.0266	64.9731	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	739.0648	(64a)
Heat gains from water heating, kWh/month													
	44.6492	39.3124	41.7884	37.3102	36.4207	33.1563	33.1563	34.4687	34.7850	38.3508	40.1393	44.2871	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	169.7167	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	306.4104	339.2401	306.4104	316.6241	306.4104	316.6241	306.4104	306.4104	316.6241	306.4104	316.6241	306.4104	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	606.6299	612.9248	597.0618	563.2914	520.6622	480.5969	453.8308	447.5358	463.3988	497.1693	539.7984	579.8637	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	39.9717	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	-135.7734	(71)
Water heating gains (Table 5)													
	60.0124	58.5007	56.1672	51.8197	48.9525	46.0095	44.5649	46.3289	48.3125	51.5468	55.7491	59.5256	(72)
Total internal gains													
	1046.9678	1084.5806	1033.5544	1005.6502	949.9402	917.1455	878.7211	874.1902	902.2505	929.0416	986.0866	1019.7148	(73)

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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	13.7000	10.6334	0.6300	0.7000	0.7700	44.5209	(74)
East	18.0100	19.6403	0.6300	0.7000	0.7700	108.1018	(76)
South	47.8000	46.7521	0.6300	0.7000	0.7700	682.9683	(78)
West	22.8100	19.6403	0.6300	0.7000	0.7700	136.9129	(80)
North	4.4300	26.0000	0.6300	0.7000	1.0000	45.7149	(82)

Solar gains	1018.2188	1777.8549	2527.5121	3257.5070	3739.3311	3745.7107	3597.8324	3237.5300	2782.4372	1992.4903	1227.9999	865.6741	(83)
Total gains	2065.1866	2862.4355	3561.0665	4263.1573	4689.2713	4662.8562	4476.5535	4111.7202	3684.6877	2921.5319	2214.0865	1885.3889	(84)

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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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.7896	23.8287	23.8670	24.0490	24.0833	24.2445	24.2445	24.2746	24.1822	24.0833	24.0139	23.9418	
alpha	2.5860	2.5886	2.5911	2.6033	2.6056	2.6163	2.6163	2.6183	2.6121	2.6056	2.6009	2.5961	
util living area													
	0.9907	0.9783	0.9558	0.9075	0.8254	0.7023	0.5721	0.6231	0.8081	0.9411	0.9832	0.9927	(86)
MIT	17.7386	18.1397	18.7259	19.4670	20.1286	20.6167	20.8419	20.7966	20.3950	19.4897	18.4667	17.6728	(87)
Th 2	19.7660	19.7677	19.7695	19.7776	19.7791	19.7861	19.7861	19.7875	19.7834	19.7791	19.7760	19.7728	(88)
util rest of house													
	0.9888	0.9741	0.9467	0.8871	0.7829	0.6212	0.4478	0.5025	0.7450	0.9241	0.9792	0.9912	(89)
MIT 2	16.7954	17.1947	17.7750	18.5025	19.1269	19.5581	19.7226	19.6987	19.3846	18.5388	17.5277	16.7340	(90)
Living area fraction										fLA = Living area / (4) =		0.1652	(91)
MIT	16.9512	17.3508	17.9321	18.6618	19.2924	19.7330	19.9075	19.8801	19.5515	18.6958	17.6828	16.8891	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.9512	17.3508	17.9321	18.6618	19.2924	19.7330	19.9075	19.8801	19.5515	18.6958	17.6828	16.8891	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9616	0.9277	0.8630	0.7625	0.6171	0.4616	0.5129	0.7303	0.9031	0.9687	0.9857	(94)
Useful gains	2028.3961	2752.6487	3303.5174	3678.9648	3575.6864	2877.4666	2066.2885	2108.9477	2690.9564	2638.3673	2144.8554	1858.4023	(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													
	8866.6745	8711.9476	7986.2721	6767.8600	5256.2996	3530.0075	2274.6139	2390.3146	3758.7000	5604.8445	7347.7864	8836.7169	(97)
Space heating kWh													
	5087.6792	4004.6488	3483.9695	2224.0045	1250.3762	0.0000	0.0000	0.0000	0.0000	2207.0590	3746.1103	5191.8660	(98a)
Space heating requirement - total per year (kWh/year)												27195.7136	
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													
	5087.6792	4004.6488	3483.9695	2224.0045	1250.3762	0.0000	0.0000	0.0000	0.0000	2207.0590	3746.1103	5191.8660	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												27195.7136	
Space heating per m2											(98c) / (4) =	54.1909	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	6464.4607	5089.0435	5220.1075	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6437	0.7190	0.6778	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	4160.9350	3659.0238	3538.2701	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5235.5084	5026.6941	4616.1152	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	773.6929	1017.5467	801.9168	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	193.4232	254.3867	200.4792	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												648.2891	(107)
Energy for space heating												54.1909	(99)
Energy for space cooling												1.2918	(108)
Total												55.4827	(109)
Fabric Energy Efficiency (TFEE)												55.5	(109)