Energy and Sustainability Statement

50 Station Road, Barnes

For Angela McDonald

November 2024

ecolytik

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Contents

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Prepared by	Kostas Mastronikolaou
Checked by	Sherleen Pang

1 Executive Summary

This statement presents the key energy and sustainability measures proposed in support of the planning application for the proposed development at 50 Station Road, Barnes, in the London Borough of Richmond upon Thames.

The proposed development comprises a new-build home. Energy and sustainability considerations have been adopted for the proposed development in accordance with relevant policies set out within the London Plan and Richmond upon Thames Local Plan (see Table 1 on the following pages).

1.1 Energy Strategy

The energy strategy has been developed in line with the London Plan (2021) Policies SI2, SI3 and SI4, the GLA's Guidance on Energy Assessments (2022) and Richmond policies. The CO_2 emissions for the dwelling have been assessed using the Standard Assessment Procedure (SAP).

Proposed energy measures for the development includes:

- **Be Lean**: Passive design with a fabric first approach (enhanced u-values, low air tightness target and careful thermal bridging detailing), together with low energy lighting.
- **Be Clean**: There are no heat networks available in the vicinity of the site. Implementation of communal heating is not relevant for a single dwelling project.
- **Be Green**: An Air Source Heat Pump system is proposed to provide space heating and hot water for the dwelling.

Through the measures outlined for each stage of the Energy Hierarchy, it is anticipated the proposed development will achieve a 64% reduction in regulated CO_2 emissions over the Part L 2021 notional building baseline.

Further to this, although this is a minor scheme, the proposed development will also achieve a 17% improvement over the baseline by energy efficiency measures alone, exceeding GLA's target improvement of 10% for major residential development.

The carbon reductions have been maximised as far as possible, which meets currently adopted GLA and Richmond energy policies for minor developments.

Carbon offset payments are not deemed applicable for the minor development based on currently adopted policy.

1.2 Sustainability Strategy

The sustainability strategy for the proposal has been developed in accordance with relevant policies within the London Plan and Richmond upon Thames policies.

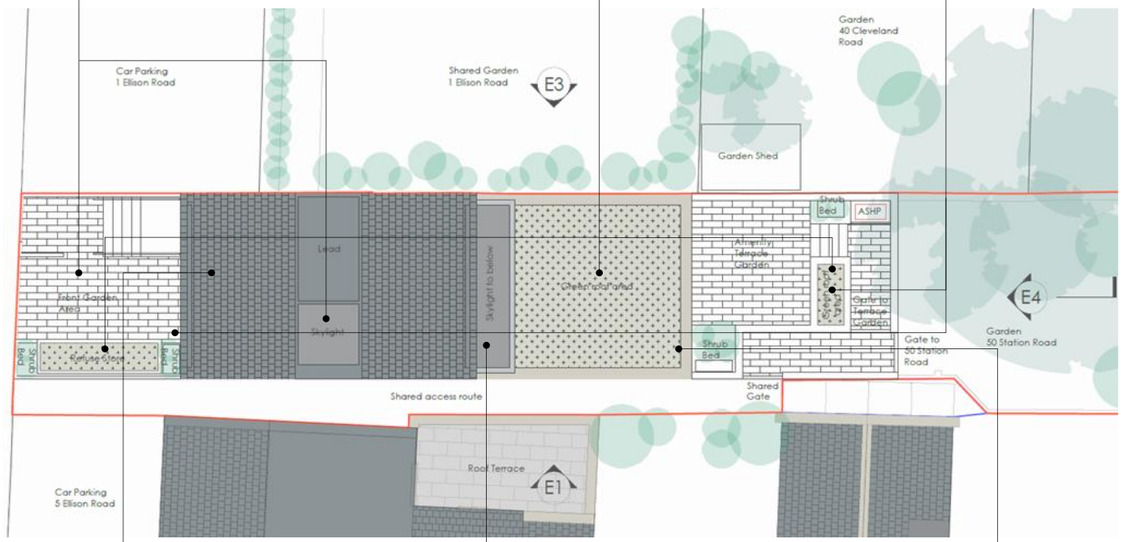
The image to the right summarises the sustainability measures integrated into the scheme and demonstrates the client and design team's aspirations to meet and exceed planning policy requirements.

Please refer to the accompanying Sustainable Design and Construction Checklist submitted in support of the planning application for further details.

Climate resilience
- Solar control and natural ventilation are the main measures to mitigate overheating risk.
- Site at flood risk only during the unlikely event of a breach within the Thames tidal flood defences. Site will not increase flood risk elsewhere.
- Runoff will be managed through permeable surfacing in the parking and any hardstanding areas.
- Rainwater butt proposed for landscape irrigation.

Ecology and biodiversity
- Planting will include wildflower green roofs over the living room, the cycle and bin stores and will focus on introducing new habitats to the site.
- Ecological enhancements will include installation of bird boxes, bug hotels, as well as open fronted and songbird boxes for nesting of common garden birds.

Sustainable transport
- Cycle parking and off-street parking with EV charging will be provided to promote active travel and the uptake of electric vehicles.



Energy and Carbon
- Fabric first approach to with high efficiency building fabric and systems to minimise energy demand.
- Heat pumps applied as low/zero carbon technologies. Energy strategy to achieve a 64% reduction in regulated CO_2 emissions onsite, approaching zero carbon as far as possible on site.

Health and Wellbeing
- Daylight and sunlight levels within habitable spaces have been considered and optimised.
- Air, noise and light pollution from proposed development will be limited and mitigated.
- Private external amenity area is integrated into design for the enjoyment of residents.
- Scheme has been developed with safety and accessibility in mind.

Materials and Waste
- Materials will be responsibly sourced where feasible.
- Materials with low environmental impact and with recycled content will be prioritised.
- Construction and demolition waste will be limited through reduction/reuse/recycling measures.

Figure 1. Summary of Energy and Sustainability measures at 50 Station Road.

Table 1. Planning policies applicable for the proposed development, and the report sections where they are responded to.

	3 Energy Strategy	4.1 Optimising Land Use	4.2 Health and Wellbeing	4.3 Nature, Landscape and Biodiversity	4.4 Climate Resilience	4.5 Water and Surface Water Runoff	4.6 Materials and Waste	4.7 Sustainable Transport
The London Plan (2021)								
GG2 Making the best use of land		◆						
GG3 Creating a healthy city	◆		◆					
GG4 Delivering the homes Londoners need		◆						
GG5 Growing a good economy		◆						
GG6 Increasing efficiency and resilience	◆				◆			
D2 Infrastructure requirements for sustainable densities		◆						◆
D11 Safety, security, and resilience to emergency			◆		◆			
D14 Noise			◆					
G1 Green infrastructure, G5 Urban greening, G6 Biodiversity and access to nature				◆				
SI1 Improving air quality			◆					
SI2 Minimising greenhouse gas emissions	◆							
Policy SI3 Energy infrastructure	◆							
SI4 Managing heat risk					◆			
SI5 Water infrastructure						◆		
SI7 Reducing waste and supporting the circular economy							◆	
SI12 Flood risk management, SI13 Sustainable Drainage					◆	◆		
T5 Cycling								◆
Richmond upon Thames Local Plan (2018)								
LP1 Local character and design quality		◆					◆	
LP2 Building heights		◆	◆					
LP8 Amenity and living conditions			◆					
LP10 Local environmental impacts, LP15 Biodiversity, LP16 Trees and landscape			◆	◆		◆		
LP17 Green roofs and walls				◆				
LP20 Climate change adaptation	◆		◆		◆			
LP21 Flood risk and sustainable drainage					◆	◆		
LP22 Sustainable design and construction	◆					◆		
LP24 Waste management							◆	
LP30 Health and wellbeing			◆					◆
LP44 Sustainable travel choices								◆
LP45 Parking								◆

	3 Energy Strategy	4.1 Optimising Land Use	4.2 Health and Wellbeing	4.3 Nature, Landscape and Biodiversity	4.4 Climate Resilience	4.5 Water and Surface Water Runoff	4.6 Materials and Waste	4.7 Sustainable Transport
Emerging Richmond upon Thames Publication Local Plan (2023) – Regulation 19 version								
LP4 Minimising Greenhouse Gas Emissions and Promoting Energy Efficiency	◆						◆	
LP6 Sustainable Construction Standards	◆							
LP7 Waste and Circular Economy							◆	
LP8 Flood Risk and Sustainable Drainage					◆			
LP39 Biodiversity and Geodiversity				◆				
LP46 Amenity and Living Conditions			◆					
LP47 Sustainable Travel Choices								◆
LP48 Vehicular Parking Standards, Cycle Parking, Servicing and Construction Logistics Management								◆

2 Introduction

2.1 Site

The proposed development at 50 Station Road is located between Station Road and Ellison Road in Barnes, within the London Borough of Richmond upon Thames. The site currently comprises a single dwelling to the eastern end, with an elongated garden to the rear and a single storey garage to the western end. The proposed works include demolition of the existing garage and provision of a single dwelling development. The site location is presented in Figure 2.

2.2 Planning policies

A review of the applicable policies has been undertaken. A full summary of the relevant Greater London Authority (GLA) and Richmond policies are presented in Appendices C and D. Where feasible, the proposed dwelling has been designed to meet the following main policy drivers which are mainly applicable to minor developments.

2.2.1 London Plan (2021)

Energy and carbon:

- For minor schemes, show that the proposed development has incorporated improvement measures that maximise performance at each stage of the energy hierarchy.

Sustainability:

- Enhance health and wellbeing provision of high quality buildings and associated amenity spaces, limiting exposure to sources of air and noise pollution.
- Provision of accessible housing.
- Optimise land use and promote higher density development.
- Design in measures to ensure safety, security and resilience (including resilience to flood risk and overheating).
- Contribute to urban greening, biodiversity and access to nature within the city where feasible.
- Water efficiency – residential schemes to meet a maximum water consumption of 105 litres per person.
- Waste management and reduction.
- Sustainable urban drainage.
- Sustainable transport.

2.2.2 Richmond upon Thames Local Plan (2018)

Energy and carbon:

- Follow the energy hierarchy and reduce carbon emissions as far as possible.

Sustainability:

- Provide well designed proposals.
- Incorporate appropriate elements of open space.
- Promote active transport.
- Manage heat risks.
- Manage flood risk.
- Achieve water efficiency of less than 110 litres per person per day.

2.2.3 Sustainable Construction Checklist Guidance Document (2020)

For all developments that results in a new dwelling, the following should be targeted:

- 35% reduction in CO2 emissions over Building Regulations (2013)
- Submit energy statement
- Meet national water consumption standards of 110 l/p/d
- A Sustainable Construction Checklist should be submitted

2.2.4 Publication Local Plan (2023) Reg 19

Although this Local Plan has not been adopted yet, the principles set out have been considered for the application.

The proposed Energy and Sustainability strategies for the proposed development are presented in the following chapters.

Figure 2. Approximate site location of 50 Station Road, Barnes

3 Energy Strategy

The Energy Strategy for the proposed development at 50 Station Road has been developed in line with the Energy Hierarchy set out in Policy SI 2 of the London Plan:

1. Be Lean: use less energy.
2. Be Clean: supply energy efficiently.
3. Be Green: access low or zero carbon (LZC) energy sources.
4. Be Seen: monitor, verify and report energy performance

The CO_2 emissions at each stage of the Hierarchy are compared to a Building Regulations Part L1 2021 (adopted June 2022) compliant baseline.

It should be noted that the estimations presented within this statement are based on the Part L calculation methodology and the associated standard assumptions regarding occupancy, space/system usage and climatic conditions; and should not be considered as a predictive assessment of the likely in-use energy requirements for the development.

The following sections present the measures adopted at each stage of the Energy Hierarchy at the proposed development.

3.1 Be Lean

A range of energy efficiency measures has been applied to the design of the building fabric and building services systems to minimise energy demand and CO_2 emissions at the Be Lean stage.

3.1.1 Passive Design

The dwelling has been designed carefully and with appropriate levels of glazing which includes rooflights. This enables a degree of passive solar heating to reduce space heating energy demand from active systems. Low-e glazing will be specified, which promotes heat retention within the dwelling in the cooler months.

The dwelling is dual aspect, has windows on all orientations and an open internal staircase with a roof window, which facilitates both cross and stack driven natural ventilation. The deeper planned Kitchen/Living/Dining area on the ground floor also benefits from a rooflight. This provides natural light deeper into the space.

The building's massing is fairly compact in nature and sits neatly into the application site. The compact building shape further promotes efficiency and reduces heat losses for a given floor area.

Please see Figure 3 for illustrations of these design principles incorporated into the scheme.

3.1.2 Fabric Performance

A fabric first approach has been implemented to minimise unwanted heat loss through the building fabric and reduce heating energy demand.

The proposed building fabric specification will go beyond the notional building standards set out within Building Regulations Part L1 2021. Proposed values for key building elements are shown in Table 2. Full details regarding targeted u-values, air permeability and thermal bridging are presented in Appendix A.

3.1.3 Heat recovery ventilation

Mechanical ventilation with heat recovery system is proposed to minimise ventilation heat losses during the winter months. The proposed dwelling will benefit from low air permeability reducing unintended ventilation heat losses through the building fabric. The targeted low air permeability for the scheme will enable the MVHR system to operate efficiently.

3.1.4 Efficient lighting

All light fittings within the proposed development will be specified as low energy lighting, and will only incorporate LEDs with an average efficacy of more than 100 lm/W.

3.1.5 Controls and Energy Monitoring

Time and temperature zone control will be provided for space heating. Hot water will be independently controlled from space heating. Where feasible, smart meters will also be installed at an accessible location to enable occupants to monitor their energy consumption.

Figure 3. Passive design measures considered for the proposed development. Ground floor (bottom), first floor (middle) and roof plan (top).

Table 2. Proposed u-values at 50 Station Road.

Element	Part L 2021 limiting u-values	Part L 2021 Notional Building u-values	Proposed u-values
External walls	0.26	0.18	0.15
Roof	0.16	0.11	0.1
Floor	0.18	0.13	0.1
Windows and rooflights	1.6	1.2	1.2

3.1.6 The Cooling Hierarchy

The proposed dwelling at 50 Station Road has considered the steps of the Cooling Hierarchy in Policy SI4 of the London plan and policy LP20 of Richmond upon Thames Local Plan.

1. **Reduce the amount of heat entering the building**
   - Southwest facing glazing which can potentially expose the dwelling to solar heat gains when ambient temperatures are higher in the afternoon has been minimised.
   - Glazing with appropriate specification is considered for any windows exposed to direct solar radiation, to further reduce potential summertime heat gains.
2. **Minimise internal heat generation through energy efficient design**
   - A standalone heating system is proposed to supply space heating and domestic hot water to the dwelling.
   - All heat sources (e.g. cylinder) will be factory insulated to reduce heat loss. Lateral heat distribution pipework will be minimised as far as feasible.
   - All light fixtures will be low energy and will not result in notable internal lighting heat gains.
3. **Manage the heat within the building through exposed internal thermal mass and high ceilings**
   - Exposed internal thermal mass is more effective for non-domestic buildings when it is possible to significantly pre-cool spaces during night-time when they are unoccupied.
   - The inclusion of exposed internal thermal mass will result in notably higher space heating demand for a domestic development of this nature.
   - Exposed internal thermal mass (at ceiling level) also requires exposed building services and is not deemed suitable for this scheme.
   - High ceilings have been provided as far as possible.
4. **Provide passive ventilation**
   - Natural ventilation through openable windows and rooflights will be the main strategy for fresh air provision and passive cooling. All habitable rooms can benefit from different passive ventilation strategies, as shown in the diagram to the right.
5. **Provide mechanical ventilation**
   - Mechanical ventilation with heat recovery is proposed for the dwelling to reduce heat losses during the winter. The system will be complete with summer bypass and boost facilities to enable its use during summertime to reduce overheating risks.
   - Where windows cannot be opened during nighttime due to security or noise constraints, the MVHR may also incorporate an air tempering coil that can enable the habitable rooms to maintain a suitable internal environment during night time. This is not a full active cooling system but a form of backup for future residents and where a small secure night time opening of windows may not be deemed sufficient.
6. **Provide active cooling systems**
   - Comfort cooling is not currently proposed.

Detailed assessments to enable compliance with Part O of Building Regulations will be carried out for the scheme post-planning.

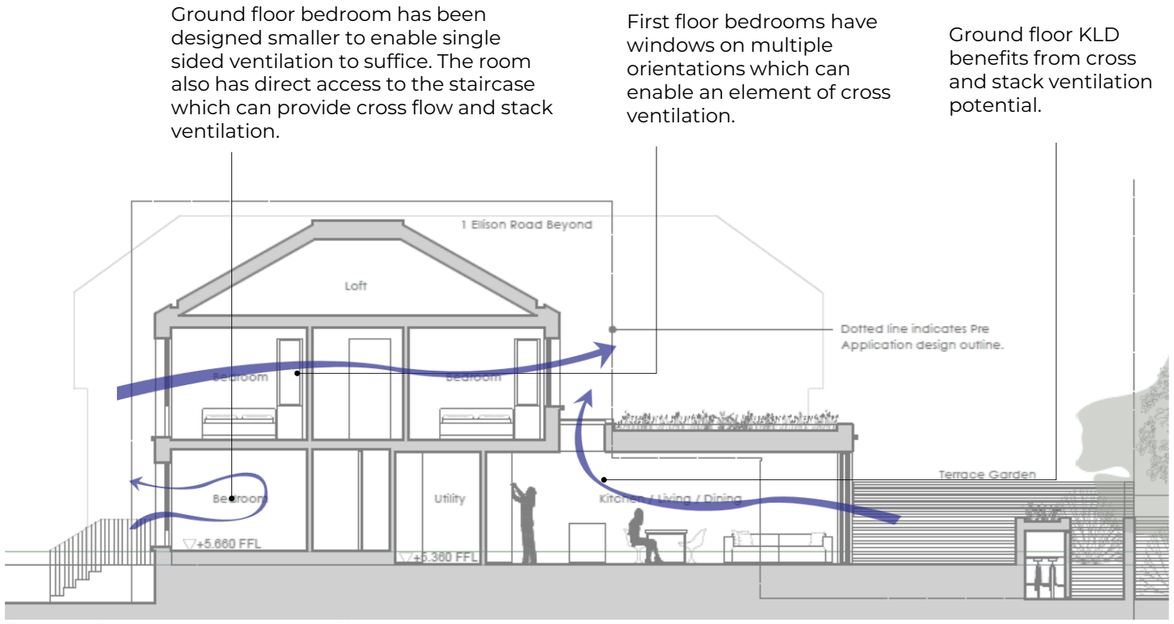


Figure 4. Dwelling design which offers excellent natural ventilation potential.

3.2 Be Clean

Policy SI 3 of the London Plan stipulates that major development proposals within Heat Network Priority Areas should have a communal heating system connected to local existing or planned heat networks, or to low/zero emission local heat sources.

A review of the London Heat Map (Figure 5) shows that there are no existing and proposed district heating network in proximity to the site.

A communal heating system is not relevant as the scheme at 50 Station Road is a single dwelling development.

The application of a standalone heating system is therefore considered as the most suitable heating strategy.

Figure 5. London Heat Map for site and surroundings (accessed 21 November 2024).

3.3 Be Green

The opportunity for producing and utilising renewable energy onsite has been explored for the proposed development, in line with Policy SI 2 of the London Plan.

An outline feasibility study has been undertaken (see Table 3), which identified Air Source Heat Pump as the most suitable low/zero carbon technology for the dwelling at 50 Station Road. The heat pump's external unit will be located in the rear garden within a concealed location and will be acoustically attenuated where required (Figure 6).

Table 3. Outline LZC feasibility.

LZC Technology	Feasibility
Photovoltaics (not adopted)	The development has prioritised the use of heat pumps which can deliver more carbon savings than PVs. The front slope of the roof facing the main road will be affected visually if PV panels are integrated to it, and all other roof areas are north facing or will be overshadowed.
Solar thermal (not adopted)	A solar thermal hot water system is not compatible with individual heat pumps without the provision of a separate thermal store.
Wind turbines (not adopted)	The installation of wind turbines at the proposed building/site will have a notable visual impact on the site and surroundings, and not deemed suitable for the development.
Ground source heat pump (GSHP) (not adopted)	The installation of ground source trench or borehole system requires notable space, time and cost, and is not deemed feasible for a scheme of this scale and nature.
Air Source Heat Pumps (adopted)	ASHP is an effective way of providing low carbon heating and hot water.
Biomass (not adopted)	Biomass systems emit high NOx levels and are not supported within urban areas. There is also no suitable space onsite for the storage of biomass.

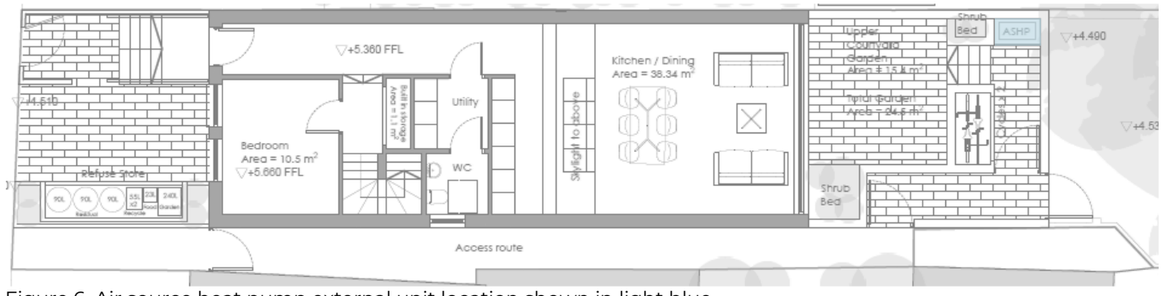


Figure 6. Air source heat pump external unit location shown in light blue.

3.4 Results

Through the measures outlined for each stage of the Energy Hierarchy, it is anticipated the proposed new home can achieve a 64% reduction in regulated CO_2 emissions over the Part L1 2021 notional baseline. A 17% reduction over the baseline will be achieved by energy efficiency measures alone.

The reductions have been maximised as far as possible, which meets currently adopted GLA and Richmond energy policies for minor schemes.

Carbon offset payments are not considered applicable for this minor development based on currently adopted policy.

Table 4, Table 5 and Figure 7 present the anticipated CO_2 emissions and savings at each stage of the Energy Hierarchy.

The space heating demand of the development was estimated to be 25.5 kWh/m^2.year and the Energy Use Intensity 56.8 kWh/m^2.year.

Table 4. Carbon emissions after each stage of the Energy Hierarchy for 50 Station Road.

	Carbon Dioxide Emissions (tCO_2/yr)	
	Regulated	**Unregulated**
Baseline: Part L 2021 Compliant Development	1.5	0.4
After energy demand reduction (be lean)	1.2	0.4
After heat network connection (be clean)	1.2	0.4
After renewable energy (be green)	0.5	0.4

Table 5. Regulated carbon savings from each stage of the Energy Hierarchy.

	Regulated carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Be lean: Savings from energy demand reduction	0.2	17%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	0.7	47%
Cumulative on site savings	**0.9**	**64%**

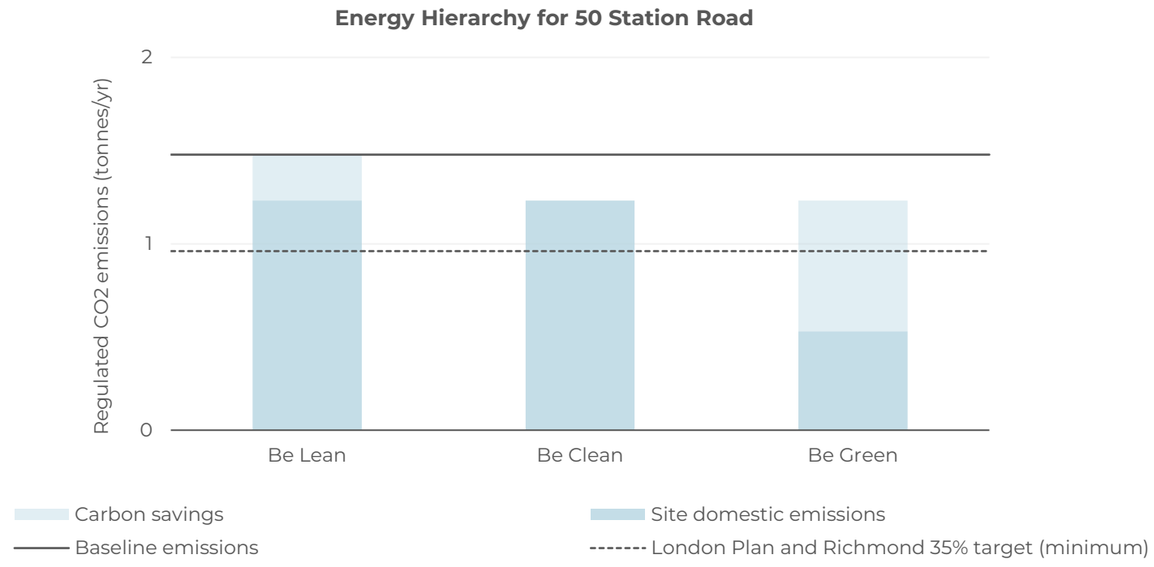


Figure 7. Regulated carbon emissions at each stage of the Energy Hierarchy.

4 Sustainability Strategy

This section of the report presents the key elements of the proposal which respond to the sustainability policies set out within the London Plan and Richmond upon Thames Local Plan.

4.1 Optimising Land Use

The site currently comprises a single storey garage to the western end. The land to the western part of the site is therefore underutilised and presents an opportunity to provide an additional home to the area. There is some vegetation around the boundaries of the site and trees which will be retained as far as feasible. The surrounding area is predominantly residential in use.

The design and size of the proposed development has been carefully considered to harmonise with the site's surroundings whilst improving layout and density. Further, the development will bring about other benefits such as enhancing the outlook and character of the site.

4.2 Health and Wellbeing

4.2.1 Air Quality

In line with GLA's SPG on The Control of Dust and Emissions during Construction and Demolition, any potential dust and stationary plant emissions during the construction period, and any potential impact from traffic flows on the local road network, during and after construction will be mitigated.

The proposed scheme is not anticipated to result in greater traffic flows compared to the existing use and therefore will not result in notable air quality impacts from operational traffic.

A heat pump driven by electricity will supply space heating and hot water at the proposed development. Therefore, there will be no PM and NOx emissions associated with fossil fuel combustion from the operation of the building services systems at the scheme.

4.2.2 Noise

The development will incorporate building fabric measures to ensure the impact of any external sources on internal noise levels are within acceptable limits, in line with BS8233:2014 or latest standards. Any potential noise impact during demolition and construction will be mitigated accordingly. Potential noise impacts from the proposed Air Source Heat Pump external unit will be mitigated where required.

4.2.3 Daylight and Sunlight

The design team has taken daylight and sunlight access to existing neighbouring properties and the proposed new dwelling into consideration when developing the site plan, building massing and internal layouts.

All neighbouring properties were found to comply with BRE's guidelines for daylight and sunlight access to their rooms and amenity spaces. All habitable spaces of the proposed dwelling were found to exceed BRE's recommendations for daylight with south facing rooms exceeding sunlight access recommendations. Further details are provided in the Daylight and Sunlight Assessments prepared by Ecolytik for the planning application.

4.2.4 External Lighting

The external lighting design and specification will be in accordance with the ILP's Guidance Note for The Reduction of Obtrusive Light (2021). The scheme will limit the amount of up-lighting and all external lighting (aside from security lighting) will be connected to daylight sensors and be time controlled.

4.2.5 Safety and security

Secure by Design principles have been incorporated into the design to ensure safe and secure spaces are provided to all users.

Figure 8. Current site, 3d view from google maps.

4.3 Nature, Landscape and Biodiversity

4.3.1 Nature and biodiversity

The design team has aimed to allocate as much green space as possible across the site. The provision of soft-landscaping has been prioritised and includes a green biodiverse roof above the ground floor living room and above the rear garden's cycle store, together with shrub elements both to the front and the rear of the proposed building.

Bird boxes and bug hotels will be implemented at the site. Any clearance or demolition works will be carried out outside the breeding season to prevent any impacts on birds in line with the ecologist's recommendations for the site. Open fronted and songbird boxes will be used to provide nesting opportunities for common garden birds, in line with the recommendations by the ecologist.

Further details can be found in the accompanying Preliminary Ecological Appraisal by Morgan & Stuckey for the planning application.

Further to this, the accompanying biodiversity net gain assessment by Morgan & Stuckey for the site has identified that a gain will be achieved through compensatory measures off site.

4.3.2 Trees

A tree survey has been undertaken by Arboricultural Association for the site and has classified trees based on their quality and the remaining contribution in years in line with BS5837:2012.

There is a Saucer Magnolia on site which is of moderate quality and will be retained. For further details, please refer to the Tree Survey prepared by Arboricultural Association for the planning application.

4.4 Climate Resilience

4.4.1 Managing risk of overheating

The design of the dwelling at 50 Station Road has considered GLA's Cooling Hierarchy. Please refer to the Energy Strategy section for further details.

4.4.2 Managing flood risk

Based on initial publicly available information, the site is located in an area at which is at high risk of river and sea flooding as shown in Figure 7.

A comprehensive flood risk assessment has been prepared by Herrington for the planning application which has evaluated in detail flood risk from a wide range of sources. The report concluded that the site is essentially at risk of flooding only during the unlikely event of a breach within the Thames tidal flood defences. To manage flood risks and to ensure the development does not increase flood risk elsewhere, the assessment recommended the ground floor of the development to be elevated above the maximum predicted flood level. In addition, the ground floor should be constructed using flood resistant and resilient design techniques. Lastly, a key recommendation of the report was that future residents should sign up to the EA's Flood Warning Service and Met Office Weather Warnings.

Please refer to the accompanying Flood Risk and Surface Water Management report by Herrington for further information.

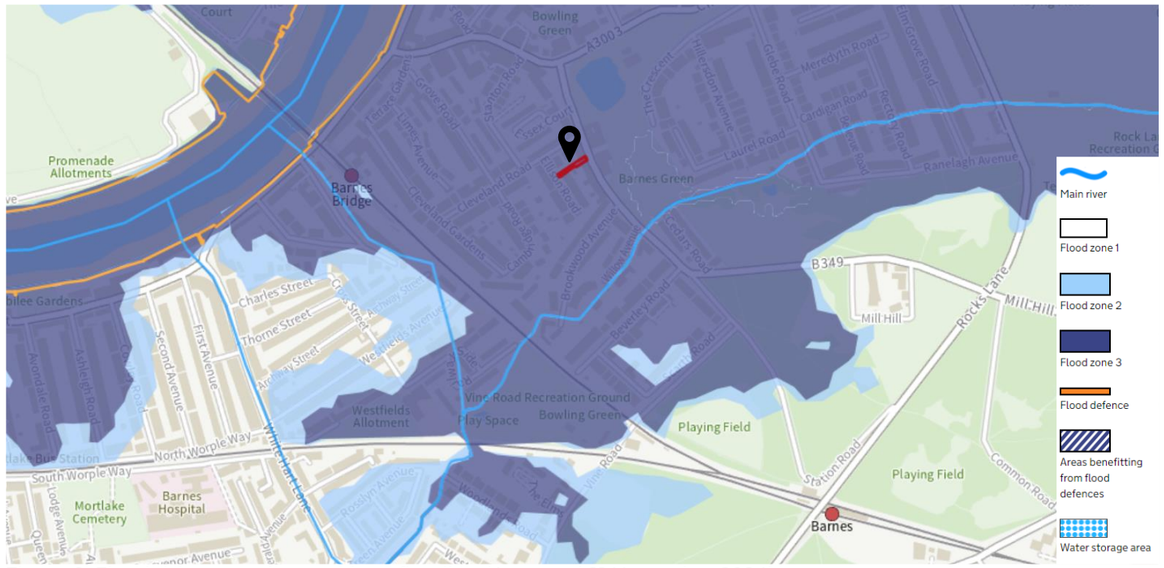


Figure 9. Flood risk map – rivers and sea flooding (Accessed 21 November 2024).

4.5 Water and Surface Water Runoff

4.5.1 Water Efficiency

The proposed development will target a mains water consumption of less than 105 litres/person/day. This is consistent with Building Regulations Part G(2) requirement and London Plan policy SI5.

The following suggested flow rates shall be considered during detailed design of the development to achieve the water consumption target:

- WCs: 6 litre / 3 litre dual flush.
- Wash basin taps: 4 litres/min.
- Kitchen sink taps: 6 litres/min.
- Showers: 8 litres/min.
- Baths: 180 litres to overflow;
- Dishwasher: 1.25 litres/place setting (where provided).
- Washing Machine: 8.17 litres/kg dry load (where provided).

The proposed development will incorporate water butt which will reduce reliance on potable water for landscape irrigation.

4.5.2 Surface water runoff

A green roof is proposed for the flat roof element above the ground floor living room. The green roof would be capable of intercepting run-off from the main pitched roof as well as providing a certain level of water storage and filtration.

Runoff from the hardstanding areas across the site, in addition to overflow from the water butt and green roof, will be directed via underground pipes into series of interconnected permeable surfacing systems located in the hardstanding and parking to the front of the development. The proposed SuDS elements are shown in Figure 10.

Please refer to the accompanying Flood Risk and Surface Water Management report by Herrington for further information.

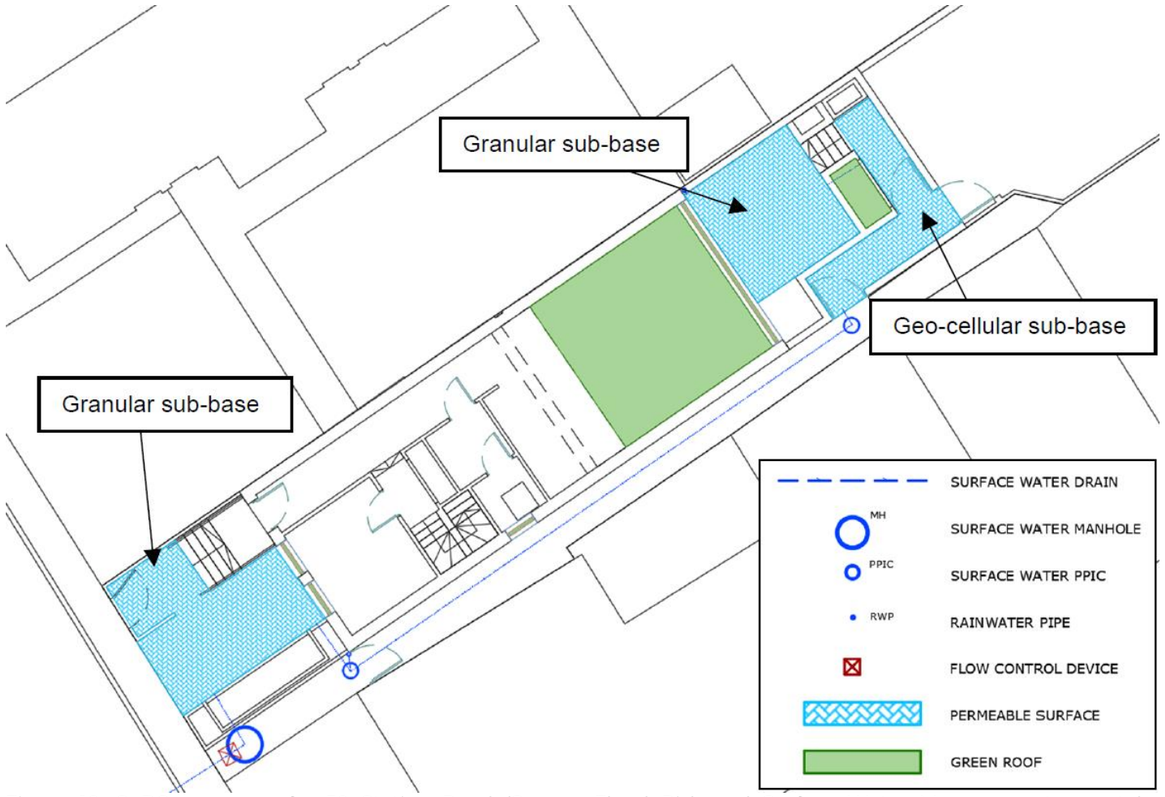


Figure 10. SuDS measures for 50 Station Road (Source: Flood Risk and Surface Water Management report by Herrington).

4.6 Materials and Waste

4.6.1 Material Selection and Procurement

The structure grid of the proposed building has been rationalised to minimise the associated structural volume. Materials will be selected for longevity and durability as well as recoverability and recyclability at end of life. To minimise potential sources of indoor air pollution, low VOC materials, paints and finishes will be prioritised where possible.

To reduce embodied carbon of the proposed development, locally sourced materials with recycled content will be prioritised as far as feasible.

All timber used on the site will be FSC or PEFC certified. Where feasible, all other construction materials utilised at the development will be certified under BES6001 and EMS or other similar responsible sourcing certification schemes.

Where practicable, the contractor will source items locally, and where possible amalgamate deliveries to reduce the overall number of vehicle movements taking place.

4.6.2 Construction Waste Management

Waste streams will be efficiently segregated (offsite) and processed during both construction and operation stages, with a target to maximise potential re-use of materials and diversion from landfill in line with GLA and Richmond upon Thames policies.

All waste that cannot be reused or recycled will be disposed of in accordance with legislation and best practice.

4.6.3 Operation Waste Management

A bin store is proposed for the development (Figure 11). The store has been sized sufficiently to include recyclable waste storage to facilitate recycling and diversion of waste from landfill.

4.7 Sustainable Transport

50 Station Road is located in a residential area and has a PTAL rating of 3. The nearest bus stops are at Barnes High Street and Beverley Road, approximately 5 mins walk away.

4.7.1 Cycle Parking

The proposed development will include secure cycle storage in accordance with London Plan and Richmond upon Thames requirements to promote use of active travel by future residents. Cycle storage is proposed to be located in the rear garden, as shown in Figure 11.

4.7.2 Car Parking

One car park space will be provided to the front of the proposed development. EV charging to be provided in line with Part S of Building Regulations to promote the uptake of electric vehicles.

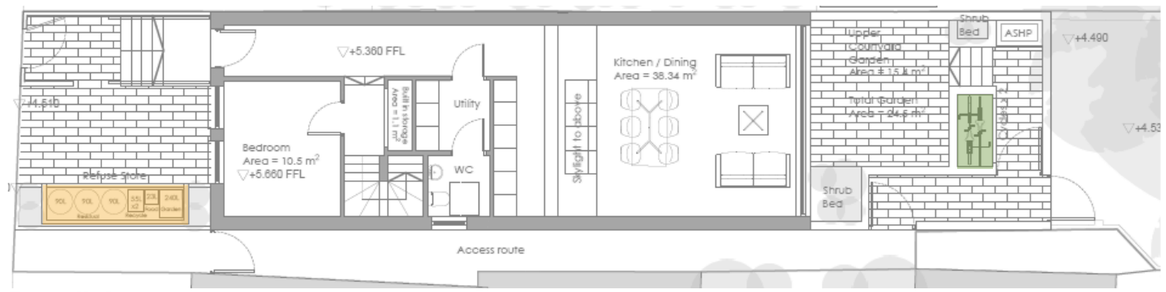


Figure 11. Cycle storage (green) and waste storage (orange) provision at the proposed development.

5 Conclusions

Through the adoption of the energy and sustainability strategies presented in this report, the client and design team demonstrated that the proposed dwelling at 50 Station Road would fulfil the relevant policy requirements stipulated by the London Plan, and by Richmond upon Thames Local Plan.

The proposed development will positively contribute to sustainability at the site and its surroundings.

Appendix A – Calculation assumptions

The items listed below are assumptions only, based on a combination of best judgement at planning stage and information from the design team where appropriate. Throughout the design and construction stages the fabric and system requirements (including provisions of renewable technologies) may change whilst the building designs are being progressed. All information detailed in this summary sheet is preliminary recommendation at the Planning Stage. It should be noted that this document is not exhaustive and the design and construction teams should allow for flexibility on site where necessary.

Building fabric parameter	Part L 2021 notional	Proposed specification	Unit	Note
Walls				
External walls	0.18	0.15	W/m²K	1
Floors				
Ground floors	0.13	0.10	W/m²K	1
Roofs/ceilings				
Sloped and flat roofs	0.11	0.10	W/m²K	1
Openings				
Dwelling entrance door (glazed)	1.0	1.2	W/m²K	1
New windows (inc. rooflights) - pane and frame	1.2	1.2	W/m²K	1
Windows solar transmittance factor (g-value)	0.63	0.5		1, 2
Windows frame factor	0.7	0.7		1
Air permeability				
Maximum air permeability (test required)	5	3	m³/m².h	1

Building fabric parameter	Part L 2021 notional	Proposed specification	Unit	Note
Thermal Bridging				
The following psi values are recommended. All junctions should either be thermally modelled or meet enhanced construction details and other accredited details with psi values below those outlined below.				
E1 Lintels	0.05	0.05	W/mK	1
E3 Sills	0.05	0.05	W/mK	1
E4 Jambs	0.05	0.05	W/mK	1
E5 Ground floor/Exposed Floor	0.16	0.08	W/mK	1
E6 Inter floor within a dwelling	0.00	0.00	W/mK	1
E11 Eaves (insulation at rafter level)	0.04	0.04	W/mK	1
E13 Gable (insulation at rafter level)	0.08	0.08	W/mK	1
E14 Flat roof	0.08	0.08	W/mK	1
E16 Corner (normal)	0.09	0.09	W/mK	1
E24 Eaves (insulation at ceiling level - inverted)	0.24	0.12	W/mK	1
R1 Head of roof window	0.08	0.08	W/mK	1
R2 Sill of roof window	0.06	0.06	W/mK	1
R3 Jamb of roof window	0.08	0.04	W/mK	1
R5 Ridge (inverted)	0.04	0.04	W/mK	1

Building Services Systems	Proposed specification	Unit	Note
Ventilation			
Type	Mechanical ventilation with heat recovery		1
System modelled	Nuaire MRXBOXAB-ECO2		
Specific fan power	< 0.77	W/l.s	1
Heat recovery efficiency	> 87	%	1
Heating and Hot Water			
Type	Individual Air Source Heat Pump		1, 3, 4
Efficiency - space heating	>300	%	1, 4
Efficiency - domestic hot water	>200	%	1, 4
Heat emitter	Underfloor or radiator		1
Flow temperature	<55	°C	1
Time and temperature zone control	Yes		1, 4
Fuel type	Electricity		1
Electricity tariff	Standard		1
Microgeneration Installation Standard	Yes		1
Pump in heated space	Yes		1, 3, 4
Hot water	From main heating system		1
Cylinder volume	200	Litres	1
Insulation	Factory - 80mm	mm	1
Cylinder in heated space	Yes		1, 4
Cylinderstat	Yes		1, 4
Primary pipework insulated	Yes		1, 4
Water heating timed separately	Yes		1, 4
Lighting			
Light fittings efficacy	> 100	Lm/W	1, 4
Domestic water consumption			
Water consumption	<105 litres per person per day	l/p.d	1, 5
Showers flow rate	<8 litres/min	l/min	1, 5

Notes	
1	Planning stage assumption to achieve planning policy or Building Regulations targets
2	Subject to detailed overheating assessment to be carried out where required
3	Building regulations requirement
4	Subject to MEP design by others
5	Required to meet enhanced target within Part G and planning policy target.
NB. Please refer to Approved Document L1 2021 for all requirements to comply with Building Regulations Part L.	

Appendix B – Planning stage SAP output

Planning stage SAP output the proposed dwelling is included in this appendix. The DER has been adjusted to remove the PV allowance included in the Notional Building and to enable calculation of Be Lean stage savings as per GLA's methodology.

Table 6. Planning stage SAP results.

Unit Reference	TER ($kgCO_2/m^2$)	Lean DER ($kgCO_2/m^2$)	Green DER ($kgCO_2/m^2$)	TFEE (kWh/m^2)	DFEE (kWh/m^2)
House	15.37	13.19	4.69	48.72	42.25

Full SAP Calculation Printout

Property Reference	House	**Issued on Date**	22/11/2024
Assessment Reference	Be Lean	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	13.19	**TER**	13.07
Environmental	88 B	**% DER < TER**			-0.92
CO_2 Emissions (t/year)	1.32	**DFEE**	42.25	**TFEE**	48.72
Compliance Check	See BREL	**% DFEE < TFEE**			13.29
% DPER < TPER	-9.23	**DPER**	74.96	**TPER**	68.62

Assessor Details	Ms. Sherleen Pang	**Assessor ID**	BA17-0001
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)	
Ground floor	40.6200 (1b)	x	2.7000 (2b)	=	109.6740	(1b) - (3b)
First floor	72.5300 (1c)	x	2.4000 (2c)	=	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	283.7460	(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		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			3.0000 (17)
Infiltration rate			0.1500 (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) =	0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =		69.6000 (23c)

Effective ac	0.3432	0.3395	0.3357	0.3170	0.3132	0.2945	0.2945	0.2907	0.3020	0.3132	0.3207	0.3282	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 270.2525 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.9237 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 89.1053 (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	32.1406	31.7895	31.4383	29.6827	29.3315	27.5759	27.5759	27.2247	28.2781	29.3315	30.0338	30.7361	(38)

Heat transfer coeff

	121.2459	120.8948	120.5436	118.7879	118.4368	116.6811	116.6811	116.3300	117.3834	118.4368	119.1391	119.8413	(39)

Average = Sum(39)m / 12 = 118.7002

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0716	1.0684	1.0653	1.0498	1.0467	1.0312	1.0312	1.0281	1.0374	1.0467	1.0529	1.0591	(40)
HLP (average)												1.0491	
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 2.8325 (42)
Hot water usage for mixer showers

71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	
Distribution loss (46)m = 0.15 x (45)m													
	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.7800	(53)
Enter (49) or (54) in (55)												1.5194	(55)
Total storage loss													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)
If cylinder contains dedicated solar storage													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
										Total per year (kWh/year) = Sum(64)m =		3310.0117	(64)
12Total per year (kWh/year)												3310	(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													
	120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains													
	646.2505	661.3583	634.0781	612.0730	581.1273	523.3430	502.0885	502.8896	519.0445	574.7564	609.6061	632.6301	(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	
East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141	(76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426	(78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019	(79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921	(80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583	(79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579	(83)
Total gains	884.3450	1110.6484	1345.9181	1625.7218	1814.1382	1784.3724	1702.9280	1538.4061	1337.2334	1099.3385	903.2132	830.6880	(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	70.0575	70.2610	70.4657	71.5071	71.7191	72.7983	72.7983	73.0180	72.3628	71.7191	71.2964	70.8786	
alpha	5.6705	5.6841	5.6977	5.7671	5.7813	5.8532	5.8532	5.8679	5.8242	5.7813	5.7531	5.7252	
util living area	0.9948	0.9819	0.9372	0.7951	0.5934	0.4170	0.3013	0.3474	0.5924	0.8964	0.9859	0.9963	(86)
MIT	19.9666	20.2272	20.5605	20.8688	20.9773	20.9976	20.9997	20.9994	20.9838	20.7767	20.3068	19.9276	(87)
Th 2	20.0241	20.0267	20.0292	20.0420	20.0446	20.0574	20.0574	20.0600	20.0523	20.0446	20.0395	20.0343	(88)
util rest of house	0.9931	0.9761	0.9192	0.7526	0.5373	0.3563	0.2369	0.2767	0.5167	0.8598	0.9804	0.9950	(89)
MIT 2	19.0961	19.3543	19.6735	19.9514	20.0322	20.0565	20.0573	20.0598	20.0453	19.8875	19.4454	19.0656	(90)
Living area fraction									fLA = Living area / (4) =			0.3389	(91)
MIT	19.3912	19.6501	19.9741	20.2624	20.3525	20.3755	20.3767	20.3783	20.3634	20.1889	19.7374	19.3578	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3912	19.6501	19.9741	20.2624	20.3525	20.3755	20.3767	20.3783	20.3634	20.1889	19.7374	19.3578	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9733	0.9180	0.7629	0.5556	0.3769	0.2587	0.3006	0.5421	0.8660	0.9782	0.9938	(94)
Useful gains	876.8857	1080.9967	1235.5399	1240.2815	1008.0144	672.4829	440.5549	462.5102	724.8867	952.0609	883.4786	825.5499	(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	1829.7432	1783.2127	1624.2202	1349.7113	1024.7781	673.8885	440.6745	462.7913	735.2175	1135.6746	1505.6034	1816.5287	(97)
Space heating kWh	708.9259	471.8891	289.1781	78.7895	12.4722	0.0000	0.0000	0.0000	0.0000	136.6086	447.9299	737.2882	(98a)
Space heating requirement - total per year (kWh/year)												2883.0815	
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	708.9259	471.8891	289.1781	78.7895	12.4722	0.0000	0.0000	0.0000	0.0000	136.6086	447.9299	737.2882	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2883.0815	
Space heating per m2											(98c) / (4) =	25.4802	(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	708.9259	471.8891	289.1781	78.7895	12.4722	0.0000	0.0000	0.0000	0.0000	136.6086	447.9299	737.2882	(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)	768.0671	511.2558	313.3024	85.3624	13.5127	0.0000	0.0000	0.0000	0.0000	148.0050	485.2978	798.7954	(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	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater												92.3000	(216)
(217)m	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	(217)
Fuel for water heating, kWh/month	361.5138	320.6777	342.5583	305.0430	298.4602	238.7615	235.9665	244.8517	247.0345	308.9280	324.3324	358.0173	(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	31.7804	28.7049	31.7804	30.7552	31.7804	30.7552	31.7804	31.7804	30.7552	31.7804	30.7552	31.7804	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	3123.5986	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	92.3000	
Water heating fuel used	3586.1449	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)		
mechanical ventilation fans (SFP = 0.9625)	333.1887	(230a)
central heating pump	41.0000	(230c)
Total electricity for the above, kWh/year	374.1887	(231)
Electricity for lighting (calculated in Appendix L)	217.2245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	7301.1568	(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	3123.5986	0.2100	655.9557	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3586.1449	0.2100	753.0904	(264)
Space and water heating			1409.0461	(265)
Pumps, fans and electric keep-hot	374.1887	0.1387	51.9046	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Total CO2, kg/year			1492.3029	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.1900	(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	3123.5986	1.1300	3529.6664	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3586.1449	1.1300	4052.3437	(278)
Space and water heating			7582.0102	(279)
Pumps, fans and electric keep-hot	374.1887	1.5128	566.0727	(281)
Energy for lighting	217.2245	1.5338	333.1863	(282)
Total Primary energy kWh/year			8481.2691	(286)
Dwelling Primary energy Rate (DPER)			74.9600	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200 (1b)	x	2.7000 (2b)	=	109.6740	(1b) - (3b)
First floor	72.5300 (1c)	x	2.4000 (2c)	=	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 113.1500						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	283.7460	(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) =	0.1410	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3910	(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) =	0.3910	(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	0.4985	0.4887	0.4789	0.4301	0.4203	0.3714	0.3714	0.3616	0.3910	0.4203	0.4398	0.4594	(22b)
Effective ac	0.6242	0.6194	0.6147	0.5925	0.5883	0.5690	0.5690	0.5654	0.5764	0.5883	0.5967	0.6055	(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	
TER Opening Type (Uw = 1.20)			21.5400	1.1450	24.6641			(27)
Staircase rooflight			2.7300	2.0221	5.5202			(27a)
Living room rooflight			4.0200	2.0221	8.1287			(27a)
Heatloss Floor 1			72.5300	0.1300	9.4289			(28a)
External Wall 1	165.5600	21.5400	144.0200	0.1800	25.9236			(29a)
External Roof 1	52.7900	2.7300	50.0600	0.1100	5.5066			(30)
0L flat roof	30.2500	4.0200	26.2300	0.1100	2.8853			(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.0574			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 270.2525 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3	Sill	7.9500	0.0500	0.3975
E4	Jamb	31.5000	0.0500	1.5750
E5	Ground floor (normal)	39.3400	0.1600	6.2944
E6	Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11	Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13	Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14	Flat roof	34.3000	0.0800	2.7440
E16	Corner (normal)	22.2000	0.0900	1.9980
E24	Eaves (insulation at ceiling level - inverted)	4.9200	0.2400	1.1808
R1	Head of roof window	6.7400	0.0800	0.5392
R2	Sill of roof window	6.7400	0.0600	0.4044
R3	Jamb of roof window	5.6400	0.0800	0.4512
R5	Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.6613 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 99.7187 (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	58.4519	58.0002	57.5574	55.4775	55.0884	53.2769	53.2769	52.9414	53.9746	55.0884	55.8756	56.6986	(38)
Heat transfer coeff	158.1707	157.7189	157.2761	155.1962	154.8071	152.9956	152.9956	152.6601	153.6933	154.8071	155.5943	156.4173	(39)
Average = Sum(39)m / 12 =												155.1944	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3979	1.3939	1.3900	1.3716	1.3682	1.3521	1.3521	1.3492	1.3583	1.3682	1.3751	1.3824	(40)
HLP (average)												1.3716	
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 2.8325 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)											Total = Sum(45)m =	2233.8751	
Distribution loss (46)m = 0.15 x (45)m	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:

Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6525 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8924 (55)

Total storage loss

27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)

If cylinder contains dedicated solar storage

27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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

282.6448	249.8917	265.1489	232.1685	224.4463	201.5666	198.3599	206.5609	209.2026	234.1081	249.9726	279.4175	(62)
WWHRS -32.7833	-28.9938	-30.3606	-25.1398	-23.4294	-20.0487	-18.7925	-19.9839	-20.7432	-24.4539	-27.7033	-32.1762	(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	249.8615	220.8979	234.7882	207.0287	201.0169	181.5179	179.5674	186.5770	188.4595	209.6542	222.2693	247.2413	(64)
										Total per year (kWh/year) = Sum(64)m =		2528.8800	(64)
12Total per year (kWh/year)												2529	(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

117.7873	104.5930	111.9699	100.2360	98.4363	90.0609	89.7626	92.4894	92.5998	101.6489	106.1558	116.7143	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	158.3163	155.6443	150.4972	139.2166	132.3069	125.0845	120.6487	124.3138	128.6109	136.6248	147.4386	156.8740	(72)
Total internal gains													
	642.0231	657.1308	629.8507	607.8455	576.8999	553.0889	531.8344	532.6355	548.7904	570.5289	605.3787	628.4026	(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	
East	2.0300	19.6403	0.6300	0.7000	0.7700	12.1847	(76)
South	1.1900	46.7521	0.6300	0.7000	0.7700	17.0028	(78)
Southwest	7.0300	36.7938	0.6300	0.7000	0.7700	79.0501	(79)
West	11.2900	19.6403	0.6300	0.7000	0.7700	67.7662	(80)
South	6.7500	26.0000	0.6300	0.7000	1.0000	69.6559	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	245.6597	463.5686	734.4683	1045.8792	1272.2222	1301.1342	1239.0290	1068.4446	844.2006	541.2551	302.9367	204.3506	(83)
Total gains	887.6827	1120.6995	1364.3190	1653.7247	1849.1221	1854.2231	1770.8634	1601.0800	1392.9910	1111.7840	908.3153	832.7533	(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	53.7027	53.8565	54.0081	54.7319	54.8695	55.5192	55.5192	55.6412	55.2671	54.8695	54.5919	54.3046	
alpha	4.5802	4.5904	4.6005	4.6488	4.6580	4.7013	4.7013	4.7094	4.6845	4.6580	4.6395	4.6203	
util living area													
	0.9955	0.9868	0.9599	0.8710	0.7076	0.5154	0.3776	0.4335	0.6970	0.9371	0.9896	0.9966	(86)
MIT	19.4986	19.7749	20.1697	20.6247	20.8874	20.9797	20.9962	20.9929	20.9230	20.5124	19.9164	19.4605	(87)
Th 2	19.7650	19.7680	19.7710	19.7852	19.7878	19.8002	19.8002	19.8025	19.7954	19.7878	19.7825	19.7769	(88)
util rest of house													
	0.9938	0.9821	0.9460	0.8316	0.6372	0.4245	0.2760	0.3233	0.5999	0.9078	0.9851	0.9954	(89)
MIT 2	18.0509	18.4033	18.8969	19.4395	19.7065	19.7907	19.7993	19.8006	19.7516	19.3329	18.5959	18.0104	(90)
Living area fraction									fLA = Living area / (4) =			0.3389	(91)
MIT	18.5416	18.8682	19.3283	19.8412	20.1067	20.1937	20.2049	20.2047	20.1486	19.7327	19.0435	18.5019	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5416	18.8682	19.3283	19.8412	20.1067	20.1937	20.2049	20.2047	20.1486	19.7327	19.0435	18.5019	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9914	0.9774	0.9397	0.8337	0.6568	0.4549	0.3106	0.3608	0.6303	0.9062	0.9812	0.9934	(94)
Useful gains	880.0840	1095.3819	1282.1040	1378.6638	1214.4332	843.5045	549.9620	577.6942	877.9383	1007.4610	891.2455	827.2941	(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													
	2252.6043	2203.0497	2017.5835	1698.0277	1301.4185	855.8140	551.5410	580.8261	929.6335	1413.8003	1858.3345	2237.0652	(97)
Space heating kWh													
	1021.1551	744.3527	547.1968	229.9421	64.7171	0.0000	0.0000	0.0000	0.0000	302.3165	696.3041	1048.8696	(98a)
Space heating requirement - total per year (kWh/year)												4654.8540	
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													
	1021.1551	744.3527	547.1968	229.9421	64.7171	0.0000	0.0000	0.0000	0.0000	302.3165	696.3041	1048.8696	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4654.8540	
Space heating per m2											(98c) / (4) =	41.1388	(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													
	1021.1551	744.3527	547.1968	229.9421	64.7171	0.0000	0.0000	0.0000	0.0000	302.3165	696.3041	1048.8696	(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)													
	1106.3436	806.4493	592.8459	249.1246	70.1160	0.0000	0.0000	0.0000	0.0000	327.5368	754.3924	1136.3701	(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													
	249.8615	220.8979	234.7882	207.0287	201.0169	181.5179	179.5674	186.5770	188.4595	209.6542	222.2693	247.2413	(64)

Efficiency of water heater												79.8000	(216)
(217)m	86.8739	86.5657	85.8915	84.2957	81.8196	79.8000	79.8000	79.8000	79.8000	84.8798	86.4410	86.9298	(217)
Fuel for water heating, kWh/month													
	287.6140	255.1795	273.3544	245.5980	245.6832	227.4661	225.0218	233.8058	236.1647	247.0012	257.1340	284.4149	(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	28.9258	23.2054	20.8939	15.3077	11.8241	9.6604	10.7864	14.0205	18.2113	23.8942	26.9884	29.7297	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-39.5248	-56.5304	-82.4103	-93.9919	-102.4456	-95.9602	-94.7177	-88.8475	-78.7202	-65.1806	-43.7161	-34.0728	(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	-19.9509	-42.2186	-84.3913	-127.4695	-169.2756	-170.3986	-168.4547	-142.3526	-103.9310	-60.6877	-26.7335	-15.7631	(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	5043.1788	(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	3018.4377	(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)	233.4478	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2007.7453	(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	6373.3190	(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	5043.1788	0.2100	1059.0675	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3018.4377	0.2100	633.8719	(264)
Space and water heating			1692.9395	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	233.4478	0.1443	33.6937	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-876.1181	0.1343	-117.6631	
PV Unit electricity exported	-1131.6272	0.1257	-142.2693	
Total			-259.9323	(269)
Total CO2, kg/year			1478.6301	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.0700	(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	5043.1788	1.1300	5698.7920	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3018.4377	1.1300	3410.8346	(278)
Space and water heating			9109.6266	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	233.4478	1.5338	358.0701	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-876.1181	1.4963	-1310.9670	
PV Unit electricity exported	-1131.6272	0.4615	-522.2159	
Total			-1833.1829	(283)
Total Primary energy kWh/year			7764.6146	(286)
Target Primary Energy Rate (TPER)			68.6200	(287)

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)	
Ground floor	40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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) =	0.1410	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2910	(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) =	0.2910	(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	0.3710	0.3637	0.3564	0.3201	0.3128	0.2764	0.2764	0.2691	0.2910	0.3128	0.3273	0.3419	(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	0.5688	0.5661	0.5635	0.5512	0.5489	0.5382	0.5382	0.5362	0.5423	0.5489	0.5536	0.5584	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		270.2525 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3	Sill	7.9500	0.0500	0.3975
E4	Jamb	31.5000	0.0500	1.5750
E5	Ground floor (normal)	39.3400	0.0800	3.1472
E6	Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11	Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13	Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14	Flat roof	34.3000	0.0800	2.7440
E16	Corner (normal)	22.2000	0.0900	1.9980
E24	Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1	Head of roof window	6.7400	0.0800	0.5392
R2	Sill of roof window	6.7400	0.0600	0.4044
R3	Jamb of roof window	5.6400	0.0800	0.4512
R5	Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9237 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	89.1053 (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	53.2618	53.0116	52.7663	51.6143	51.3988	50.3954	50.3954	50.2096	50.7819	51.3988	51.8348	52.2906	(38)
Heat transfer coeff	142.3670	142.1168	141.8716	140.7196	140.5040	139.5007	139.5007	139.3149	139.8872	140.5040	140.9401	141.3959	(39)

Average = Sum(39)m / 12 = 140.7185

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2582	1.2560	1.2538	1.2437	1.2418	1.2329	1.2329	1.2312	1.2363	1.2418	1.2456	1.2496	(40)
HLP (average)												1.2436	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8325 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)
Hot water usage for other uses	43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day)	68.3763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	74.5986	72.5520	70.3177	67.5369	65.0561	62.4780	61.9426	64.1724	66.4593	69.1068	71.9121	74.4940	(44)
Energy conte	118.1460	103.3131	108.0756	92.4547	87.5781	76.8240	74.9142	79.4588	81.9510	93.7773	102.4520	116.6395	(45)
Energy content (annual)											Total = Sum(45)m =	1135.5843	
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													
	100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(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													
	100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(64)
										Total per year (kWh/year) = Sum(64)m =		965.2467	(64)
12Total per year (kWh/year)												965	(64)
Electric shower(s)													
	57.4286	51.1693	55.8749	53.3208	54.3213	51.8173	53.5445	54.3213	53.3208	55.8749	54.8243	57.4286	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		653.2466	(64a)
Heat gains from water heating, kWh/month													
	39.4632	34.7464	36.9348	32.9768	32.1907	29.2794	29.3054	30.4653	30.7448	33.8964	35.4771	39.1430	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	53.0419	51.7059	49.6436	45.8011	43.2670	40.6659	39.3890	40.9480	42.7011	45.5597	49.2738	52.6116	(72)
Total internal gains													
	533.7486	550.1925	525.9970	511.4301	484.8600	468.6702	450.5747	449.2697	462.8806	476.4638	504.2138	521.1402	(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	
East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141	(76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426	(78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019	(79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921	(80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583	(79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856	(82)

Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579	(83)
Total gains	771.8431	999.4826	1237.8370	1525.0789	1717.8709	1729.6997	1651.4142	1484.7863	1281.0695	1001.0459	797.8209	719.1981	(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	59.6640	59.7690	59.8724	60.3625	60.4551	60.8899	60.8899	60.9711	60.7217	60.4551	60.2681	60.0738	
alpha	4.9776	4.9846	4.9915	5.0242	5.0303	5.0593	5.0593	5.0647	5.0481	5.0303	5.0179	5.0049	
util living area													
	0.9975	0.9909	0.9669	0.8764	0.7037	0.5072	0.3701	0.4281	0.6992	0.9477	0.9934	0.9982	(86)
MIT	19.5947	19.8651	20.2474	20.6791	20.9143	20.9864	20.9977	20.9954	20.9390	20.5507	19.9781	19.5489	(87)
Th 2	19.8737	19.8755	19.8772	19.8852	19.8867	19.8938	19.8938	19.8951	19.8911	19.8867	19.8837	19.8805	(88)
util rest of house													
	0.9966	0.9876	0.9554	0.8396	0.6373	0.4236	0.2779	0.3272	0.6078	0.9231	0.9906	0.9976	(89)
MIT 2	18.6079	18.8775	19.2514	19.6527	19.8381	19.8887	19.8933	19.8941	19.8635	19.5529	18.9976	18.5676	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	18.9424	19.2122	19.5890	20.0005	20.2029	20.2608	20.2676	20.2674	20.2280	19.8911	19.3300	18.9002	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9424	19.2122	19.5890	20.0005	20.2029	20.2608	20.2676	20.2674	20.2280	19.8911	19.3300	18.9002	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9851	0.9517	0.8438	0.6571	0.4518	0.3092	0.3615	0.6372	0.9232	0.9886	0.9968	(94)
Useful gains	768.3754	984.5460	1178.0692	1286.9093	1128.7723	781.4857	510.6983	536.7539	816.3053	924.1413	788.7536	716.8736	(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													
	2084.5893	2034.0107	1856.9561	1562.0646	1194.6874	789.6815	511.6394	538.7807	857.2301	1305.4370	1723.6915	2078.5497	(97)
Space heating kWh													
	979.2632	705.2403	505.0918	198.1118	49.0408	0.0000	0.0000	0.0000	0.0000	283.6840	673.1553	1013.0870	(98a)
Space heating requirement - total per year (kWh/year)												4406.6741	
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

979.2632	705.2403	505.0918	198.1118	49.0408	0.0000	0.0000	0.0000	0.0000	283.6840	673.1553	1013.0870 (98c)

Space heating requirement after solar contribution - total per year (kWh/year) 4406.6741
Space heating per m2 (98c) / (4) = 38.9454 (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	1311.3066	1032.3052	1058.7932	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9446	0.9731	0.9560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1238.6496	1004.5103	1012.2208	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1876.9734	1792.9696	1614.9887	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	459.5931	586.6137	448.4593	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	114.8983	146.6534	112.1148	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement 373.6665 (107)
Energy for space heating 38.9454 (99)
Energy for space cooling 3.3024 (108)
Total 42.2478 (109)
Fabric Energy Efficiency (DFEE) 42.2 (109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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) =	0.1410 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3910 (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) =		0.3910 (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	0.4985	0.4887	0.4789	0.4301	0.4203	0.3714	0.3714	0.3616	0.3910	0.4203	0.4398	0.4594	(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	0.6242	0.6194	0.6147	0.5925	0.5883	0.5690	0.5690	0.5654	0.5764	0.5883	0.5967	0.6055	(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	
TER Opening Type (Uw = 1.20)			21.5400	1.1450	24.6641			(27)
Staircase rooflight			2.7300	2.0221	5.5202			(27a)
Living room rooflight			4.0200	2.0221	8.1287			(27a)
Heatloss Floor 1			72.5300	0.1300	9.4289			(28a)
External Wall 1	165.5600	21.5400	144.0200	0.1800	25.9236			(29a)
External Roof 1	52.7900	2.7300	50.0600	0.1100	5.5066			(30)
0L flat roof	30.2500	4.0200	26.2300	0.1100	2.8853			(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.0574			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 270.2525 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3	Sill	7.9500	0.0500	0.3975
E4	Jamb	31.5000	0.0500	1.5750
E5	Ground floor (normal)	39.3400	0.1600	6.2944
E6	Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11	Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13	Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14	Flat roof	34.3000	0.0800	2.7440
E16	Corner (normal)	22.2000	0.0900	1.9980
E24	Eaves (insulation at ceiling level - inverted)	4.9200	0.2400	1.1808
R1	Head of roof window	6.7400	0.0800	0.5392
R2	Sill of roof window	6.7400	0.0600	0.4044
R3	Jamb of roof window	5.6400	0.0800	0.4512
R5	Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.6613 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 99.7187 (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	58.4519	58.0002	57.5574	55.4775	55.0884	53.2769	53.2769	52.9414	53.9746	55.0884	55.8756	56.6986	(38)
Heat transfer coeff	158.1707	157.7189	157.2761	155.1962	154.8071	152.9956	152.9956	152.6601	153.6933	154.8071	155.5943	156.4173	(39)
Average = Sum(39)m / 12 =												155.1944	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3979	1.3939	1.3900	1.3716	1.3682	1.3521	1.3521	1.3492	1.3583	1.3682	1.3751	1.3824	(40)
HLP (average)												1.3716	
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 2.8325 (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

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 68.3763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	74.5986	72.5520	70.3177	67.5369	65.0561	62.4780	61.9426	64.1724	66.4593	69.1068	71.9121	74.4940	(44)
Energy conte	118.1460	103.3131	108.0756	92.4547	87.5781	76.8240	74.9142	79.4588	81.9510	93.7773	102.4520	116.6395	(45)
Energy content (annual)										Total = Sum(45)m =		1135.5843	

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

100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(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

100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(64)
							Total per year (kWh/year) = Sum(64)m =				965.2467	(64)
12Total per year (kWh/year)											965	(64)

Electric shower(s)

57.4286	51.1693	55.8749	53.3208	54.3213	51.8173	53.5445	54.3213	53.3208	55.8749	54.8243	57.4286	(64a)
				Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							653.2466	(64a)

Heat gains from water heating, kWh/month

39.4632	34.7464	36.9348	32.9768	32.1907	29.2794	29.3054	30.4653	30.7448	33.8964	35.4771	39.1430	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)	53.0419	51.7059	49.6436	45.8011	43.2670	40.6659	39.3890	40.9480	42.7011	45.5597	49.2738	52.6116	(72)
Total internal gains	533.7486	550.1925	525.9970	511.4301	484.8600	468.6702	450.5747	449.2697	462.8806	476.4638	504.2138	521.1402	(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	
East	2.0300	19.6403	0.6300	0.7000	0.7700	12.1847	(76)
South	1.1900	46.7521	0.6300	0.7000	0.7700	17.0028	(78)

Southwest				7.0300		36.7938		0.6300		0.7000		0.7700	79.0501 (79)
West				11.2900		19.6403		0.6300		0.7000		0.7700	67.7662 (80)
South				6.7500		26.0000		0.6300		0.7000		1.0000	69.6559 (82)
Solar gains	245.6597	463.5686	734.4683	1045.8792	1272.2222	1301.1342	1239.0290	1068.4446	844.2006	541.2551	302.9367	204.3506 (83)	
Total gains	779.4083	1013.7611	1260.4653	1557.3092	1757.0822	1769.8044	1689.6037	1517.7143	1307.0812	1017.7188	807.1505	725.4909 (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	53.7027	53.8565	54.0081	54.7319	54.8695	55.5192	55.5192	55.6412	55.2671	54.8695	54.5919	54.3046	
alpha	4.5802	4.5904	4.6005	4.6488	4.6580	4.7013	4.7013	4.7094	4.6845	4.6580	4.6395	4.6203	
util living area	0.9974	0.9911	0.9697	0.8904	0.7328	0.5374	0.3952	0.4560	0.7287	0.9531	0.9935	0.9981 (86)	
MIT	19.4078	19.6884	20.0949	20.5786	20.8695	20.9759	20.9954	20.9913	20.9071	20.4506	19.8333	19.3699 (87)	
Th 2	19.7650	19.7680	19.7710	19.7852	19.7878	19.8002	19.8002	19.8025	19.7954	19.7878	19.7825	19.7769 (88)	
util rest of house	0.9964	0.9878	0.9586	0.8547	0.6630	0.4437	0.2892	0.3408	0.6320	0.9296	0.9906	0.9974 (89)	
MIT 2	18.3390	18.6197	19.0194	19.4778	19.7131	19.7913	19.7993	19.8006	19.7531	19.3790	18.7762	18.3101 (90)	
Living area fraction										fLA = Living area / (4) =		0.3389 (91)	
MIT	18.7012	18.9819	19.3839	19.8509	20.1050	20.1928	20.2047	20.2042	20.1442	19.7422	19.1345	18.6693 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.7012	18.9819	19.3839	19.8509	20.1050	20.1928	20.2047	20.2042	20.1442	19.7422	19.1345	18.6693 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9850	0.9542	0.8569	0.6825	0.4752	0.3253	0.3801	0.6622	0.9285	0.9884	0.9965 (94)	
Useful gains	775.6264	998.5177	1202.7930	1334.5031	1199.2100	840.9342	549.5769	576.8404	865.5883	944.9196	797.8126	722.9168 (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	2277.8542	2220.9844	2026.3300	1699.5438	1301.1606	855.6756	551.5033	580.7447	928.9575	1415.2811	1872.4933	2263.2469 (97)	
Space heating kWh	1117.6574	821.4976	612.7116	262.8293	75.8513	0.0000	0.0000	0.0000	0.0000	349.9490	773.7701	1146.0056 (98a)	
Space heating requirement - total per year (kWh/year)												5160.2718	
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	1117.6574	821.4976	612.7116	262.8293	75.8513	0.0000	0.0000	0.0000	0.0000	349.9490	773.7701	1146.0056 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												5160.2718	
Space heating per m2										(98c) / (4) =		45.6056 (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	1438.1585	1132.1673	1160.2169	0.0000	0.0000	0.0000	0.0000 (100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9202	0.9577	0.9349	0.0000	0.0000	0.0000	0.0000 (101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1323.4521	1084.3273	1084.6835	0.0000	0.0000	0.0000	0.0000 (102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1921.0304	1834.9431	1651.2633	0.0000	0.0000	0.0000	0.0000 (103)	
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	430.2563	558.4581	421.5354	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	107.5641	139.6145	105.3838	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling requirement												352.5625 (107)	
Energy for space heating												45.6056 (99)	
Energy for space cooling												3.1159 (108)	
Total												48.7215 (109)	
Fabric Energy Efficiency (TFEE)												48.7 (109)	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200 (1b)	x	2.7000 (2b)	=	109.6740 (1b)	- (3b)
First floor	72.5300 (1c)	x	2.4000 (2c)	=	174.0720 (1c)	- (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	283.7460	(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		3.0000	(17)
Infiltration rate		0.1500	(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) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	69.6000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3432	0.3395	0.3357	0.3170	0.3132	0.2945	0.2945	0.2907	0.3020	0.3132	0.3207	0.3282	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		270.2525 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9237 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	89.1053 (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	32.1406	31.7895	31.4383	29.6827	29.3315	27.5759	27.5759	27.2247	28.2781	29.3315	30.0338	30.7361	(38)
Heat transfer coeff	121.2459	120.8948	120.5436	118.7879	118.4368	116.6811	116.6811	116.3300	117.3834	118.4368	119.1391	119.8413	(39)
Average = Sum(39)m / 12 =												118.7002	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0716	1.0684	1.0653	1.0498	1.0467	1.0312	1.0312	1.0281	1.0374	1.0467	1.0529	1.0591	(40)
HLP (average)												1.0491	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8325 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day)	134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	

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

34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:

Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.7800	(53)
Enter (49) or (54) in (55)												1.5194	(55)
Total storage loss													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)
If cylinder contains dedicated solar storage													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
										Total per year (kWh/year) = Sum(64)m =		3310.0117	(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													
	120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains													
	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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	
East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141	(76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426	(78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019	(79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921	(80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583	(79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856	(82)

Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579	(83)
Total gains	957.8149	1167.1751	1408.7053	1670.9047	1850.1627	1804.8202	1722.8726	1560.3783	1363.2203	1142.9297	955.9628	899.0144	(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	70.0575	70.2610	70.4657	71.5071	71.7191	72.7983	72.7983	73.0180	72.3628	71.7191	71.2964	70.8786	
alpha	5.6705	5.6841	5.6977	5.7671	5.7813	5.8532	5.8532	5.8679	5.8242	5.7813	5.7531	5.7252	
util living area													
	0.9924	0.9774	0.9257	0.7813	0.5830	0.4124	0.2978	0.3425	0.5822	0.8825	0.9816	0.9945	(86)
MIT	20.0305	20.2725	20.5990	20.8805	20.9792	20.9977	20.9997	20.9994	20.9852	20.7977	20.3503	19.9877	(87)
Th 2	20.0241	20.0267	20.0292	20.0420	20.0446	20.0574	20.0574	20.0600	20.0523	20.0446	20.0395	20.0343	(88)
util rest of house													
	0.9899	0.9703	0.9054	0.7380	0.5274	0.3523	0.2341	0.2728	0.5074	0.8432	0.9747	0.9926	(89)
MIT 2	19.1592	19.3981	19.7081	19.9601	20.0333	20.0566	20.0574	20.0598	20.0459	19.9042	19.4873	19.1252	(90)
Living area fraction											fLA = Living area / (4) =	0.3389	(91)
MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9674	0.9049	0.7489	0.5457	0.3727	0.2557	0.2964	0.5325	0.8506	0.9723	0.9911	(94)
Useful gains	946.2620	1129.1439	1274.7655	1251.3402	1009.6271	672.5740	440.5633	462.5338	725.8816	972.2007	929.5224	891.0004	(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													
	1837.4214	1788.5708	1628.5515	1350.8611	1024.9410	673.8980	440.6755	462.7940	735.3195	1137.8286	1510.6583	1823.6888	(97)
Space heating kWh													
	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98a)
Space heating requirement - total per year (kWh/year)												2687.9880	
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

663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202 (98c)

Space heating requirement after solar contribution - total per year (kWh/year) 2687.9880

Space heating per m2 (98c) / (4) = 23.7560 (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													
	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(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)													
	718.3343	480.1028	285.1753	77.6327	12.3440	0.0000	0.0000	0.0000	0.0000	133.5072	453.3238	751.8095	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater													
(217)m	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	(217)
Fuel for water heating, kWh/month													
	361.5138	320.6777	342.5583	305.0430	298.4602	238.7615	235.9665	244.8517	247.0345	308.9280	324.3324	358.0173	(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	31.7804	28.7049	31.7804	30.7552	31.7804	30.7552	31.7804	31.7804	30.7552	31.7804	30.7552	31.7804	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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 2912.2297 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 92.3000

Water heating fuel used 3586.1449 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)

mechanical ventilation fans (SFP = 0.9625) 333.1887 (230a)

central heating pump 41.0000 (230c)

Total electricity for the above, kWh/year 374.1887 (231)

Electricity for lighting (calculated in Appendix L) 217.2245 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation 0.0000 (233)

Wind generation 0.0000 (234)

Hydro-electric generation (Appendix N) 0.0000 (235a)

Electricity generated - Micro CHP (Appendix N) 0.0000 (235)

Appendix Q - special features

Energy saved or generated -0.0000 (236)

Energy used 0.0000 (237)

Total delivered energy for all uses 7089.7879 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2912.2297	3.6400	106.0052	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3586.1449	3.6400	130.5357	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	374.1887	16.4900	61.7037	(249)
Energy for lighting	217.2245	16.4900	35.8203	(250)
Additional standing charges			92.0000	(251)
Total energy cost			426.0649	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.3600 (256)

Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.9699 (257)

SAP value 84.2786

SAP rating (Section 12) 84 (258)

SAP band B

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	2912.2297	0.2100	611.5682	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3586.1449	0.2100	753.0904	(264)
Space and water heating			1364.6587	(265)
Pumps, fans and electric keep-hot	374.1887	0.1387	51.9046	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Total CO2, kg/year			1447.9155	(272)
CO2 emissions per m2			12.8000	(273)
EI value			87.7319	
EI rating			88	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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		3.0000	(17)
Infiltration rate		0.1500	(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) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1575	0.1500	0.1500	0.1388	0.1388	0.1237	0.1275	0.1200	0.1237	0.1313	0.1313	0.1425	(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) =	69.6000 (23c)

Effective ac	0.3095	0.3020	0.3020	0.2907	0.2907	0.2757	0.2795	0.2720	0.2757	0.2833	0.2833	0.2945	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		270.2525 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750

E5 Ground floor (normal)	39.3400	0.0800	3.1472	
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000	
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936	
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552	
E14 Flat roof	34.3000	0.0800	2.7440	
E16 Corner (normal)	22.2000	0.0900	1.9980	
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904	
R1 Head of roof window	6.7400	0.0800	0.5392	
R2 Sill of roof window	6.7400	0.0600	0.4044	
R3 Jamb of roof window	5.6400	0.0800	0.4512	
R5 Ridge (inverted)	11.1000	0.0400	0.4440	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.9237 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 89.1053 (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	28.9804	28.2781	28.2781	27.2247	27.2247	25.8202	26.1713	25.4690	25.8202	26.5224	26.5224	27.5759	(38)
Heat transfer coeff	118.0857	117.3834	117.3834	116.3300	116.3300	114.9254	115.2766	114.5743	114.9254	115.6277	115.6277	116.6811	(39)

Average = Sum(39)m / 12 = 116.0959

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0436	1.0374	1.0374	1.0281	1.0281	1.0157	1.0188	1.0126	1.0157	1.0219	1.0219	1.0312	(40)
HLP (average)												1.0260	
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 2.8325 (42)

Hot water usage for mixer showers

71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)											Total = Sum(45)m =	2233.8751	
Distribution loss (46)m = 0.15 x (45)m	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:

Store volume 200.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.8434 (52)
Temperature factor from Table 2b 0.7800 (53)
Enter (49) or (54) in (55) 1.5194 (55)

Total storage loss

47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)

If cylinder contains dedicated solar storage

47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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

333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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

333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)

Total per year (kWh/year) = Sum(64)m = 3310.0117 (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

120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(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)	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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	
East	2.4800	22.3313	0.5000	0.7000	0.7700	13.4328	(76)
South	1.4500	50.9848	0.5000	0.7000	0.7700	17.9312	(78)
Southwest	6.3200	40.4699	0.5000	0.7000	0.7700	62.0370	(79)

West			13.7900		22.3313		0.5000		0.7000		0.7700	74.6930	(80)
Southwest			2.2700		40.4699		0.5000		0.7000		0.7700	22.2823	(79)
South			8.2400		30.0000		0.5000		0.7000		1.0000	77.8680	(82)
Solar gains	268.2443	455.9839	714.1950	1048.0340	1241.6062	1358.6897	1279.9449	1129.0211	889.8661	568.6690	339.0040	220.8992	(83)
Total gains	987.9647	1173.8689	1411.0603	1705.2899	1858.7580	1902.4804	1801.9781	1653.8828	1434.8975	1187.0166	1001.3597	921.8557	(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	71.9324	72.3628	72.3628	73.0180	73.0180	73.9104	73.6853	74.1369	73.9104	73.4615	73.4615	72.7983	
alpha	5.7955	5.8242	5.8242	5.8679	5.8679	5.9274	5.9124	5.9425	5.9274	5.8974	5.8974	5.8532	
util living area	0.9884	0.9701	0.9006	0.7150	0.4963	0.3019	0.1983	0.2217	0.4619	0.8148	0.9676	0.9915	(86)
MIT	20.1828	20.3927	20.7044	20.9346	20.9926	20.9997	21.0000	21.0000	20.9965	20.8910	20.5137	20.1446	(87)
Th 2	20.0471	20.0523	20.0523	20.0600	20.0600	20.0703	20.0677	20.0729	20.0703	20.0651	20.0651	20.0574	(88)
util rest of house	0.9845	0.9607	0.8744	0.6662	0.4398	0.2458	0.1387	0.1575	0.3892	0.7615	0.9556	0.9886	(89)
MIT 2	19.3285	19.5360	19.8241	20.0182	20.0565	20.0702	20.0677	20.0729	20.0691	19.9970	19.6662	19.2995	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9581	0.8765	0.6806	0.4588	0.2648	0.1589	0.1792	0.4138	0.7759	0.9538	0.9867	(94)
Useful gains	970.3868	1124.6694	1236.8327	1160.6348	852.8268	503.8340	286.3054	296.4040	593.8028	921.0204	955.1147	909.6068	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1714.3741	1669.9369	1493.4028	1213.1829	857.7935	503.9750	286.3099	296.4129	595.7086	1005.9622	1382.1492	1690.2368	(97)
Space heating kWh	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98a)
Space heating requirement - total per year (kWh/year)												2103.8144	
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	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2103.8144	
Space heating per m2											(98c) / (4) =	18.5931	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(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)	599.7037	396.9878	206.8127	40.9909	4.0034	0.0000	0.0000	0.0000	0.0000	68.4688	333.1147	629.2402	(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	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater												92.3000	(216)
(217)m	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	(217)
Fuel for water heating, kWh/month	361.5138	320.6777	342.5583	305.0430	298.4602	238.7615	235.9665	244.8517	247.0345	308.9280	324.3324	358.0173	(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	31.7804	28.7049	31.7804	30.7552	31.7804	30.7552	31.7804	31.7804	30.7552	31.7804	30.7552	31.7804	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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												2279.3222	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												92.3000	
Water heating fuel used												3586.1449	(219)

Space cooling fuel		0.0000 (221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)		
mechanical ventilation fans (SFP = 0.9625)		333.1887 (230a)
central heating pump		41.0000 (230c)
Total electricity for the above, kWh/year		374.1887 (231)
Electricity for lighting (calculated in Appendix L)		217.2245 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		0.0000 (233)
Wind generation		0.0000 (234)
Hydro-electric generation (Appendix N)		0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (235)
Appendix Q - special features		
Energy saved or generated		-0.0000 (236)
Energy used		0.0000 (237)
Total delivered energy for all uses		6456.8804 (238)

10a. Fuel costs - using BEDF prices (554)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2279.3222	5.6000	127.6420	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3586.1449	5.6000	200.8241	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	374.1887	26.0600	97.5136	(249)
Energy for lighting	217.2245	26.0600	56.6087	(250)
Additional standing charges			99.0000	(251)
Total energy cost			581.5885	(255)

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	2279.3222	0.2100	478.6577	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3586.1449	0.2100	753.0904	(264)
Space and water heating			1231.7481	(265)
Pumps, fans and electric keep-hot	374.1887	0.1387	51.9046	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Total CO2, kg/year			1315.0049	(272)

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	2279.3222	1.1300	2575.6341	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3586.1449	1.1300	4052.3437	(278)
Space and water heating			6627.9778	(279)
Pumps, fans and electric keep-hot	374.1887	1.5128	566.0727	(281)
Energy for lighting	217.2245	1.5338	333.1863	(282)
Total Primary energy kWh/year			7527.2368	(286)

SAP 10 EPC IMPROVEMENTS

Be Lean

Current energy efficiency rating: B 84
Current environmental impact rating: B 88

N Solar water heating	SAP increase too small	
U Solar photovoltaic panels	Recommended	
V2 Wind turbine	Not applicable	

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 5.0	-£ 222	-114 kg (8.7%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 31	-182 kg (13.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£222	1.01 kg/m²	B 89	B 89
Total Savings	£222	1.01 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 89

Fuel prices for cost data on this page from database revision number 554 TEST (31 Oct 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£154	£154	£0
Mains gas	£427	£427	£0
Space heating	£324	£324	£0
Water heating	£201	£201	£0
Lighting	£57	£57	£0
Generated (PV)	-£0	-£222	£222

Total cost of fuels	£581	£359	£222
Total cost of uses	£582	£360	£222
Delivered energy	57 kWh/m²	50 kWh/m²	8 kWh/m²
Carbon dioxide emissions	1.3 tonnes	1.2 tonnes	0.1 tonnes
CO2 emissions per m²	12 kg/m²	11 kg/m²	1 kg/m²
Primary energy	67 kWh/m²	55 kWh/m²	11 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200 (1b)	x	2.7000 (2b)	=	109.6740	(1b) - (3b)
First floor	72.5300 (1c)	x	2.4000 (2c)	=	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	283.7460	(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		3.0000	(17)
Infiltration rate		0.1500	(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) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	69.6000	(23c)

Effective ac	0.3432	0.3395	0.3357	0.3170	0.3132	0.2945	0.2945	0.2907	0.3020	0.3132	0.3207	0.3282	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 30579.0700	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	270.2525	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392

R2 Sill of roof window	6.7400	0.0600	0.4044		
R3 Jamb of roof window	5.6400	0.0800	0.4512		
R5 Ridge (inverted)	11.1000	0.0400	0.4440		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				13.9237	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	89.1053	(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	32.1406	31.7895	31.4383	29.6827	29.3315	27.5759	27.5759	27.2247	28.2781	29.3315	30.0338	30.7361	(38)
Heat transfer coeff	121.2459	120.8948	120.5436	118.7879	118.4368	116.6811	116.6811	116.3300	117.3834	118.4368	119.1391	119.8413	(39)
Average = Sum(39)m / 12 =												118.7002	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0716	1.0684	1.0653	1.0498	1.0467	1.0312	1.0312	1.0281	1.0374	1.0467	1.0529	1.0591	(40)
HLP (average)												1.0491	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8325	(42)
Hot water usage for mixer showers	71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)
Hot water usage for baths	30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)
Hot water usage for other uses	43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)
Average daily hot water use (litres/day)												134.4915	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	
Distribution loss (46)m = 0.15 x (45)m	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.7800	(53)
Enter (49) or (54) in (55)												1.5194	(55)
Total storage loss	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)
If cylinder contains dedicated solar storage	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
										Total per year (kWh/year) = Sum(64)m =		3310.0117	(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	120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(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)	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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	
East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141	(76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426	(78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019	(79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921	(80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583	(79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856	(82)

Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579	(83)
Total gains	957.8149	1167.1751	1408.7053	1670.9047	1850.1627	1804.8202	1722.8726	1560.3783	1363.2203	1142.9297	955.9628	899.0144	(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	70.0575	70.2610	70.4657	71.5071	71.7191	72.7983	72.7983	73.0180	72.3628	71.7191	71.2964	70.8786	
alpha	5.6705	5.6841	5.6977	5.7671	5.7813	5.8532	5.8532	5.8679	5.8242	5.7813	5.7531	5.7252	
util living area													
	0.9924	0.9774	0.9257	0.7813	0.5830	0.4124	0.2978	0.3425	0.5822	0.8825	0.9816	0.9945	(86)
MIT	20.0305	20.2725	20.5990	20.8805	20.9792	20.9977	20.9997	20.9994	20.9852	20.7977	20.3503	19.9877	(87)
Th 2	20.0241	20.0267	20.0292	20.0420	20.0446	20.0574	20.0574	20.0600	20.0523	20.0446	20.0395	20.0343	(88)
util rest of house													
	0.9899	0.9703	0.9054	0.7380	0.5274	0.3523	0.2341	0.2728	0.5074	0.8432	0.9747	0.9926	(89)
MIT 2	19.1592	19.3981	19.7081	19.9601	20.0333	20.0566	20.0574	20.0598	20.0459	19.9042	19.4873	19.1252	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9674	0.9049	0.7489	0.5457	0.3727	0.2557	0.2964	0.5325	0.8506	0.9723	0.9911	(94)
Useful gains	946.2620	1129.1439	1274.7655	1251.3402	1009.6271	672.5740	440.5633	462.5338	725.8816	972.2007	929.5224	891.0004	(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													
	1837.4214	1788.5708	1628.5515	1350.8611	1024.9410	673.8980	440.6755	462.7940	735.3195	1137.8286	1510.6583	1823.6888	(97)
Space heating kWh													
	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98a)
Space heating requirement - total per year (kWh/year)												2687.9880	
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													
	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2687.9880	
Space heating per m2											(98c) / (4) =	23.7560	(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													
	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(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)													
	718.3343	480.1028	285.1753	77.6327	12.3440	0.0000	0.0000	0.0000	0.0000	133.5072	453.3238	751.8095	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater												92.3000	(216)
(217)m	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	(217)
Fuel for water heating, kWh/month													
	361.5138	320.6777	342.5583	305.0430	298.4602	238.7615	235.9665	244.8517	247.0345	308.9280	324.3324	358.0173	(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	31.7804	28.7049	31.7804	30.7552	31.7804	30.7552	31.7804	31.7804	30.7552	31.7804	30.7552	31.7804	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-34.8420	-50.8701	-75.8655	-88.6361	-98.4829	-93.1060	-92.0006	-85.3891	-74.1607	-59.6419	-38.9295	-29.9187	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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												2912.2297	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												92.3000	
Water heating fuel used												3586.1449	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)													
mechanical ventilation fans (SFP = 0.9625)												333.1887	(230a)
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												374.1887	(231)
Electricity for lighting (calculated in Appendix L)												217.2245	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-821.8430	(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	6267.9449	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2912.2297	3.6400	106.0052	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3586.1449	3.6400	130.5357	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	374.1887	16.4900	61.7037	(249)
Energy for lighting	217.2245	16.4900	35.8203	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-821.8430	16.4900	-135.5219	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-135.5219	(252)
Total energy cost			290.5430	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6614	(257)
SAP value		89.2792	
SAP rating (Section 12)		89	(258)
SAP band		B	

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	2912.2297	0.2100	611.5682	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3586.1449	0.2100	753.0904	(264)
Space and water heating			1364.6587	(265)
Pumps, fans and electric keep-hot	374.1887	0.1387	51.9046	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-821.8430	0.1338	-109.9629	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-109.9629	(269)
Total CO2, kg/year			1337.9525	(272)
CO2 emissions per m2			11.8200	(273)
EI value			88.6636	
EI rating			89	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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	3.0000	(17)
Infiltration rate	0.1500	(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) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1575	0.1500	0.1500	0.1388	0.1388	0.1237	0.1275	0.1200	0.1237	0.1313	0.1313	0.1425	(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) =	69.6000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3095	0.3020	0.3020	0.2907	0.2907	0.2757	0.2795	0.2720	0.2757	0.2833	0.2833	0.2945	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) =	30579.0700	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	270.2525	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.9237	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	89.1053	(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	28.9804	28.2781	28.2781	27.2247	27.2247	25.8202	26.1713	25.4690	25.8202	26.5224	26.5224	27.5759	(38)
Heat transfer coeff	118.0857	117.3834	117.3834	116.3300	116.3300	114.9254	115.2766	114.5743	114.9254	115.6277	115.6277	116.6811	(39)
Average = Sum(39)m / 12 =												116.0959	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0436	1.0374	1.0374	1.0281	1.0281	1.0157	1.0188	1.0126	1.0157	1.0219	1.0219	1.0312	(40)
HLP (average)												1.0260	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8325	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day)	134.4915	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	

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

34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:		
Store volume	200.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.8434	(52)
Temperature factor from Table 2b	0.7800	(53)
Enter (49) or (54) in (55)	1.5194	(55)

Total storage loss

47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)

If cylinder contains dedicated solar storage

47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)

Primary loss

54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
										Total per year (kWh/year) = Sum(64)m =		3310.0117	(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													
	120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains													
	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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	
East	2.4800	22.3313	0.5000	0.7000	0.7700	13.4328	(76)
South	1.4500	50.9848	0.5000	0.7000	0.7700	17.9312	(78)
Southwest	6.3200	40.4699	0.5000	0.7000	0.7700	62.0370	(79)
West	13.7900	22.3313	0.5000	0.7000	0.7700	74.6930	(80)
Southwest	2.2700	40.4699	0.5000	0.7000	0.7700	22.2823	(79)
South	8.2400	30.0000	0.5000	0.7000	1.0000	77.8680	(82)

Solar gains	268.2443	455.9839	714.1950	1048.0340	1241.6062	1358.6897	1279.9449	1129.0211	889.8661	568.6690	339.0040	220.8992	(83)
Total gains	987.9647	1173.8689	1411.0603	1705.2899	1858.7580	1902.4804	1801.9781	1653.8828	1434.8975	1187.0166	1001.3597	921.8557	(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	71.9324	72.3628	72.3628	73.0180	73.0180	73.9104	73.6853	74.1369	73.9104	73.4615	73.4615	72.7983	
alpha	5.7955	5.8242	5.8242	5.8679	5.8679	5.9274	5.9124	5.9425	5.9274	5.8974	5.8974	5.8532	
util living area													
	0.9884	0.9701	0.9006	0.7150	0.4963	0.3019	0.1983	0.2217	0.4619	0.8148	0.9676	0.9915	(86)
MIT	20.1828	20.3927	20.7044	20.9346	20.9926	20.9997	21.0000	21.0000	20.9965	20.8910	20.5137	20.1446	(87)
Th 2	20.0471	20.0523	20.0523	20.0600	20.0600	20.0703	20.0677	20.0729	20.0703	20.0651	20.0651	20.0574	(88)
util rest of house													
	0.9845	0.9607	0.8744	0.6662	0.4398	0.2458	0.1387	0.1575	0.3892	0.7615	0.9556	0.9886	(89)
MIT 2	19.3285	19.5360	19.8241	20.0182	20.0565	20.0702	20.0677	20.0729	20.0691	19.9970	19.6662	19.2995	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9581	0.8765	0.6806	0.4588	0.2648	0.1589	0.1792	0.4138	0.7759	0.9538	0.9867	(94)
Useful gains	970.3868	1124.6694	1236.8327	1160.6348	852.8268	503.8340	286.3054	296.4040	593.8028	921.0204	955.1147	909.6068	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1714.3741	1669.9369	1493.4028	1213.1829	857.7935	503.9750	286.3099	296.4129	595.7086	1005.9622	1382.1492	1690.2368	(97)
Space heating kWh													
	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98a)
Space heating requirement - total per year (kWh/year)												2103.8144	
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													
	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2103.8144	
Space heating per m2											(98c) / (4) =	18.5931	(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													
	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(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)													
	599.7037	396.9878	206.8127	40.9909	4.0034	0.0000	0.0000	0.0000	0.0000	68.4688	333.1147	629.2402	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater												92.3000	(216)
(217)m	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	(217)
Fuel for water heating, kWh/month													
	361.5138	320.6777	342.5583	305.0430	298.4602	238.7615	235.9665	244.8517	247.0345	308.9280	324.3324	358.0173	(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	31.7804	28.7049	31.7804	30.7552	31.7804	30.7552	31.7804	31.7804	30.7552	31.7804	30.7552	31.7804	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.2150	-51.2365	-75.7840	-90.2250	-98.6943	-96.6948	-95.0079	-89.4161	-77.8442	-62.8639	-43.3538	-32.5984	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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	2279.3222	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	92.3000	
Water heating fuel used	3586.1449	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)		
mechanical ventilation fans (SFP = 0.9625)	333.1887	(230a)
central heating pump	41.0000	(230c)
Total electricity for the above, kWh/year	374.1887	(231)
Electricity for lighting (calculated in Appendix L)	217.2245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-851.9339	(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	5604.9465	(238)

10a. Fuel costs - using BEDF prices (554)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2279.3222	5.6000	127.6420	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3586.1449	5.6000	200.8241	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	374.1887	26.0600	97.5136	(249)
Energy for lighting	217.2245	26.0600	56.6087	(250)
Additional standing charges			99.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-851.9339	26.0600	-222.0140	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-222.0140	(252)
Total energy cost			359.5745	(255)

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	2279.3222	0.2100	478.6577	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3586.1449	0.2100	753.0904	(264)
Space and water heating			1231.7481	(265)
Pumps, fans and electric keep-hot	374.1887	0.1387	51.9046	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-851.9339	0.1338	-114.0220	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-114.0220	(269)
Total CO2, kg/year			1200.9829	(272)

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	2279.3222	1.1300	2575.6341	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3586.1449	1.1300	4052.3437	(278)
Space and water heating			6627.9778	(279)
Pumps, fans and electric keep-hot	374.1887	1.5128	566.0727	(281)
Energy for lighting	217.2245	1.5338	333.1863	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-851.9339	1.4946	-1273.2920	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1273.2920	(283)
Total Primary energy kWh/year			6253.9448	(286)

Full SAP Calculation Printout

Property Reference	House	**Issued on Date**	22/11/2024
Assessment Reference	Be Green	**Prop Type Ref**	
Property			

SAP Rating	79 C	**DER**	4.69	**TER**	13.07
Environmental	96 A	**% DER < TER**			64.12
CO_2 Emissions (t/year)	0.48	**DFEE**	42.25	**TFEE**	48.72
Compliance Check	See BREL	**% DFEE < TFEE**			13.29
% DPER < TPER	28.30	**DPER**	49.20	**TPER**	68.62

Assessor Details	Ms. Sherleen Pang	**Assessor ID**	BA17-0001
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)	
Ground floor	40.6200 (1b)	x	2.7000 (2b)	=	109.6740	(1b) - (3b)
First floor	72.5300 (1c)	x	2.4000 (2c)	=	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	283.7460	(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			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				3.0000	(17)
Infiltration rate				0.1500	(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) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		(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) =	69.6000	(23c)

Effective ac	0.3432	0.3395	0.3357	0.3170	0.3132	0.2945	0.2945	0.2907	0.3020	0.3132	0.3207	0.3282	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 270.2525 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.9237 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 89.1053 (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	32.1406	31.7895	31.4383	29.6827	29.3315	27.5759	27.5759	27.2247	28.2781	29.3315	30.0338	30.7361	(38)

Heat transfer coeff

	121.2459	120.8948	120.5436	118.7879	118.4368	116.6811	116.6811	116.3300	117.3834	118.4368	119.1391	119.8413	(39)

Average = Sum(39)m / 12 = 118.7002

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0716	1.0684	1.0653	1.0498	1.0467	1.0312	1.0312	1.0281	1.0374	1.0467	1.0529	1.0591	(40)
HLP (average)												1.0491	
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 2.8325 (42)
Hot water usage for mixer showers

71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	
Distribution loss (46)m = 0.15 x (45)m													
	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.7800	(53)
Enter (49) or (54) in (55)												1.5194	(55)
Total storage loss													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)
If cylinder contains dedicated solar storage													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
										Total per year (kWh/year) = Sum(64)m =		3310.0117	(64)
12Total per year (kWh/year)												3310	(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													
	120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains													
	646.2505	661.3583	634.0781	612.0730	581.1273	523.3430	502.0885	502.8896	519.0445	574.7564	609.6061	632.6301	(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	
East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141	(76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426	(78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019	(79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921	(80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583	(79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579	(83)
Total gains	884.3450	1110.6484	1345.9181	1625.7218	1814.1382	1784.3724	1702.9280	1538.4061	1337.2334	1099.3385	903.2132	830.6880	(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	70.0575	70.2610	70.4657	71.5071	71.7191	72.7983	72.7983	73.0180	72.3628	71.7191	71.2964	70.8786	
alpha	5.6705	5.6841	5.6977	5.7671	5.7813	5.8532	5.8532	5.8679	5.8242	5.7813	5.7531	5.7252	
util living area	0.9948	0.9819	0.9372	0.7951	0.5934	0.4170	0.3013	0.3474	0.5924	0.8964	0.9859	0.9963	(86)
MIT	19.9666	20.2272	20.5605	20.8688	20.9773	20.9976	20.9997	20.9994	20.9838	20.7767	20.3068	19.9276	(87)
Th 2	20.0241	20.0267	20.0292	20.0420	20.0446	20.0574	20.0574	20.0600	20.0523	20.0446	20.0395	20.0343	(88)
util rest of house	0.9931	0.9761	0.9192	0.7526	0.5373	0.3563	0.2369	0.2767	0.5167	0.8598	0.9804	0.9950	(89)
MIT 2	19.0961	19.3543	19.6735	19.9514	20.0322	20.0565	20.0573	20.0598	20.0453	19.8875	19.4454	19.0656	(90)
Living area fraction									fLA = Living area / (4) =			0.3389	(91)
MIT	19.3912	19.6501	19.9741	20.2624	20.3525	20.3755	20.3767	20.3783	20.3634	20.1889	19.7374	19.3578	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3912	19.6501	19.9741	20.2624	20.3525	20.3755	20.3767	20.3783	20.3634	20.1889	19.7374	19.3578	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9733	0.9180	0.7629	0.5556	0.3769	0.2587	0.3006	0.5421	0.8660	0.9782	0.9938	(94)
Useful gains	876.8857	1080.9967	1235.5399	1240.2815	1008.0144	672.4829	440.5549	462.5102	724.8867	952.0609	883.4786	825.5499	(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	1829.7432	1783.2127	1624.2202	1349.7113	1024.7781	673.8885	440.6745	462.7913	735.2175	1135.6746	1505.6034	1816.5287	(97)
Space heating kWh	708.9259	471.8891	289.1781	78.7895	12.4722	0.0000	0.0000	0.0000	0.0000	136.6086	447.9299	737.2882	(98a)
Space heating requirement - total per year (kWh/year)												2883.0815	
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	708.9259	471.8891	289.1781	78.7895	12.4722	0.0000	0.0000	0.0000	0.0000	136.6086	447.9299	737.2882	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2883.0815	
Space heating per m2											(98c) / (4) =	25.4802	(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 %)	219.3000	(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	708.9259	471.8891	289.1781	78.7895	12.4722	0.0000	0.0000	0.0000	0.0000	136.6086	447.9299	737.2882	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	323.2676	215.1797	131.8642	35.9277	5.6873	0.0000	0.0000	0.0000	0.0000	62.2930	204.2544	336.2007	(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	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	175.2506	155.4546	166.0616	147.8754	144.6842	115.7442	114.3892	118.6965	119.7546	149.7587	157.2263	173.5556	(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	28.2982	25.5597	28.2982	27.3854	28.2982	27.3854	28.2982	28.2982	27.3854	28.2982	27.3854	28.2982	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	1314.6747	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1738.4515	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)		
mechanical ventilation fans (SFP = 0.9625)	333.1887	(230a)
Total electricity for the above, kWh/year	333.1887	(231)
Electricity for lighting (calculated in Appendix L)	217.2245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3603.5395	(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	1314.6747	0.1577	207.3000	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1738.4515	0.1415	245.9790	(264)
Space and water heating			453.2790	(265)
Pumps, fans and electric keep-hot	333.1887	0.1387	46.2174	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Total CO2, kg/year			530.8486	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.6900	(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	1314.6747	1.5837	2082.0285	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1738.4515	1.5232	2648.0676	(278)
Space and water heating			4730.0961	(279)
Pumps, fans and electric keep-hot	333.1887	1.5128	504.0479	(281)
Energy for lighting	217.2245	1.5338	333.1863	(282)
Total Primary energy kWh/year			5567.3303	(286)
Dwelling Primary energy Rate (DPER)			49.2000	(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)	
Ground floor	40.6200 (1b)	x	2.7000 (2b)	=	109.6740	(1b) - (3b)
First floor	72.5300 (1c)	x	2.4000 (2c)	=	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 113.1500						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	283.7460	(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) =	0.1410 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3910 (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) =	0.3910 (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	0.4985	0.4887	0.4789	0.4301	0.4203	0.3714	0.3714	0.3616	0.3910	0.4203	0.4398	0.4594	(22b)
Effective ac	0.6242	0.6194	0.6147	0.5925	0.5883	0.5690	0.5690	0.5654	0.5764	0.5883	0.5967	0.6055	(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 Opening Type (Uw = 1.20)			21.5400	1.1450	24.6641			(27)
Staircase rooflight			2.7300	2.0221	5.5202			(27a)
Living room rooflight			4.0200	2.0221	8.1287			(27a)
Heatloss Floor 1			72.5300	0.1300	9.4289			(28a)
External Wall 1	165.5600	21.5400	144.0200	0.1800	25.9236			(29a)
External Roof 1	52.7900	2.7300	50.0600	0.1100	5.5066			(30)
0L flat roof	30.2500	4.0200	26.2300	0.1100	2.8853			(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.0574			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 270.2525 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3	Sill	7.9500	0.0500	0.3975
E4	Jamb	31.5000	0.0500	1.5750
E5	Ground floor (normal)	39.3400	0.1600	6.2944
E6	Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11	Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13	Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14	Flat roof	34.3000	0.0800	2.7440
E16	Corner (normal)	22.2000	0.0900	1.9980
E24	Eaves (insulation at ceiling level - inverted)	4.9200	0.2400	1.1808
R1	Head of roof window	6.7400	0.0800	0.5392
R2	Sill of roof window	6.7400	0.0600	0.4044
R3	Jamb of roof window	5.6400	0.0800	0.4512
R5	Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.6613 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 99.7187 (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	58.4519	58.0002	57.5574	55.4775	55.0884	53.2769	53.2769	52.9414	53.9746	55.0884	55.8756	56.6986	(38)
Heat transfer coeff	158.1707	157.7189	157.2761	155.1962	154.8071	152.9956	152.9956	152.6601	153.6933	154.8071	155.5943	156.4173	(39)
Average = Sum(39)m / 12 =												155.1944	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3979	1.3939	1.3900	1.3716	1.3682	1.3521	1.3521	1.3492	1.3583	1.3682	1.3751	1.3824	(40)
HLP (average)												1.3716	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8325 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	
Distribution loss (46)m = 0.15 x (45)m	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:

Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6525 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8924 (55)

Total storage loss

27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)

If cylinder contains dedicated solar storage

27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
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)
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)

Primary loss

Combi loss

Total heat required for water heating calculated for each month

282.6448	249.8917	265.1489	232.1685	224.4463	201.5666	198.3599	206.5609	209.2026	234.1081	249.9726	279.4175	(62)
-32.7833	-28.9938	-30.3606	-25.1398	-23.4294	-20.0487	-18.7925	-19.9839	-20.7432	-24.4539	-27.7033	-32.1762	(63a)
-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)
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)
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)

WWHRS

PV diverter

Solar input

FGHRS

Output from w/h

249.8615	220.8979	234.7882	207.0287	201.0169	181.5179	179.5674	186.5770	188.4595	209.6542	222.2693	247.2413	(64)

Total per year (kWh/year) = Sum(64)m = 2528.8800 (64)

12Total per year (kWh/year) 2529 (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

117.7873	104.5930	111.9699	100.2360	98.4363	90.0609	89.7626	92.4894	92.5998	101.6489	106.1558	116.7143	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	158.3163	155.6443	150.4972	139.2166	132.3069	125.0845	120.6487	124.3138	128.6109	136.6248	147.4386	156.8740	(72)
Total internal gains													
	642.0231	657.1308	629.8507	607.8455	576.8999	553.0889	531.8344	532.6355	548.7904	570.5289	605.3787	628.4026	(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	
East	2.0300	19.6403	0.6300	0.7000	0.7700	12.1847	(76)
South	1.1900	46.7521	0.6300	0.7000	0.7700	17.0028	(78)
Southwest	7.0300	36.7938	0.6300	0.7000	0.7700	79.0501	(79)
West	11.2900	19.6403	0.6300	0.7000	0.7700	67.7662	(80)
South	6.7500	26.0000	0.6300	0.7000	1.0000	69.6559	(82)

Solar gains	245.6597	463.5686	734.4683	1045.8792	1272.2222	1301.1342	1239.0290	1068.4446	844.2006	541.2551	302.9367	204.3506	(83)
Total gains	887.6827	1120.6995	1364.3190	1653.7247	1849.1221	1854.2231	1770.8634	1601.0800	1392.9910	1111.7840	908.3153	832.7533	(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	53.7027	53.8565	54.0081	54.7319	54.8695	55.5192	55.5192	55.6412	55.2671	54.8695	54.5919	54.3046	
alpha	4.5802	4.5904	4.6005	4.6488	4.6580	4.7013	4.7013	4.7094	4.6845	4.6580	4.6395	4.6203	
util living area													
	0.9955	0.9868	0.9599	0.8710	0.7076	0.5154	0.3776	0.4335	0.6970	0.9371	0.9896	0.9966	(86)
MIT	19.4986	19.7749	20.1697	20.6247	20.8874	20.9797	20.9962	20.9929	20.9230	20.5124	19.9164	19.4605	(87)
Th 2	19.7650	19.7680	19.7710	19.7852	19.7878	19.8002	19.8002	19.8025	19.7954	19.7878	19.7825	19.7769	(88)
util rest of house													
	0.9938	0.9821	0.9460	0.8316	0.6372	0.4245	0.2760	0.3233	0.5999	0.9078	0.9851	0.9954	(89)
MIT 2	18.0509	18.4033	18.8969	19.4395	19.7065	19.7907	19.7993	19.8006	19.7516	19.3329	18.5959	18.0104	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	18.5416	18.8682	19.3283	19.8412	20.1067	20.1937	20.2049	20.2047	20.1486	19.7327	19.0435	18.5019	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5416	18.8682	19.3283	19.8412	20.1067	20.1937	20.2049	20.2047	20.1486	19.7327	19.0435	18.5019	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9914	0.9774	0.9397	0.8337	0.6568	0.4549	0.3106	0.3608	0.6303	0.9062	0.9812	0.9934	(94)
Useful gains	880.0840	1095.3819	1282.1040	1378.6638	1214.4332	843.5045	549.9620	577.6942	877.9383	1007.4610	891.2455	827.2941	(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													
	2252.6043	2203.0497	2017.5835	1698.0277	1301.4185	855.8140	551.5410	580.8261	929.6335	1413.8003	1858.3345	2237.0652	(97)
Space heating kWh													
	1021.1551	744.3527	547.1968	229.9421	64.7171	0.0000	0.0000	0.0000	0.0000	302.3165	696.3041	1048.8696	(98a)
Space heating requirement - total per year (kWh/year)												4654.8540	
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													
	1021.1551	744.3527	547.1968	229.9421	64.7171	0.0000	0.0000	0.0000	0.0000	302.3165	696.3041	1048.8696	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4654.8540	
Space heating per m2											(98c) / (4) =	41.1388	(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													
	1021.1551	744.3527	547.1968	229.9421	64.7171	0.0000	0.0000	0.0000	0.0000	302.3165	696.3041	1048.8696	(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)													
	1106.3436	806.4493	592.8459	249.1246	70.1160	0.0000	0.0000	0.0000	0.0000	327.5368	754.3924	1136.3701	(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													
	249.8615	220.8979	234.7882	207.0287	201.0169	181.5179	179.5674	186.5770	188.4595	209.6542	222.2693	247.2413	(64)
Efficiency of water heater												79.8000	(216)

(217)m	86.8739	86.5657	85.8915	84.2957	81.8196	79.8000	79.8000	79.8000	79.8000	84.8798	86.4410	86.9298	(217)
Fuel for water heating, kWh/month													
	287.6140	255.1795	273.3544	245.5980	245.6832	227.4661	225.0218	233.8058	236.1647	247.0012	257.1340	284.4149	(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	28.9258	23.2054	20.8939	15.3077	11.8241	9.6604	10.7864	14.0205	18.2113	23.8942	26.9884	29.7297	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-39.5248	-56.5304	-82.4103	-93.9919	-102.4456	-95.9602	-94.7177	-88.8475	-78.7202	-65.1806	-43.7161	-34.0728	(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	-19.9509	-42.2186	-84.3913	-127.4695	-169.2756	-170.3986	-168.4547	-142.3526	-103.9310	-60.6877	-26.7335	-15.7631	(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	5043.1788	(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	3018.4377	(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)	233.4478	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2007.7453	(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	6373.3190	(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	5043.1788	0.2100	1059.0675	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3018.4377	0.2100	633.8719	(264)
Space and water heating			1692.9395	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	233.4478	0.1443	33.6937	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-876.1181	0.1343	-117.6631	
PV Unit electricity exported	-1131.6272	0.1257	-142.2693	
Total			-259.9323	(269)
Total CO2, kg/year			1478.6301	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.0700	(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	5043.1788	1.1300	5698.7920	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3018.4377	1.1300	3410.8346	(278)
Space and water heating			9109.6266	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	233.4478	1.5338	358.0701	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-876.1181	1.4963	-1310.9670	
PV Unit electricity exported	-1131.6272	0.4615	-522.2159	
Total			-1833.1829	(283)
Total Primary energy kWh/year			7764.6146	(286)
Target Primary Energy Rate (TPER)			68.6200	(287)

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)	
Ground floor	40.6200 (1b)	x	2.7000 (2b)	=	109.6740	(1b) - (3b)
First floor	72.5300 (1c)	x	2.4000 (2c)	=	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	283.7460	(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) =	0.1410	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2910	(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) =	0.2910	(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	0.3710	0.3637	0.3564	0.3201	0.3128	0.2764	0.2764	0.2691	0.2910	0.3128	0.3273	0.3419	(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	0.5688	0.5661	0.5635	0.5512	0.5489	0.5382	0.5382	0.5362	0.5423	0.5489	0.5536	0.5584	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		270.2525 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9237 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	89.1053 (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	53.2618	53.0116	52.7663	51.6143	51.3988	50.3954	50.3954	50.2096	50.7819	51.3988	51.8348	52.2906	(38)
Heat transfer coeff	142.3670	142.1168	141.8716	140.7196	140.5040	139.5007	139.5007	139.3149	139.8872	140.5040	140.9401	141.3959	(39)
Average = Sum(39)m / 12 =												140.7185	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2582	1.2560	1.2538	1.2437	1.2418	1.2329	1.2329	1.2312	1.2363	1.2418	1.2456	1.2496	(40)
HLP (average)												1.2436	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8325 (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

	30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

	43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)
Average daily hot water use (litres/day)												68.3763	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	74.5986	72.5520	70.3177	67.5369	65.0561	62.4780	61.9426	64.1724	66.4593	69.1068	71.9121	74.4940	(44)

Energy conte	118.1460	103.3131	108.0756	92.4547	87.5781	76.8240	74.9142	79.4588	81.9510	93.7773	102.4520	116.6395	(45)
Energy content (annual)										Total = Sum(45)m =		1135.5843	
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													
	100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(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													
	100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(64)
										Total per year (kWh/year) = Sum(64)m =		965.2467	(64)
12Total per year (kWh/year)												965	(64)
Electric shower(s)													
	57.4286	51.1693	55.8749	53.3208	54.3213	51.8173	53.5445	54.3213	53.3208	55.8749	54.8243	57.4286	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		653.2466	(64a)
Heat gains from water heating, kWh/month													
	39.4632	34.7464	36.9348	32.9768	32.1907	29.2794	29.3054	30.4653	30.7448	33.8964	35.4771	39.1430	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	53.0419	51.7059	49.6436	45.8011	43.2670	40.6659	39.3890	40.9480	42.7011	45.5597	49.2738	52.6116	(72)
Total internal gains													
	533.7486	550.1925	525.9970	511.4301	484.8600	468.6702	450.5747	449.2697	462.8806	476.4638	504.2138	521.1402	(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	
East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141	(76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426	(78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019	(79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921	(80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583	(79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856	(82)

Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579	(83)
Total gains	771.8431	999.4826	1237.8370	1525.0789	1717.8709	1729.6997	1651.4142	1484.7863	1281.0695	1001.0459	797.8209	719.1981	(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	59.6640	59.7690	59.8724	60.3625	60.4551	60.8899	60.8899	60.9711	60.7217	60.4551	60.2681	60.0738	
alpha	4.9776	4.9846	4.9915	5.0242	5.0303	5.0593	5.0593	5.0647	5.0481	5.0303	5.0179	5.0049	
util living area													
	0.9975	0.9909	0.9669	0.8764	0.7037	0.5072	0.3701	0.4281	0.6992	0.9477	0.9934	0.9982	(86)
MIT	19.5947	19.8651	20.2474	20.6791	20.9143	20.9864	20.9977	20.9954	20.9390	20.5507	19.9781	19.5489	(87)
Th 2	19.8737	19.8755	19.8772	19.8852	19.8867	19.8938	19.8938	19.8951	19.8911	19.8867	19.8837	19.8805	(88)
util rest of house													
	0.9966	0.9876	0.9554	0.8396	0.6373	0.4236	0.2779	0.3272	0.6078	0.9231	0.9906	0.9976	(89)
MIT 2	18.6079	18.8775	19.2514	19.6527	19.8381	19.8887	19.8933	19.8941	19.8635	19.5529	18.9976	18.5676	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	18.9424	19.2122	19.5890	20.0005	20.2029	20.2608	20.2676	20.2674	20.2280	19.8911	19.3300	18.9002	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9424	19.2122	19.5890	20.0005	20.2029	20.2608	20.2676	20.2674	20.2280	19.8911	19.3300	18.9002	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9851	0.9517	0.8438	0.6571	0.4518	0.3092	0.3615	0.6372	0.9232	0.9886	0.9968	(94)
Useful gains	768.3754	984.5460	1178.0692	1286.9093	1128.7723	781.4857	510.6983	536.7539	816.3053	924.1413	788.7536	716.8736	(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													
	2084.5893	2034.0107	1856.9561	1562.0646	1194.6874	789.6815	511.6394	538.7807	857.2301	1305.4370	1723.6915	2078.5497	(97)
Space heating kWh													
	979.2632	705.2403	505.0918	198.1118	49.0408	0.0000	0.0000	0.0000	0.0000	283.6840	673.1553	1013.0870	(98a)
Space heating requirement - total per year (kWh/year)												4406.6741	
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													

	979.2632	705.2403	505.0918	198.1118	49.0408	0.0000	0.0000	0.0000	283.6840	673.1553	1013.0870	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)											4406.6741	
Space heating per m2										(98c) / (4) =	38.9454	(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	1311.3066	1032.3052	1058.7932	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9446	0.9731	0.9560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1238.6496	1004.5103	1012.2208	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1876.9734	1792.9696	1614.9887	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	459.5931	586.6137	448.4593	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	114.8983	146.6534	112.1148	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												373.6665	(107)
Energy for space heating												38.9454	(99)
Energy for space cooling												3.3024	(108)
Total												42.2478	(109)
Fabric Energy Efficiency (DFEE)												42.2	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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) =	0.1410	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3910	(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) =	0.3910	(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													
	0.4985	0.4887	0.4789	0.4301	0.4203	0.3714	0.3714	0.3616	0.3910	0.4203	0.4398	0.4594	(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	0.6242	0.6194	0.6147	0.5925	0.5883	0.5690	0.5690	0.5654	0.5764	0.5883	0.5967	0.6055	(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	
TER Opening Type (Uw = 1.20)			21.5400	1.1450	24.6641			(27)
Staircase rooflight			2.7300	2.0221	5.5202			(27a)
Living room rooflight			4.0200	2.0221	8.1287			(27a)
Heatloss Floor 1			72.5300	0.1300	9.4289			(28a)
External Wall 1	165.5600	21.5400	144.0200	0.1800	25.9236			(29a)
External Roof 1	52.7900	2.7300	50.0600	0.1100	5.5066			(30)
0L flat roof	30.2500	4.0200	26.2300	0.1100	2.8853			(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.0574			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							270.2525	(35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total	
E1	Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840	
E3	Sill	7.9500	0.0500	0.3975	
E4	Jamb	31.5000	0.0500	1.5750	
E5	Ground floor (normal)	39.3400	0.1600	6.2944	
E6	Intermediate floor within a dwelling	26.3500	0.0000	0.0000	
E11	Eaves (insulation at rafter level)	9.8400	0.0400	0.3936	
E13	Gable (insulation at rafter level)	6.9400	0.0800	0.5552	
E14	Flat roof	34.3000	0.0800	2.7440	
E16	Corner (normal)	22.2000	0.0900	1.9980	
E24	Eaves (insulation at ceiling level - inverted)	4.9200	0.2400	1.1808	
R1	Head of roof window	6.7400	0.0800	0.5392	
R2	Sill of roof window	6.7400	0.0600	0.4044	
R3	Jamb of roof window	5.6400	0.0800	0.4512	
R5	Ridge (inverted)	11.1000	0.0400	0.4440	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.6613 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 99.7187 (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	58.4519	58.0002	57.5574	55.4775	55.0884	53.2769	53.2769	52.9414	53.9746	55.0884	55.8756	56.6986	(38)
Heat transfer coeff	158.1707	157.7189	157.2761	155.1962	154.8071	152.9956	152.9956	152.6601	153.6933	154.8071	155.5943	156.4173	(39)

Average = Sum(39)m / 12 = 155.1944

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3979	1.3939	1.3900	1.3716	1.3682	1.3521	1.3521	1.3492	1.3583	1.3682	1.3751	1.3824	(40)
HLP (average)												1.3716	
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 2.8325 (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

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 68.3763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	74.5986	72.5520	70.3177	67.5369	65.0561	62.4780	61.9426	64.1724	66.4593	69.1068	71.9121	74.4940	(44)
Energy conte	118.1460	103.3131	108.0756	92.4547	87.5781	76.8240	74.9142	79.4588	81.9510	93.7773	102.4520	116.6395	(45)

Energy content (annual) Total = Sum(45)m = 1135.5843

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

100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(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

100.4241	87.8161	91.8643	78.5865	74.4414	65.3004	63.6771	67.5400	69.6583	79.7107	87.0842	99.1436	(64)

Total per year (kWh/year) = Sum(64)m = 965.2467 (64)

12Total per year (kWh/year) 965 (64)

Electric shower(s)

57.4286	51.1693	55.8749	53.3208	54.3213	51.8173	53.5445	54.3213	53.3208	55.8749	54.8243	57.4286	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 653.2466 (64a)

Heat gains from water heating, kWh/month

39.4632	34.7464	36.9348	32.9768	32.1907	29.2794	29.3054	30.4653	30.7448	33.8964	35.4771	39.1430	(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	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	141.6235	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	139.2135	154.1292	139.2135	143.8539	139.2135	143.8539	139.2135	139.2135	143.8539	139.2135	143.8539	139.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.0063	278.8703	271.6529	256.2880	236.8924	218.6634	206.4853	203.6212	210.8386	226.2036	245.5991	263.8281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	37.1623	(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)	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)	53.0419	51.7059	49.6436	45.8011	43.2670	40.6659	39.3890	40.9480	42.7011	45.5597	49.2738	52.6116	(72)
Total internal gains	533.7486	550.1925	525.9970	511.4301	484.8600	468.6702	450.5747	449.2697	462.8806	476.4638	504.2138	521.1402	(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	
East	2.0300	19.6403	0.6300	0.7000	0.7700	12.1847	(76)
South	1.1900	46.7521	0.6300	0.7000	0.7700	17.0028	(78)
Southwest	7.0300	36.7938	0.6300	0.7000	0.7700	79.0501	(79)

West			11.2900		19.6403		0.6300		0.7000		0.7700	67.7662	(80)
South			6.7500		26.0000		0.6300		0.7000		1.0000	69.6559	(82)
Solar gains	245.6597	463.5686	734.4683	1045.8792	1272.2222	1301.1342	1239.0290	1068.4446	844.2006	541.2551	302.9367	204.3506	(83)
Total gains	779.4083	1013.7611	1260.4653	1557.3092	1757.0822	1769.8044	1689.6037	1517.7143	1307.0812	1017.7188	807.1505	725.4909	(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	53.7027	53.8565	54.0081	54.7319	54.8695	55.5192	55.5192	55.6412	55.2671	54.8695	54.5919	54.3046	
alpha	4.5802	4.5904	4.6005	4.6488	4.6580	4.7013	4.7013	4.7094	4.6845	4.6580	4.6395	4.6203	
util living area	0.9974	0.9911	0.9697	0.8904	0.7328	0.5374	0.3952	0.4560	0.7287	0.9531	0.9935	0.9981	(86)
MIT	19.4078	19.6884	20.0949	20.5786	20.8695	20.9759	20.9954	20.9913	20.9071	20.4506	19.8333	19.3699	(87)
Th 2	19.7650	19.7680	19.7710	19.7852	19.7878	19.8002	19.8002	19.8025	19.7954	19.7878	19.7825	19.7769	(88)
util rest of house	0.9964	0.9878	0.9586	0.8547	0.6630	0.4437	0.2892	0.3408	0.6320	0.9296	0.9906	0.9974	(89)
MIT 2	18.3390	18.6197	19.0194	19.4778	19.7131	19.7913	19.7993	19.8006	19.7531	19.3790	18.7762	18.3101	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	18.7012	18.9819	19.3839	19.8509	20.1050	20.1928	20.2047	20.2042	20.1442	19.7422	19.1345	18.6693	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7012	18.9819	19.3839	19.8509	20.1050	20.1928	20.2047	20.2042	20.1442	19.7422	19.1345	18.6693	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9850	0.9542	0.8569	0.6825	0.4752	0.3253	0.3801	0.6622	0.9285	0.9884	0.9965	(94)
Useful gains	775.6264	998.5177	1202.7930	1334.5031	1199.2100	840.9342	549.5769	576.8404	865.5883	944.9196	797.8126	722.9168	(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	2277.8542	2220.9844	2026.3300	1699.5438	1301.1606	855.6756	551.5033	580.7447	928.9575	1415.2811	1872.4933	2263.2469	(97)
Space heating kWh	1117.6574	821.4976	612.7116	262.8293	75.8513	0.0000	0.0000	0.0000	0.0000	349.9490	773.7701	1146.0056	(98a)
Space heating requirement - total per year (kWh/year)												5160.2718	
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	1117.6574	821.4976	612.7116	262.8293	75.8513	0.0000	0.0000	0.0000	0.0000	349.9490	773.7701	1146.0056	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5160.2718	
Space heating per m2											(98c) / (4) =	45.6056	(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	1438.1585	1132.1673	1160.2169	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9202	0.9577	0.9349	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1323.4521	1084.3273	1084.6835	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1921.0304	1834.9431	1651.2633	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	430.2563	558.4581	421.5354	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	107.5641	139.6145	105.3838	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												352.5625	(107)
Energy for space heating												45.6056	(99)
Energy for space cooling												3.1159	(108)
Total												48.7215	(109)
Fabric Energy Efficiency (TFEE)												48.7	(109)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor		72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	69.6000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3432	0.3395	0.3357	0.3170	0.3132	0.2945	0.2945	0.2907	0.3020	0.3132	0.3207	0.3282	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		270.2525 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9237 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	89.1053 (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	32.1406	31.7895	31.4383	29.6827	29.3315	27.5759	27.5759	27.2247	28.2781	29.3315	30.0338	30.7361	(38)
Heat transfer coeff	121.2459	120.8948	120.5436	118.7879	118.4368	116.6811	116.6811	116.3300	117.3834	118.4368	119.1391	119.8413	(39)
Average = Sum(39)m / 12 =												118.7002	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0716	1.0684	1.0653	1.0498	1.0467	1.0312	1.0312	1.0281	1.0374	1.0467	1.0529	1.0591	(40)
HLP (average)												1.0491	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8325 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day)	134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	
Distribution loss (46)m = 0.15 x (45)m													
	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:

Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.7800	(53)
Enter (49) or (54) in (55)												1.5194	(55)
Total storage loss													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)
If cylinder contains dedicated solar storage													
	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
									Total per year (kWh/year) = Sum(64)m =			3310.0117	(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													
	120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(65)

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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains													
	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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	
East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141	(76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426	(78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019	(79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921	(80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583	(79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856	(82)

Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579	(83)
Total gains	957.8149	1167.1751	1408.7053	1670.9047	1850.1627	1804.8202	1722.8726	1560.3783	1363.2203	1142.9297	955.9628	899.0144	(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	70.0575	70.2610	70.4657	71.5071	71.7191	72.7983	72.7983	73.0180	72.3628	71.7191	71.2964	70.8786	
alpha	5.6705	5.6841	5.6977	5.7671	5.7813	5.8532	5.8532	5.8679	5.8242	5.7813	5.7531	5.7252	
util living area													
	0.9924	0.9774	0.9257	0.7813	0.5830	0.4124	0.2978	0.3425	0.5822	0.8825	0.9816	0.9945	(86)
MIT	20.0305	20.2725	20.5990	20.8805	20.9792	20.9977	20.9997	20.9994	20.9852	20.7977	20.3503	19.9877	(87)
Th 2	20.0241	20.0267	20.0292	20.0420	20.0446	20.0574	20.0574	20.0600	20.0523	20.0446	20.0395	20.0343	(88)
util rest of house													
	0.9899	0.9703	0.9054	0.7380	0.5274	0.3523	0.2341	0.2728	0.5074	0.8432	0.9747	0.9926	(89)
MIT 2	19.1592	19.3981	19.7081	19.9601	20.0333	20.0566	20.0574	20.0598	20.0459	19.9042	19.4873	19.1252	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9674	0.9049	0.7489	0.5457	0.3727	0.2557	0.2964	0.5325	0.8506	0.9723	0.9911	(94)
Useful gains	946.2620	1129.1439	1274.7655	1251.3402	1009.6271	672.5740	440.5633	462.5338	725.8816	972.2007	929.5224	891.0004	(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													
	1837.4214	1788.5708	1628.5515	1350.8611	1024.9410	673.8980	440.6755	462.7940	735.3195	1137.8286	1510.6583	1823.6888	(97)
Space heating kWh													
	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98a)
Space heating requirement - total per year (kWh/year)												2687.9880	
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													

	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)											2687.9880	
Space heating per m2										(98c) / (4) =	23.7560	(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 %)											219.3000	(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													
	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98)
Space heating efficiency (main heating system 1)													
	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)													
	302.3359	202.0679	120.0259	32.6744	5.1954	0.0000	0.0000	0.0000	0.0000	56.1911	190.7970	316.4251	(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													
	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month													
	175.2506	155.4546	166.0616	147.8754	144.6842	115.7442	114.3892	118.6965	119.7546	149.7587	157.2263	173.5556	(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	28.2982	25.5597	28.2982	27.3854	28.2982	27.3854	28.2982	28.2982	27.3854	28.2982	27.3854	28.2982	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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	1225.7127	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1738.4515	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)		
mechanical ventilation fans (SFP = 0.9625)	333.1887	(230a)
Total electricity for the above, kWh/year	333.1887	(231)
Electricity for lighting (calculated in Appendix L)	217.2245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3514.5775	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1225.7127	16.4900	202.1200	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1738.4515	16.4900	286.6707	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	333.1887	16.4900	54.9428	(249)
Energy for lighting	217.2245	16.4900	35.8203	(250)
Additional standing charges			0.0000	(251)
Total energy cost			579.5538	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.3192	(257)
SAP value		78.6150	
SAP rating (Section 12)		79	(258)
SAP band		C	

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	1225.7127	0.1578	193.3634	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1738.4515	0.1415	245.9790	(264)
Space and water heating			439.3424	(265)
Pumps, fans and electric keep-hot	333.1887	0.1387	46.2174	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Total CO2, kg/year			516.9120	(272)
CO2 emissions per m2			4.5700	(273)
EI value			95.6202	
EI rating			96	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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		3.0000	(17)
Infiltration rate		0.1500	(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) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1575	0.1500	0.1500	0.1388	0.1388	0.1237	0.1275	0.1200	0.1237	0.1313	0.1313	0.1425	(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) =	69.6000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3095	0.3020	0.3020	0.2907	0.2907	0.2757	0.2795	0.2720	0.2757	0.2833	0.2833	0.2945	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	30579.0700	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	270.2525	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000

E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936	
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552	
E14 Flat roof	34.3000	0.0800	2.7440	
E16 Corner (normal)	22.2000	0.0900	1.9980	
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904	
R1 Head of roof window	6.7400	0.0800	0.5392	
R2 Sill of roof window	6.7400	0.0600	0.4044	
R3 Jamb of roof window	5.6400	0.0800	0.4512	
R5 Ridge (inverted)	11.1000	0.0400	0.4440	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.9237 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 89.1053 (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	28.9804	28.2781	28.2781	27.2247	27.2247	25.8202	26.1713	25.4690	25.8202	26.5224	26.5224	27.5759	(38)
Heat transfer coeff	118.0857	117.3834	117.3834	116.3300	116.3300	114.9254	115.2766	114.5743	114.9254	115.6277	115.6277	116.6811	(39)

Average = Sum(39)m / 12 = 116.0959

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0436	1.0374	1.0374	1.0281	1.0281	1.0157	1.0188	1.0126	1.0157	1.0219	1.0219	1.0312	(40)
HLP (average)												1.0260	
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 2.8325 (42)

Hot water usage for mixer showers

71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day) 134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	
Distribution loss (46)m = 0.15 x (45)m	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:

Store volume 200.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.8434 (52)
Temperature factor from Table 2b 0.7800 (53)
Enter (49) or (54) in (55) 1.5194 (55)

Total storage loss

47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)

If cylinder contains dedicated solar storage

47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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

333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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 333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
									Total per year (kWh/year) = Sum(64)m =		3310.0117	(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

120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(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)	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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	
East	2.4800	22.3313	0.5000	0.7000	0.7700	13.4328	(76)
South	1.4500	50.9848	0.5000	0.7000	0.7700	17.9312	(78)
Southwest	6.3200	40.4699	0.5000	0.7000	0.7700	62.0370	(79)
West	13.7900	22.3313	0.5000	0.7000	0.7700	74.6930	(80)
Southwest	2.2700	40.4699	0.5000	0.7000	0.7700	22.2823	(79)

South				8.2400	30.0000	0.5000	0.7000	1.0000				77.8680	(82)
Solar gains	268.2443	455.9839	714.1950	1048.0340	1241.6062	1358.6897	1279.9449	1129.0211	889.8661	568.6690	339.0040	220.8992	(83)
Total gains	987.9647	1173.8689	1411.0603	1705.2899	1858.7580	1902.4804	1801.9781	1653.8828	1434.8975	1187.0166	1001.3597	921.8557	(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	71.9324	72.3628	72.3628	73.0180	73.0180	73.9104	73.6853	74.1369	73.9104	73.4615	73.4615	72.7983	
alpha	5.7955	5.8242	5.8242	5.8679	5.8679	5.9274	5.9124	5.9425	5.9274	5.8974	5.8974	5.8532	
util living area	0.9884	0.9701	0.9006	0.7150	0.4963	0.3019	0.1983	0.2217	0.4619	0.8148	0.9676	0.9915	(86)
MIT	20.1828	20.3927	20.7044	20.9346	20.9926	20.9997	21.0000	21.0000	20.9965	20.8910	20.5137	20.1446	(87)
Th 2	20.0471	20.0523	20.0523	20.0600	20.0600	20.0703	20.0677	20.0729	20.0703	20.0651	20.0651	20.0574	(88)
util rest of house	0.9845	0.9607	0.8744	0.6662	0.4398	0.2458	0.1387	0.1575	0.3892	0.7615	0.9556	0.9886	(89)
MIT 2	19.3285	19.5360	19.8241	20.0182	20.0565	20.0702	20.0677	20.0729	20.0691	19.9970	19.6662	19.2995	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9581	0.8765	0.6806	0.4588	0.2648	0.1589	0.1792	0.4138	0.7759	0.9538	0.9867	(94)
Useful gains	970.3868	1124.6694	1236.8327	1160.6348	852.8268	503.8340	286.3054	296.4040	593.8028	921.0204	955.1147	909.6068	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1714.3741	1669.9369	1493.4028	1213.1829	857.7935	503.9750	286.3099	296.4129	595.7086	1005.9622	1382.1492	1690.2368	(97)
Space heating kWh	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98a)
Space heating requirement - total per year (kWh/year)												2103.8144	
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	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2103.8144	
Space heating per m2										(98c) / (4) =		18.5931	(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 %)												219.3000	(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	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	252.4061	167.0861	87.0443	17.2524	1.6850	0.0000	0.0000	0.0000	0.0000	28.8175	140.2028	264.8375	(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	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	175.2506	155.4546	166.0616	147.8754	144.6842	115.7442	114.3892	118.6965	119.7546	149.7587	157.2263	173.5556	(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	28.2982	25.5597	28.2982	27.3854	28.2982	27.3854	28.2982	28.2982	27.3854	28.2982	27.3854	28.2982	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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												959.3317	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1738.4515	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)

mechanical ventilation fans (SFP = 0.9625)	333.1887	(230a)
Total electricity for the above, kWh/year	333.1887	(231)
Electricity for lighting (calculated in Appendix L)	217.2245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3248.1965	(238)

10a. Fuel costs - using BEDF prices (554)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	959.3317	26.0600	250.0018	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1738.4515	26.0600	453.0405	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	333.1887	26.0600	86.8290	(249)
Energy for lighting	217.2245	26.0600	56.6087	(250)
Additional standing charges			0.0000	(251)
Total energy cost			846.4800	(255)

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	959.3317	0.1586	152.1416	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1738.4515	0.1415	245.9790	(264)
Space and water heating			398.1206	(265)
Pumps, fans and electric keep-hot	333.1887	0.1387	46.2174	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Total CO2, kg/year			475.6902	(272)

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	959.3317	1.5870	1522.4868	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1738.4515	1.5232	2648.0676	(278)
Space and water heating			4170.5544	(279)
Pumps, fans and electric keep-hot	333.1887	1.5128	504.0479	(281)
Energy for lighting	217.2245	1.5338	333.1863	(282)
Total Primary energy kWh/year			5007.7886	(286)

SAP 10 EPC IMPROVEMENTS

Be Green

Current energy efficiency rating: C 79
Current environmental impact rating: A 96

N Solar water heating	Recommended
U Solar photovoltaic panels	Recommended
V2 Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.6	-£ 77	-36 kg (7.7%)
U Solar photovoltaic panels	+ 5.6	-£ 247	-127 kg (29.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	0.32 kg/m²	C 80	A 96
Solar photovoltaic panels	£247	1.12 kg/m²	B 86	A 97
Total Savings	£324	1.45 kg/m²		

Potential energy efficiency rating: B 86
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 554 TEST (31 Oct 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£846	£770	£77
Space heating	£337	£358	-£21
Water heating	£453	£356	£97
Lighting	£57	£57	£0
Generated (PV)	-£0	-£247	£247
Total cost of fuels	£846	£523	£324
Total cost of uses	£847	£524	£323
Delivered energy	29 kWh/m²	18 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes

CO2 emissions per m²	4 kg/m²	3 kg/m²	1 kg/m²
Primary energy	44 kWh/m²	28 kWh/m²	16 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200	(1b)	x 2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c)	x 2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =		69.6000 (23c)

Effective ac	0.3432	0.3395	0.3357	0.3170	0.3132	0.2945	0.2945	0.2907	0.3020	0.3132	0.3207	0.3282	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		270.2525 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9237 (36)
Point Thermal bridges	(36a) =	0.0000

Total fabric heat loss (33) + (36) + (36a) = 89.1053 (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	32.1406	31.7895	31.4383	29.6827	29.3315	27.5759	27.5759	27.2247	28.2781	29.3315	30.0338	30.7361	(38)
Heat transfer coeff	121.2459	120.8948	120.5436	118.7879	118.4368	116.6811	116.6811	116.3300	117.3834	118.4368	119.1391	119.8413	(39)
Average = Sum(39)m / 12 =												118.7002	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0716	1.0684	1.0653	1.0498	1.0467	1.0312	1.0312	1.0281	1.0374	1.0467	1.0529	1.0591	(40)
HLP (average)												1.0491	
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 2.8325 (42)

Hot water usage for mixer showers	71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)
Hot water usage for baths	30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)
Hot water usage for other uses	43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)
Average daily hot water use (litres/day)												134.4915	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)										Total = Sum(45)m =		2233.8751	
Distribution loss (46)m = 0.15 x (45)m	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.7800	(53)
Enter (49) or (54) in (55)												1.5194	(55)
Total storage loss	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(56)
If cylinder contains dedicated solar storage	47.1009	42.5427	47.1009	45.5815	47.1009	45.5815	47.1009	47.1009	45.5815	47.1009	45.5815	47.1009	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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	333.6772	295.9855	316.1813	281.5547	275.4787	220.3769	217.7971	225.9981	228.0128	285.1405	299.3588	330.4499	(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)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												650.7992	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												650.7992	
Solar input	-0.0000	-16.1689	-59.7979	-83.9618	-112.5900	-101.6058	-101.2024	-87.4332	-59.1275	-28.9117	-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	333.6772	279.8166	256.3834	197.5930	162.8887	118.7711	116.5947	138.5649	168.8853	256.2288	299.3588	330.4499	(64)
									Total per year (kWh/year) = Sum(64)m =			2659.2126	(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	120.9325	107.4338	115.1152	103.2797	101.5816	68.6438	67.6317	70.3585	71.1828	104.7941	109.1996	119.8595	(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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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

East	2.4800	19.6403	0.5000	0.7000	0.7700	11.8141 (76)
South	1.4500	46.7521	0.5000	0.7000	0.7700	16.4426 (78)
Southwest	6.3200	36.7938	0.5000	0.7000	0.7700	56.4019 (79)
West	13.7900	19.6403	0.5000	0.7000	0.7700	65.6921 (80)
Southwest	2.2700	36.7938	0.5000	0.7000	0.7700	20.2583 (79)
South	8.2400	26.0000	0.5000	0.7000	1.0000	67.4856 (82)

Solar gains	238.0944	449.2901	711.8400	1013.6488	1233.0109	1261.0295	1200.8395	1035.5166	818.1889	524.5821	293.6071	198.0579 (83)
Total gains	957.8149	1167.1751	1408.7053	1670.9047	1850.1627	1804.8202	1722.8726	1560.3783	1363.2203	1142.9297	955.9628	899.0144 (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	70.0575	70.2610	70.4657	71.5071	71.7191	72.7983	72.7983	73.0180	72.3628	71.7191	71.2964	70.8786	
alpha	5.6705	5.6841	5.6977	5.7671	5.7813	5.8532	5.8532	5.8679	5.8242	5.7813	5.7531	5.7252	
util living area	0.9924	0.9774	0.9257	0.7813	0.5830	0.4124	0.2978	0.3425	0.5822	0.8825	0.9816	0.9945	(86)
MIT	20.0305	20.2725	20.5990	20.8805	20.9792	20.9977	20.9997	20.9994	20.9852	20.7977	20.3503	19.9877	(87)
Th 2	20.0241	20.0267	20.0292	20.0420	20.0446	20.0574	20.0574	20.0600	20.0523	20.0446	20.0395	20.0343	(88)
util rest of house	0.9899	0.9703	0.9054	0.7380	0.5274	0.3523	0.2341	0.2728	0.5074	0.8432	0.9747	0.9926	(89)
MIT 2	19.1592	19.3981	19.7081	19.9601	20.0333	20.0566	20.0574	20.0598	20.0459	19.9042	19.4873	19.1252	(90)
Living area fraction										fLA = Living area / (4) =		0.3389	(91)
MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4545	19.6944	20.0101	20.2720	20.3539	20.3756	20.3768	20.3783	20.3643	20.2071	19.7798	19.4175	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9674	0.9049	0.7489	0.5457	0.3727	0.2557	0.2964	0.5325	0.8506	0.9723	0.9911	(94)
Useful gains	946.2620	1129.1439	1274.7655	1251.3402	1009.6271	672.5740	440.5633	462.5338	725.8816	972.2007	929.5224	891.0004	(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	1837.4214	1788.5708	1628.5515	1350.8611	1024.9410	673.8980	440.6755	462.7940	735.3195	1137.8286	1510.6583	1823.6888	(97)
Space heating kWh	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98a)
Space heating requirement - total per year (kWh/year)												2687.9880	
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	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2687.9880	
Space heating per m2											(98c) / (4) =	23.7560	(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 %)	219.3000 (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	663.0226	443.1349	263.2168	71.6550	11.3935	0.0000	0.0000	0.0000	0.0000	123.2272	418.4178	693.9202	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	302.3359	202.0679	120.0259	32.6744	5.1954	0.0000	0.0000	0.0000	0.0000	56.1911	190.7970	316.4251	(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	333.6772	279.8166	256.3834	197.5930	162.8887	118.7711	116.5947	138.5649	168.8853	256.2288	299.3588	330.4499	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	175.2506	146.9625	134.6552	103.7778	85.5508	62.3798	61.2367	72.7757	88.7003	134.5740	157.2263	173.5556	(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	35.0927	31.6967	35.0927	33.9607	35.0927	33.9607	35.0927	35.0927	33.9607	35.0927	33.9607	35.0927	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-39.4147	-59.0709	-88.0288	-100.3471	-109.5480	-101.8258	-100.5607	-93.9526	-81.7465	-67.5445	-44.2932	-33.6766	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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												1225.7127	(211)
Space heating fuel - main system 2												0.0000	(213)

Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1396.6453	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)		
mechanical ventilation fans (SFP = 0.9625)	333.1887	(230a)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	413.1887	(231)
Electricity for lighting (calculated in Appendix L)	217.2245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-920.0096	(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	2332.7617	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1225.7127	16.4900	202.1200	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1396.6453	16.4900	230.3068	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	333.1887	16.4900	54.9428	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	217.2245	16.4900	35.8203	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-920.0096	16.4900	-151.7096	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-151.7096	(252)
Total energy cost			384.6724	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.8756	(257)
SAP value	85.8059	
SAP rating (Section 12)	86	(258)
SAP band	B	

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	1225.7127	0.1578	193.3634	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1396.6453	0.1449	202.4030	(264)
Space and water heating			395.7664	(265)
Pumps, fans and electric keep-hot	413.1887	0.1387	57.3144	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-920.0096	0.1341	-123.3951	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-123.3951	(269)
Total CO2, kg/year			361.0380	(272)
CO2 emissions per m2			3.1900	(273)
EI value			96.9409	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.6200	(1b) x	2.7000	(2b) =	109.6740	(1b) - (3b)
First floor	72.5300	(1c) x	2.4000	(2c) =	174.0720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.1500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		283.7460	(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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1500 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1575	0.1500	0.1500	0.1388	0.1388	0.1237	0.1275	0.1200	0.1237	0.1313	0.1313	0.1425	(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) =	69.6000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3095	0.3020	0.3020	0.2907	0.2907	0.2757	0.2795	0.2720	0.2757	0.2833	0.2833	0.2945	(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	
Glazing (Uw = 1.20)			24.0400	1.1450	27.5267			(27)
Glazed door (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
Staircase rooflight			3.3300	1.1450	3.8130			(27a)
Living room rooflight			4.9100	1.1450	5.6221			(27a)
Heatloss Floor 1			72.5300	0.1000	7.2530	110.0000	7978.3000	(28a)
External Wall 1	165.5600	26.3100	139.2500	0.1500	20.8875	60.0000	8355.0000	(29a)
External Roof 1	52.7900	3.3300	49.4600	0.1000	4.9460	0.0000	0.0000	(30)
0L flat roof	30.2500	4.9100	25.3400	0.1000	2.5340	9.0000	228.0600	(30)
Total net area of external elements Aum(A, m2)			321.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.1816			(33)
Internal Wall 1			167.4100			75.0000	12555.7500	(32c)
Internal Floor 1			40.6100			18.0000	730.9800	(32d)
Internal Ceiling 1			81.2200			9.0000	730.9800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 30579.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	270.2525 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	13.6800	0.0500	0.6840
E3 Sill	7.9500	0.0500	0.3975
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	39.3400	0.0800	3.1472
E6 Intermediate floor within a dwelling	26.3500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	9.8400	0.0400	0.3936
E13 Gable (insulation at rafter level)	6.9400	0.0800	0.5552
E14 Flat roof	34.3000	0.0800	2.7440
E16 Corner (normal)	22.2000	0.0900	1.9980
E24 Eaves (insulation at ceiling level - inverted)	4.9200	0.1200	0.5904
R1 Head of roof window	6.7400	0.0800	0.5392
R2 Sill of roof window	6.7400	0.0600	0.4044
R3 Jamb of roof window	5.6400	0.0800	0.4512
R5 Ridge (inverted)	11.1000	0.0400	0.4440

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.9237 (36)
Point Thermal bridges	(36a) = 0.0000
Total fabric heat loss	(33) + (36) + (36a) = 89.1053 (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	28.9804	28.2781	28.2781	27.2247	27.2247	25.8202	26.1713	25.4690	25.8202	26.5224	26.5224	27.5759	(38)
Heat transfer coeff	118.0857	117.3834	117.3834	116.3300	116.3300	114.9254	115.2766	114.5743	114.9254	115.6277	115.6277	116.6811	(39)
Average = Sum(39)m / 12 =												116.0959	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0436	1.0374	1.0374	1.0281	1.0281	1.0157	1.0188	1.0126	1.0157	1.0219	1.0219	1.0312	(40)
HLP (average)												1.0260	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8325 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.7110	70.6333	69.0629	66.0583	63.8409	61.3682	59.9626	61.5211	63.2295	65.8846	68.9537	71.4363	(42a)

Hot water usage for baths

30.9613	30.5015	29.8540	28.6601	27.7661	26.7748	26.2393	26.8823	27.5824	28.6431	29.8616	30.8566	(42b)

Hot water usage for other uses

43.6373	42.0505	40.4637	38.8769	37.2901	35.7033	35.7033	37.2901	38.8769	40.4637	42.0505	43.6373	(42c)

Average daily hot water use (litres/day)	134.4915 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.3096	143.1853	139.3806	133.5952	128.8971	123.8462	121.9052	125.6935	129.6889	134.9914	140.8659	145.9302	(44)
Energy conte	231.7187	203.8940	214.2228	182.8852	173.5202	152.2834	147.4338	155.6348	159.9193	183.1820	200.6893	228.4915	(45)
Energy content (annual)											Total = Sum(45)m =	2233.8751	
Distribution loss (46)m = 0.15 x (45)m													
	34.7578	30.5841	32.1334	27.4328	26.0280	22.8425	22.1151	23.3452	23.9879	27.4773	30.1034	34.2737	(46)

Water storage loss:
Store volume 200.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.8434 (52)
Temperature factor from Table 2b 0.7800 (53)
Enter (49) or (54) in (55) 1.5194 (55)
Total storage loss
47.1009 42.5427 47.1009 45.5815 47.1009 45.5815 47.1009 47.1009 45.5815 47.1009 45.5815 47.1009 (56)
If cylinder contains dedicated solar storage
47.1009 42.5427 47.1009 45.5815 47.1009 45.5815 47.1009 47.1009 45.5815 47.1009 45.5815 47.1009 (57)
Primary loss 54.8576 49.5488 54.8576 53.0880 54.8576 22.5120 23.2624 23.2624 22.5120 54.8576 53.0880 54.8576 (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
333.6772 295.9855 316.1813 281.5547 275.4787 220.3769 217.7971 225.9981 228.0128 285.1405 299.3588 330.4499 (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)
Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.8000 (H2)
Collector linear heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0000 (H4)
Collector loop efficiency 0.9000 (H5)
Incidence angle modifier 1.0000 (H6)
Overshading factor 0.8000 (H8)
Overall heat loss coefficient of system 6.5000 (H10)
Heat loss coefficient of collector loop 3.9667 (H11)
Dedicated solar storage volume 75.0000 (H12)
Effective solar volume 75.0000 (H14)
Reference volume 225.0000 (H15)
Storage tank correction coefficient 1.3161 (H16)
Heat delivered to hot water 711.7156 (H24)
Heat delivered to space heating 0.0000 (H29)
Solar input 711.7156
Solar input -0.0000 -17.5830 -60.8698 -88.7115 -114.8179 -112.1631 -110.3133 -98.8962 -68.2647 -36.1649 -3.9311 -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
333.6772 278.4026 255.3115 192.8432 160.6608 108.2137 107.4838 127.1019 159.7481 248.9756 295.4277 330.4499 (64)
Total per year (kWh/year) = Sum(64)m = 2598.2961 (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
120.9325 107.4338 115.1152 103.2797 101.5816 68.6438 67.6317 70.3585 71.1828 104.7941 109.1996 119.8595 (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	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	169.9482	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.7504	27.3122	22.2118	16.8158	12.5700	10.6121	11.4667	14.9049	20.0053	25.4014	29.6472	31.6050	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	411.9496	416.2244	405.4522	382.5194	353.5708	326.3633	308.1870	303.9122	314.6844	337.6172	366.5658	393.7733	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	54.8273	(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)													
	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	-113.2988	(71)
Water heating gains (Table 5)													
	162.5437	159.8717	154.7247	143.4441	136.5344	95.3386	90.9028	94.5679	98.8650	140.8523	151.6661	161.1015	(72)
Total internal gains													
	719.7204	717.8850	696.8653	657.2559	617.1518	543.7907	522.0332	524.8617	545.0314	618.3476	662.3557	700.9565	(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	
East	2.4800	22.3313	0.5000	0.7000	0.7700	13.4328	(76)
South	1.4500	50.9848	0.5000	0.7000	0.7700	17.9312	(78)
Southwest	6.3200	40.4699	0.5000	0.7000	0.7700	62.0370	(79)
West	13.7900	22.3313	0.5000	0.7000	0.7700	74.6930	(80)
Southwest	2.2700	40.4699	0.5000	0.7000	0.7700	22.2823	(79)
South	8.2400	30.0000	0.5000	0.7000	1.0000	77.8680	(82)

Solar gains	268.2443	455.9839	714.1950	1048.0340	1241.6062	1358.6897	1279.9449	1129.0211	889.8661	568.6690	339.0040	220.8992	(83)
Total gains	987.9647	1173.8689	1411.0603	1705.2899	1858.7580	1902.4804	1801.9781	1653.8828	1434.8975	1187.0166	1001.3597	921.8557	(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	71.9324	72.3628	72.3628	73.0180	73.0180	73.9104	73.6853	74.1369	73.9104	73.4615	73.4615	72.7983	
alpha	5.7955	5.8242	5.8242	5.8679	5.8679	5.9274	5.9124	5.9425	5.9274	5.8974	5.8974	5.8532	
util living area													
	0.9884	0.9701	0.9006	0.7150	0.4963	0.3019	0.1983	0.2217	0.4619	0.8148	0.9676	0.9915	(86)
MIT	20.1828	20.3927	20.7044	20.9346	20.9926	20.9997	21.0000	21.0000	20.9965	20.8910	20.5137	20.1446	(87)
Th 2	20.0471	20.0523	20.0523	20.0600	20.0600	20.0703	20.0677	20.0729	20.0703	20.0651	20.0651	20.0574	(88)
util rest of house													
	0.9845	0.9607	0.8744	0.6662	0.4398	0.2458	0.1387	0.1575	0.3892	0.7615	0.9556	0.9886	(89)
MIT 2	19.3285	19.5360	19.8241	20.0182	20.0565	20.0702	20.0677	20.0729	20.0691	19.9970	19.6662	19.2995	(90)
Living area fraction									fLA = Living area / (4) =			0.3389	(91)
MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6181	19.8263	20.1224	20.3288	20.3738	20.3852	20.3837	20.3871	20.3834	20.3000	19.9534	19.5859	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9581	0.8765	0.6806	0.4588	0.2648	0.1589	0.1792	0.4138	0.7759	0.9538	0.9867	(94)
Useful gains	970.3868	1124.6694	1236.8327	1160.6348	852.8268	503.8340	286.3054	296.4040	593.8028	921.0204	955.1147	909.6068	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1714.3741	1669.9369	1493.4028	1213.1829	857.7935	503.9750	286.3099	296.4129	595.7086	1005.9622	1382.1492	1690.2368	(97)
Space heating kWh	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98a)
Space heating requirement - total per year (kWh/year)												2103.8144	
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	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2103.8144	
Space heating per m2											(98c) / (4) =	18.5931	(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 %)												219.3000	(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	553.5265	366.4197	190.8881	37.8346	3.6952	0.0000	0.0000	0.0000	0.0000	63.1967	307.4648	580.7887	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	252.4061	167.0861	87.0443	17.2524	1.6850	0.0000	0.0000	0.0000	0.0000	28.8175	140.2028	264.8375	(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	333.6772	278.4026	255.3115	192.8432	160.6608	108.2137	107.4838	127.1019	159.7481	248.9756	295.4277	330.4499	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	175.2506	146.2198	134.0922	101.2832	84.3807	56.8349	56.4516	66.7552	83.9013	130.7645	155.1616	173.5556	(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	35.0927	31.6967	35.0927	33.9607	35.0927	33.9607	35.0927	35.0927	33.9607	35.0927	33.9607	35.0927	(231)
Lighting	26.9156	21.5927	19.4418	14.2439	11.0024	8.9891	10.0368	13.0462	16.9457	22.2337	25.1129	27.6637	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.2119	-58.9784	-86.7333	-101.0302	-109.3214	-105.3840	-103.5269	-98.1304	-85.7788	-70.4516	-49.1503	-36.6598	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
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												959.3317	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1364.6513	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9625)													
mechanical ventilation fans (SFP = 0.9625)												333.1887	(230a)
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												413.1887	(231)
Electricity for lighting (calculated in Appendix L)												217.2245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-948.3570	(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												2006.0394	(238)

10a. Fuel costs - using BEDF prices (554)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	959.3317	26.0600	250.0018	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1364.6513	26.0600	355.6281	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	333.1887	26.0600	86.8290	(249)
Pump for solar water heating	80.0000	26.0600	20.8480	(249)
Energy for lighting	217.2245	26.0600	56.6087	(250)

Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-948.3570	26.0600	-247.1418	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-247.1418	(252)
Total energy cost			522.7739	(255)

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

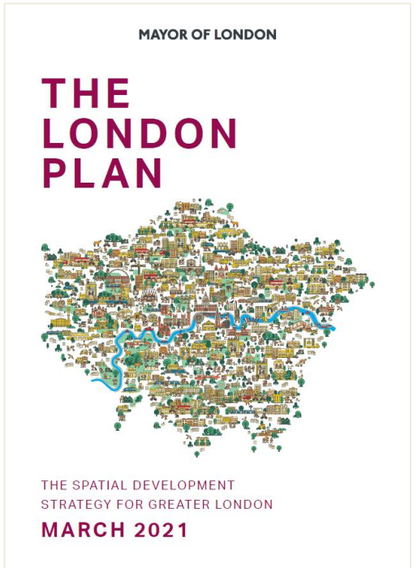
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	959.3317	0.1586	152.1416	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1364.6513	0.1454	198.4007	(264)
Space and water heating			350.5423	(265)
Pumps, fans and electric keep-hot	413.1887	0.1387	57.3144	(267)
Energy for lighting	217.2245	0.1443	31.3522	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-948.3570	0.1341	-127.1999	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-127.1999	(269)
Total CO2, kg/year			312.0090	(272)

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	959.3317	1.5870	1522.4868	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1364.6513	1.5378	2098.5625	(278)
Space and water heating			3621.0493	(279)
Pumps, fans and electric keep-hot	413.1887	1.5128	625.0719	(281)
Energy for lighting	217.2245	1.5338	333.1863	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-948.3570	1.4957	-1418.4336	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1418.4336	(283)
Total Primary energy kWh/year			3160.8738	(286)

Appendix C – GLA policies

London Plan (March 2021)



The London Plan is part of the statutory development plan for London and sets out a framework for how for how the city will develop sustainably over the next 20-25 years.

The energy and sustainability policies within the London Plan relevant to the proposed development at 50 Station Road are summarised below.

Policy GG2 Making the best use of land

- enable the development of brownfield land, particularly in Opportunity Areas, on surplus public sector land, and sites within and on the edge of town centres, as well as utilising small sites.
- proactively explore the potential to intensify the use of land, promoting higher density development.
- protect and enhance London's open spaces, and promote the creation of new green infrastructure and urban greening, including aiming to secure net biodiversity gains where possible.
- plan for good local walking, cycling and public transport connections.

Policy GG3 Creating a healthy city

- promote more active and healthy lives for all Londoners and enable them to make healthy choices, utilise the Healthy Streets Approach
- seek to improve London's air quality and green spaces.
- ensure that new buildings are well-insulated and sufficiently ventilated to avoid the health problems associated with damp, heat and cold.
- seek to create a healthy food environment.

Policy GG4 Delivering the homes Londoners need

- ensure that more homes are delivered.
- create mixed and inclusive communities, with good quality homes that meet high standards of design.

Policy GG5 Growing a good economy

- promote the strength and potential of the wider city region to ensure that London's economy diversifies and that the benefits of economic success are shared more equitably across London.

Policy GG6 Increasing efficiency and resilience

- seek to improve energy efficiency and support the move towards a low carbon circular economy, contributing towards London becoming a zero carbon city by 2050.
- ensure buildings and infrastructure are designed to adapt to a changing climate.

Policy D2 Infrastructure requirements for sustainable densities

- density of development proposals should consider, and be linked to, the provision of future planned levels of infrastructure rather than existing levels.
- density of development should be proportionate to the site's connectivity and accessibility by walking, cycling, and public transport to jobs and services.

Policy D7 Accessible Housing

- at least 10 per cent of dwellings (which are created via works to which Part M volume 1 of the Building Regulations applies) meet Building Regulation requirement M4(3) 'wheelchair user dwellings'
- all other dwellings (which are created via works to which Part M volume 1 of the Building Regulations applies) meet Building Regulation requirement M4(2) 'accessible and adaptable dwellings'.

Policy D8 Public realm

- ensure the public realm is well-designed, safe, accessible, inclusive, attractive, well-connected, related to the local and historic context, and easy to understand, service and maintain.
- landscape treatment, planting, street furniture and surface materials should be of good quality, fit-for-purpose, durable and sustainable.
- lighting, including for advertisements, should be carefully considered and well-designed in order to minimise intrusive lighting infrastructure and reduce light pollution.
- encourage active travel and ensure its design discourages travel by car and excessive on-street parking, which can obstruct people's safe enjoyment of the space.
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Policy D11 Safety, security, and resilience to emergency

- maximise building resilience and minimise potential physical risks, including those arising as a result of extreme weather, fire, flood and related hazards.
- Include measures to design out crime.

Policy D14 Noise

- avoiding significant adverse noise impacts on health and quality of life.
- mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses.
- improving and enhancing the acoustic environment and promoting appropriate soundscapes.

Policy H2 Small sites

- Boroughs should pro-actively support well-designed new homes on small sites (below 0.25 hectares in size) through both planning decisions and plan-making.

Policy G1 Green infrastructure

- incorporate appropriate elements of green infrastructure that are integrated into London's wider green infrastructure network.

Policy G5 Urban greening

- contribute to the greening of London by including urban greening as a fundamental element of site and building design, and by incorporating measures such as high-quality landscaping (including trees), green roofs, green walls and nature-based sustainable drainage.

Policy G6 Biodiversity and access to nature

- manage impacts on biodiversity and aim to secure net biodiversity gain.

Policy G7 Trees and woodlands

- ensure that, wherever possible, existing trees of value are retained.

Policy SI1 Improving air quality

- demonstrate how developments plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.
- ensure that 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. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.

Policy SI2 Minimising greenhouse gas emissions

- Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
    1. be lean: use less energy and manage demand during operation
    2. be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
    3. be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
    4. be seen: monitor, verify and report on energy performance.
- Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.
- A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
    - through a cash in lieu contribution to the borough's carbon offset fund, or
    - off-site provided that an alternative proposal is identified and delivery is certain.
- Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

Policy SI3 Energy infrastructure

- Identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure. Identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

Policy SI4 Managing heat risk

- minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.
- 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.

Policy SI5 Water infrastructure

- to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.
- 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).
- seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided.

Policy SI7 Reducing waste and supporting the circular economy

- promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible
- encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products.
- design developments with adequate, flexible, and easily accessible storage space and collection systems that support, as a minimum, the separate collection of dry recyclables (at least card, paper, mixed plastics, metals, glass) and food.

Policy SI12 Flood risk management

- ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

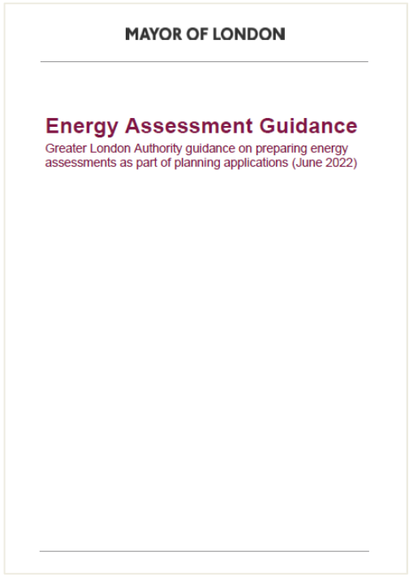
Policy SI13 Sustainable Drainage

- aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the drainage hierarchy.

Policy T5 Cycling

- securing the provision of appropriate levels of cycle parking which should be fit for purpose, secure and well-located. Developments should provide cycle parking at least in accordance with the minimum standards set out in Table 10.2 and Figure 10.3 the London Plan.
- Cycle parking should be designed and laid out in accordance with the guidance contained in the London Cycling Design Standards.

Energy Assessment Guidance (June 2022)


MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (June 2022)

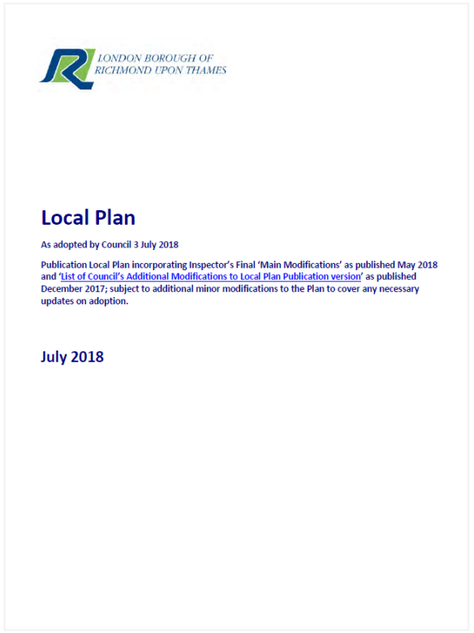
This document provides guidance on how to prepare energy statements that meets London Plan Policy SI2 for GLA referable projects. It is also useful reference for Major Developments (>10 dwellings or >1,000m^2 non-domestic space) proposed for within Greater London.

The main principles relevant to the proposed scheme at 50 Station Road are summarised below:

- Major developments are required to achieve a minimum 35 per cent on-site carbon reduction over Part L 2021. Residential developments are expected to be able to exceed this, and so an additional benchmark (50 per cent reduction) has been set that residential developments should be aiming to achieve.
- Energy demand should be reduced as far as possible before the heating strategy and installation of low carbon and renewable technologies is considered. This is important in protecting consumers from high prices. Developments are expected to achieve carbon reductions beyond Part L 2021 of 10 per cent for residential developments and 15 per cent for non-residential developments through energy efficiency measures alone, before other measures are applied.

Appendix D – Richmond's policies

Richmond upon Thames Local Plan (2018)


LONDON BOROUGH OF RICHMOND UPON THAMES

Local Plan

As adopted by Council 3 July 2018

Publication Local Plan incorporating Inspector's Final 'Main Modifications' as published May 2018 and 'List of Council's Additional Modifications to Local Plan Publication version' as published December 2017; subject to additional minor modifications to the Plan to cover any necessary updates on adoption.

July 2018

The Local Plan document sets out the planning policies, site allocations and land designations Borough-wide.

The energy and sustainability policies within the Richmond upon Thames Local Plan relevant to the proposed development at 50 Station Road are summarised below.

LP1 Local character and design quality

- All development should be of high architectural and urban design quality.
- The following should be considered:
  - Compatibility with local character
  - Sustainable design and construction
  - Layout, siting and access
  - Inclusive design
  - Suitability of uses.

LP2 Building heights

- Respect and strengthen the setting of the borough's valued townscapes and landscapes, through appropriate building heights.

LP8 Amenity and living conditions

- Protect the amenity and living conditions for occupants of new, existing, adjoining and neighbouring properties.

LP10 Local environmental impacts

- Implement good air quality design and new technologies. Developers should secure at least 'Emissions Neutral' development.
- Consider good acoustic design to ensure occupiers of new and existing noise sensitive buildings are protected.
- Ensure that artificial lighting in new developments does not lead to unacceptable impacts.

LP15 Biodiversity

- Protect and enhance the borough's biodiversity, in particular, but not exclusively, the sites designated for their biodiversity and nature conservation value.
- Enhancements to biodiversity will be supported.

LP16 Trees, woodlands and landscape

- Protect existing trees and provide new trees, shrubs and other vegetation of landscape significance that complement existing, or create new, high quality green areas, which deliver amenity and biodiversity benefits.
- Retain important landscape features.

LP17 Green roofs and walls

- Green roofs and/or brown roofs should be incorporated into new major developments with roof plate areas of 100sqm or more where technically feasible and subject to considerations of visual impact.

LP20 Climate change adaptation

- The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.
- New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the cooling hierarchy.

LP21 Flood risk and sustainable drainage

- 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.
- The council will require the use of Sustainable Drainage Systems (SuDS) in all development proposals.

LP22 Sustainable design and construction

- Achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change.
- Follow the energy hierarchy and achieve at least 35% improvement over Part L of Building Regulations.
- Achieve a maximum water consumption of 110 litres / person / day.

LP24 Waste management

- Waste should be managed in accordance with the waste hierarchy, which is to reduce, reuse or recycle waste as close as possible to where it is produced.

LP30 Health and wellbeing

- Create environments that enhance people's health and wellbeing.
- Promote sustainable and active forms of travel.

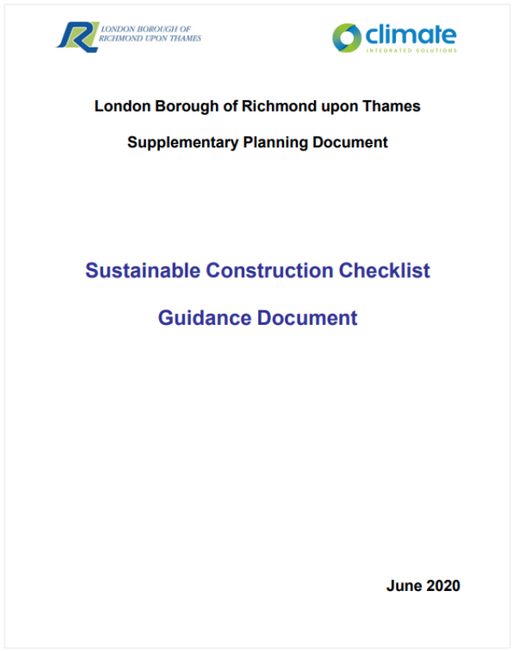
LP44 Sustainable travel choices

- Promote safe, sustainable and accessible transport solutions, which minimise the impacts of development including in relation to congestion, air pollution and carbon dioxide emissions.

LP45 Parking

- New development is required to make provision for the accommodation of vehicles in order to provide for the needs of the development while minimising the impact of car based travel including on the operation of the road network and local environment, and ensuring making the best use of land.

Sustainable Design and Construction Checklist (2020)


LONDON BOROUGH OF RICHMOND UPON THAMES

climate INTEGRATED SOLUTIONS

London Borough of Richmond upon Thames

Supplementary Planning Document

Sustainable Construction Checklist

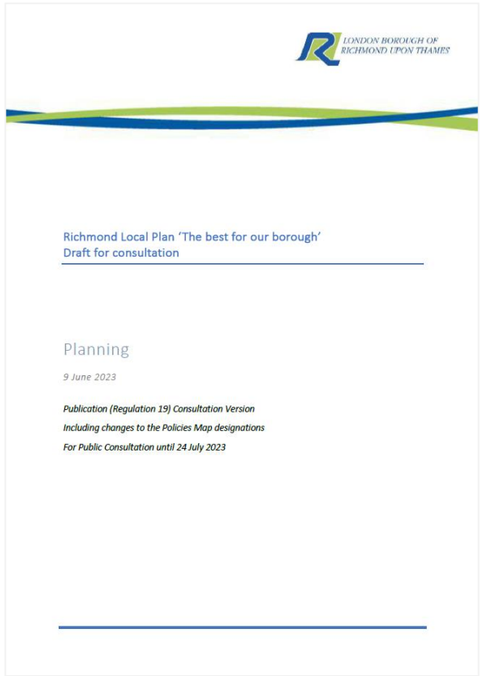
Guidance Document

June 2020

The main requirements for new residential unit include:

- 35% reduction in CO2 emissions over Building Regulations (2013)
- Submit energy statement
- National water standards 110 l/p/d
- Sustainable Construction Checklist should be submitted

Richmond upon Thames Publication Local Plan (2023) – Regulation 19


LONDON BOROUGH OF RICHMOND UPON THAMES

Richmond Local Plan 'The best for our borough'
Draft for consultation

Planning

9 June 2023

Publication (Regulation 19) Consultation Version
Including changes to the Policies Map designations
For Public Consultation until 24 July 2023

The following policies have been considered for the proposed development at 50 Station Road following the pre-application feedback.

LP4 Minimising Greenhouse Gas Emissions and Promoting Energy Efficiency

- Follow the Energy Hierarchy
- Make the fullest contribution to supplying energy efficiently
- Consider multi-functional use roofs
- Adopt a circular economy approach.
- Achieve zero carbon with a minimum of 60% reduction in emissions on site
- Avoid fossil fuel use.
- Demonstrate how energy demand has been minimised
- Assess on site renewables and target solar technologies with a minimum of 40% of the building's footprint area.
- Disclose the Energy Use Intensity.
- Offset any remaining carbon emissions.

LP6 Sustainable Construction Standards

- Submit the Sustainable Design and Construction checklist
- Achieve four star rating under BRE Home Quality Mark.
- Target water consumption of 110 l/p/d.
- Space heating demand target of 20 kWh/m^2.year should be achieved for detached dwellings.

LP7 Waste and Circular Economy

- Provide adequate refuse and recycling storage.
- Adopt a circular economy approach to building design.
- Choose durable materials and ensure resource efficiency.

LP8 Flood Risk and Sustainable Drainage

- minimise or reduce contributing to all sources of flooding, including fluvial, tidal, surface water, groundwater and flooding from sewers; taking account of climate change and that they do not increase flood risk elsewhere.
- Provide SuDS for all development proposals.
- Reduce surface water discharge to greenfield run-off rates.

LP39 Biodiversity and Geodiversity

- Minimise ecological impacts and avoid harm to biodiversity and geodiversity
- Provide a net gain in biodiversity of 20%

LP46 Amenity and Living Conditions

- All development will be required to protect the amenity and living conditions for occupants of new, existing, adjoining and neighbouring properties and the visual amenity of the area as a whole

LP47 Sustainable Travel Choices

- Promote active travel and inclusive mobility
- Provide high quality walking and cycling environment.

LP48 Vehicular Parking Standards, Cycle Parking, Servicing and Construction Logistics Management

- New developments should make provision for the accommodation of vehicles to provide for the needs of the development while minimising the impact of car-based travel
- Promote the uptake of electric vehicles.
- Car free development may be appropriate in certain circumstances.

ecolytik

86-90 Paul Street
London
EC2A 4NE

+44 (0) 0203 835 4114
mail@ecolytik.com
ecolytik.com