

Energy and Sustainability Statement

Land North of Arundel Road, Fontwell

For Harlequin Developments

March 2026

ecolytik

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1 Executive Summary

This Energy and Sustainability Statement presents the key measures proposed for the development at Land North of Arundel Road in Fontwell, within the jurisdiction of Arun District Council ('ADC').

The proposed development comprises the erection of 64no. new homes with associated access, amenity and landscaping.

1.1 Energy Strategy

The energy strategy for the project has been developed in line with the Arun Local Plan (adopted July 2018) and the Climate Change and Sustainability Section of the Arun Design Guide Supplementary Planning Document (SPD) (See Table 1 on the following page).

The CO₂ emissions for the development have been assessed using the Standard Assessment Procedure (SAP) for the dwellings.

Proposed energy measures for the development includes:

- **Steps 1-4 – Passive design and Energy Efficiency:** Passive design with a fabric first approach (enhanced u-values, low air tightness target and careful thermal bridging detailing) and low energy lighting.
- **Step 5 – Renewable technology:** High efficiency Air Source Heat Pumps will be provided to all homes as a low carbon heat source.

Overall, the proposed development is anticipated to achieve a 58% reduction in regulated CO₂ emissions over the Part L 2021 baseline. The planning stage energy calculations indicate that 69% of the total energy demand of the scheme is anticipated to be met by Air Source Heat Pumps as a low carbon technology, notably exceeding the 10% target set out in Policy ECC SP2 of the Arun Local Plan.

1.2 Sustainability Strategy

The sustainability strategy for the proposal has been developed in accordance with relevant policies within the Arun Local Plan and Arun Design Guide SPD.

Key considerations include health and wellbeing, climate resilience, water efficiency and surface water runoff, daylight, materials and waste, among other aspects detailed within this report.

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

	3 Energy Strategy	4.1 Health and Wellbeing	4.2 Nature, Landscape and Biodiversity	4.3 Climate Resilience	4.4 Water and Surface Water Runoff	4.5 Materials and Waste	4.6 Sustainable Transport
Arun Local Plan 2011-2031 (2018)							
Policy ECC SP1 Adapting to climate change	◆			◆			
Policy ECC SP2 Energy and climate change mitigation	◆						
Policy T DM1 Sustainable Travel and Public Rights of Way							◆
Policy ENV DM5 Development and biodiversity			◆				
Policy W SP1 Water				◆	◆		
Policy W DM1 Water supply and quality					◆		
Policy W DM3 Sustainable Urban Drainage Systems				◆	◆		
Policy WM DM1 Waste Management						◆	
Policy QE DM1 Noise pollution		◆					
Policy QE DM2 Light pollution		◆					
Policy QE DM3 Air pollution		◆					
Arun District Design Guide SPD (2024)							
Maximise energy efficiency and minimise whole life carbon	◆						
Reduce, re-use and recover materials and protect the District's water resources					◆	◆	
Design for resilience and adaptability to climate change to ensure the future-proofing of developments				◆	◆		
Incorporate Sustainable Drainage Systems (SuDS) and other flood risk mitigation				◆	◆		
Incorporate air, noise and light pollution mitigation		◆					
Promote the highest standards of health and well-being		◆					

2 Introduction

2.1 Site

The site is located to the north of Arundel Road, Fontwell, and falls within the Built-up Area Boundary of Fontwell. The site is allocated for residential use within the Walberton Neighbourhood Development Plan. The site is currently an open green field measuring 2.74 hectares of land bounded by mature trees and hedgerow.

The proposed development comprises the erection of 64no. new homes with associated access, amenity and landscaping. The site location is presented in Figure 1.

2.2 Planning policies

A review of the applicable policies for the proposed development has been undertaken. A full summary of the relevant Arun Local Plan policies and Arun Design Guide SPD topics are presented in Appendix C.

The proposed development has been designed to meet and exceed (where feasible) the following main policy drivers.

2.2.1 Adoption Arun Local Plan 2011-2031 (2018)

Energy and carbon:

- Achieve energy efficiencies measures in line with current standards;
- Use design and layout to promote energy efficiency;
- Incorporate decentralised, renewable and low carbon energy supply systems;
- Major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site.

Sustainability:

- Enhance health and wellbeing provision of high quality buildings and associated amenity spaces, limiting exposure to sources of air and noise pollution.
- Design in measures to ensure climate resilience (including resilience to flood risk and overheating).
- Contribute to, biodiversity and access to nature.
- Water efficiency – to meet a maximum water consumption of 110 l/p/d.
- Waste management and reduction.
- Sustainable urban drainage.
- Sustainable transport.

2.2.2 Arun Design Guide SPD (2024)

Energy and carbon:

- Follow the energy hierarchy.
- Ensure incorporation of low and zero carbon technologies.

Sustainability:

- Design for resilience.
- Provide green infrastructure and enhance biodiversity.
- Resource (waste, material, energy, water) efficiency.
- Minimise noise, air and light pollution.
- Reduction of flood risk and incorporation of Sustainable Urban Drainage systems.

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



Figure 1. Approximate site location of Land North of Arundel Road (source: Google Maps, accessed: February 2026).

3 Energy Strategy

The Energy Strategy for the proposed development at Land North of Arundel Road has been developed in line with the Energy Hierarchy set out in the Arun Design Guide SPD:

- 1. Site location
- 2. Form and orientation
- 3. High efficiency building fabric.
- 4. High efficiency building services.
- 5. Renewable technology.
- 6. Energy monitoring.

The CO₂ 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 Steps 1-4 – Passive Design and Energy Efficiency

3.1.1 Passive Design

Building orientations have been optimised as far as feasible within the constraints of the site. The majority of homes will be dual/triple aspect with access to at least one east/south/west facing window, which enables some passive solar heating to reduce space heating energy demand from active systems.

All buildings are designed to have simple and compact forms to minimise unnecessary fabric heat loss. Complex and superfluous building features have been designed out as far as feasible.

Low-e and solar control glazing will be specified, which promotes heat retention within the dwellings in the cooler months whilst limiting excessive solar gains during the summer.

Full height glazing is limited to where access to gardens or terraces is required. All glazed elements have generous extents of openable areas to enable good air flow and passive cooling potential.

Please see Figure 2 for illustrations of these design principles incorporated into the scheme.

3.1.2 Fabric Performance

A fabric first approach has been adopted to minimise unwanted heat loss through the building fabric and reduce heating energy demand over the cooler months. The proposed building fabric specification will meet or go beyond the notional building standards set out within Building Regulations Part L 2021 (Table 2).

Further details regarding targeted u-values, air permeability and thermal bridging are presented in Appendix A.

3.1.3 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.

3.1.4 Ventilation

Natural cross ventilation is the predominant strategy for ventilation of the homes at Arundel Road. For homes located in closer proximity to the A27 where noise constraints are applicable, mechanical ventilation with heat recovery (MVHR) will be implemented to enable fresh air provision and overheating mitigation.

3.1.5 Controls

Time and temperature zone control will be provided for space heating for all homes. Hot water will be independently controlled from space heating.

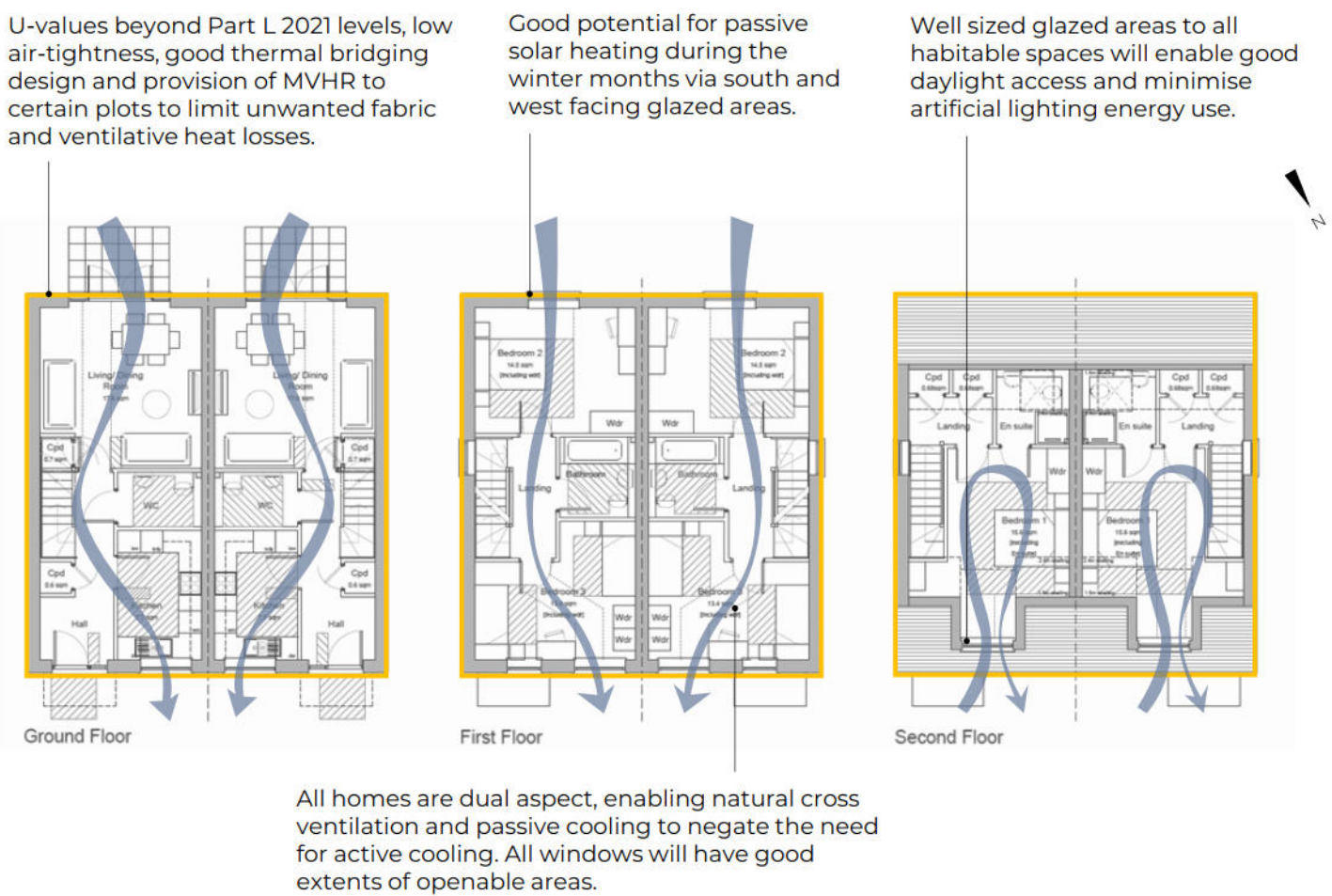


Figure 2. Passive design measures considered for the proposed development (House Type 05 shown). Similar design principles have been adopted across the scheme.

Table 2. Proposed building fabric specifications at Arundel Road.

Element	Part L 2021 limiting values	Part L 2021 Notional Building values	Proposed specification
External Wall u-value (W/m ² .K)	0.26	0.18	0.18
Roof u-value (W/m ² .K)	0.16	0.11	0.1
Floor u-value (W/m ² .K)	0.18	0.13	0.1
Window u-value (W/m ² .K)	1.6	1.2	1.2
Air permeability (m ³ /m ² ..hr @50Pa)	8	5	3 for homes with MVHR, 4 for homes with no MVHR.

3.2 Step 5 – Renewable Technology

The opportunity for producing and utilising renewable energy onsite has been explored for the proposed development, in line with ADC’s policies and guidance.

An outline feasibility study has been undertaken (see Table 3). which identified ASHPs and as the most suitable low/zero carbon technology for the scheme.

Heat pump systems will supply both space heating and hot water. The external units of the heat pumps can be located within acoustic enclosures (where required).

3.3 Step 6 – Energy Monitoring

Where feasible, smart meters will also be installed at an accessible location at each home to enable occupants to monitor their energy consumption.

Table 3. Outline LZC feasibility for Arundel House

LZC Technology	Adopted	Feasibility
Photovoltaics	N	Air source heat pumps are the preferred renewable technology for the site. It can provide heating and hot water which is the majority of the energy demand of the development.
Solar thermal	N	A solar thermal hot water system is not compatible with individual heat pumps without the provision of a separate thermal store.
Wind turbines	N	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)	N	The installation of ground source trench or borehole system for each dwelling requires notable space, time and cost, and is not deemed feasible for a scheme of this scale and nature.
Air Source Heat pumps (ASHP)	Y	Heat pump is an effective way of providing low carbon heating and hot water, and will be applied to all homes.
Biomass	N	Biomass systems emit high NOx levels and are not supported within sub-urban areas. There is also no suitable space onsite for the storage of biomass.

3.4 Results

3.4.1 Energy demand

Table 4 presents the energy demand by end use for the proposed scheme.

With space heating and hot water being provided by Air Source Heat Pumps as a low and zero carbon technology, the proportion of the building’s energy demand met by this LZC technology is anticipated to be 69%, as shown in Table 5. This notably exceeds the 10% target set out in Policy ECC SP2 of the Arun Local Plan.

Table 4. Energy demand for the proposed dwellings.

Space heating (kWh/ year)	Hot water (kWh/ year)	Cooling (kWh /year)	Auxiliary, Lighting and Equipment (kWh/ year)	Total energy demand (kWh / year)
161,500	169,100	-	151,700	477,700

Table 5. Energy demand met by renewable technology for the dwellings.

LZC technology proposed	Demand met by LZC technology (kWh/ year)	% Energy demand met by LZC technology
Air Source Heat Pump	330,600	69%

3.4.2 Carbon emissions

Through the measures outlined for each stage of the Energy Hierarchy, it is anticipated the proposed development can achieve a 58% reduction in regulated CO₂ emissions over the Part L 2021 notional baseline.

The reductions have been maximised, which meets currently adopted Arun District Council energy policies.

Table 6, Table 7 and Figure 3 present the anticipated CO₂ emissions and savings at each stage of the Energy Hierarchy.

Table 6. Carbon emissions after each stage of the Energy Hierarchy

	Carbon Dioxide Emissions (tCO ₂ /yr)	
	Regulated	Unregulated
Baseline: Part L 2021 Compliant Development	61.4	19.0
After energy demand reduction (Steps 1-4)	61.5	19.0
After renewable energy (Step 5)	25.7	19.0

Table 7. Regulated carbon savings from each stage of the Energy Hierarchy.

	Regulated carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Steps 1-4: Savings from energy demand reduction	0	0%
Step 5: Savings from renewable energy	35.8	58%
Cumulative on-site savings	35.7	58%

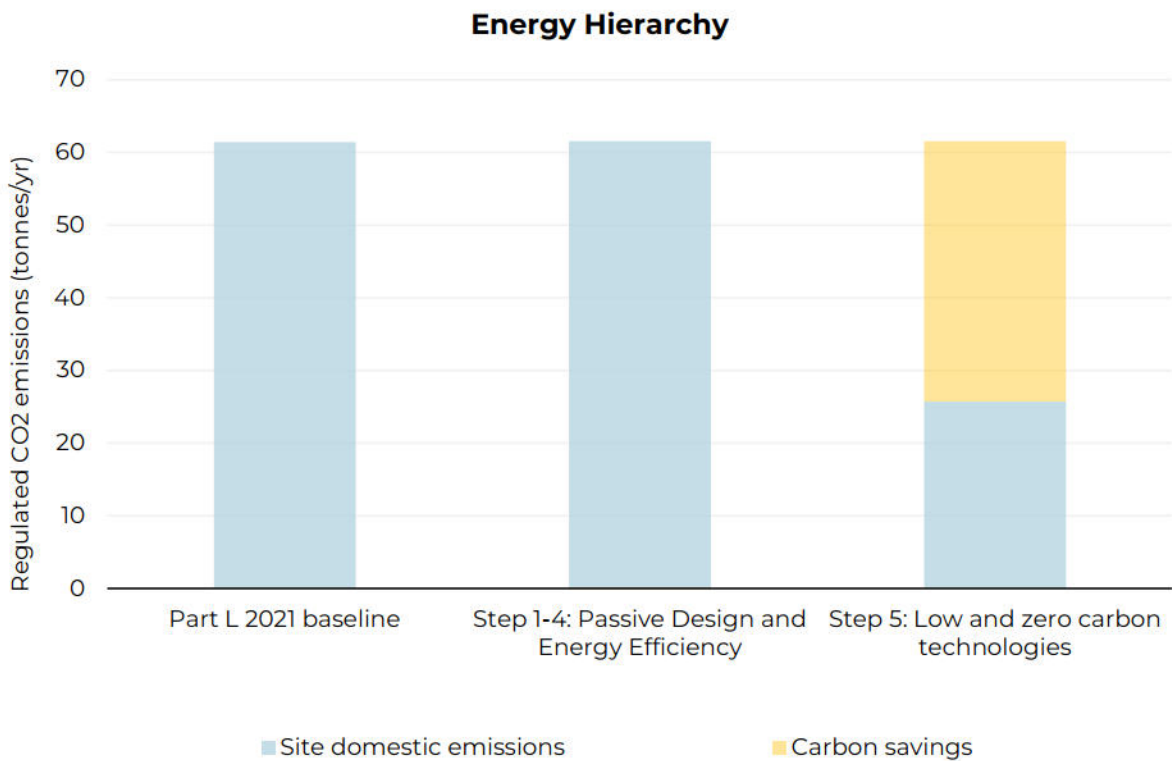


Figure 3. Regulated carbon emissions at each stage of the Energy Hierarchy.

4 Sustainability Strategy

This section of the report presents the key elements of the development which responds to the sustainable development policies and guidance set out within Arun's Local Plan and Design Guide SPD.

4.1 Health and Wellbeing

4.1.1 Air Quality

Any potential dust and stationary plant emissions during the construction period will be mitigated.

Electrically driven heat pump systems will supply space heating and hot water at the new homes. Therefore, there will be no PM and NOx emissions associated with fossil fuel combustion from the operation of the building services systems.

4.1.2 Noise

The development will incorporate mitigation measures to ensure the impact of any external sources on internal ambient noise levels are within acceptable limits, in line with BS8233:2014 or latest standard. Any potential noise impact during construction will be mitigated accordingly.

An initial assessment has been carried out in relation to the acoustic requirements outlined in Approved Document O (2021) to the Building Regulations 2010. Based upon the expected external noise levels, for properties located along the boundary to the A27 (Plots 4-11, 48-64), open bedroom windows at night should not be relied upon as a method to removing excess heat. MVHR with air tempering coils will be installed to these plots.

Further details are presented within the accompanying Noise Assessment prepared by Acoustic South East and Overheating Assessment prepared by Ecolytik.

Attenuation will be provided for the external units of the heat pumps where required.

4.1.3 Daylight and Sunlight

The majority of homes will be at least dual aspect and will have access to well sized windows for good daylight and sunlight levels. The proposed scheme is also not anticipated to have any daylight and sunlight impacts to neighbouring buildings due to its scale and distance to surrounding properties.

4.1.4 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.

4.1.5 External amenity

All homes will have access to private gardens as external amenity. Public open spaces comprising soft landscaping and play spaces are also proposed along the northern and eastern boundaries for the enjoyment of residents.

Further details can be found in the Design and Access Statement prepared by ECE Architecture.

4.2 Nature, Landscape and Biodiversity

4.2.1 Nature and Biodiversity

An Ecological Assessment was carried out for the site by Derek Finnie Associates.

Based on the findings of the habitat survey, the site comprises a semi-improved grass field, which appears to have been sub-divided into several horse grazing paddocks in the past. Outgrown hedgerows are present along the east and southern boundaries, whilst a linear belt of broadleaved plantation woodland is present along the northeast boundary.

The site or the immediate surrounding area is not covered by any form of designation on ecological grounds. The semi-improved grassland within the Site is deemed to be of low to moderate ecological value due to the species assessment. The mature hedgerow and linear belts of trees around the periphery of the site offers some local biodiversity value. The bat population was assessed as being of local value only.

Mitigation and enhancement measures are proposed for the scheme as part of the ecological assessment, which are predicted to more than offset the potential impacts of the scheme. This is reinforced by the results of the BNG metric with a 23.07% increase in biodiversity value of habitats and 168% increase in hedgerows within the site post development.

Further details are presented in the Ecological Assessment and BNG Design Report prepared by Derek Finnie Associates.

4.2.2 Landscape

The landscape design aims to establish an inviting external space sensitive to surrounding character, achieve BNG targets and to provide a safe and inviting landscaped environment for the residents of the scheme. Planting of native species are proposed throughout the scheme, with the creation of continuous green corridors linking various habitable takes to enhance habitat connectivity across the site. Boundary vegetation will be preserved and enhanced with additional native planting. The addition of new habitats will increase biodiversity and ecological resilience.

Further details are presented in the Landscape Design Strategy and Landscape Plan prepared by Lizard.



Figure 4. Landscape strategy masterplan, prepared by Lizard.

4.3 Climate Resilience

4.3.1 Managing risk of overheating

Planning stage analysis has been carried out to evaluate the summertime performance of the dwellings and in order to reduce potential overheating risks in line with Part O of the Building Regulations.

Please refer to the accompanying Overheating Risk Assessment Report prepared for the application for further details.

4.3.2 Managing flood risk

The site is located in Flood Zone 1 with low risk of flooding from rivers or sea. The site is also not at risk from flooding from any other source.

Further details are presented in the site-specific Flood Risk Assessment and Drainage Strategy prepared by DHA.



Figure 5. Thermal model of the proposed development (view from southwest).

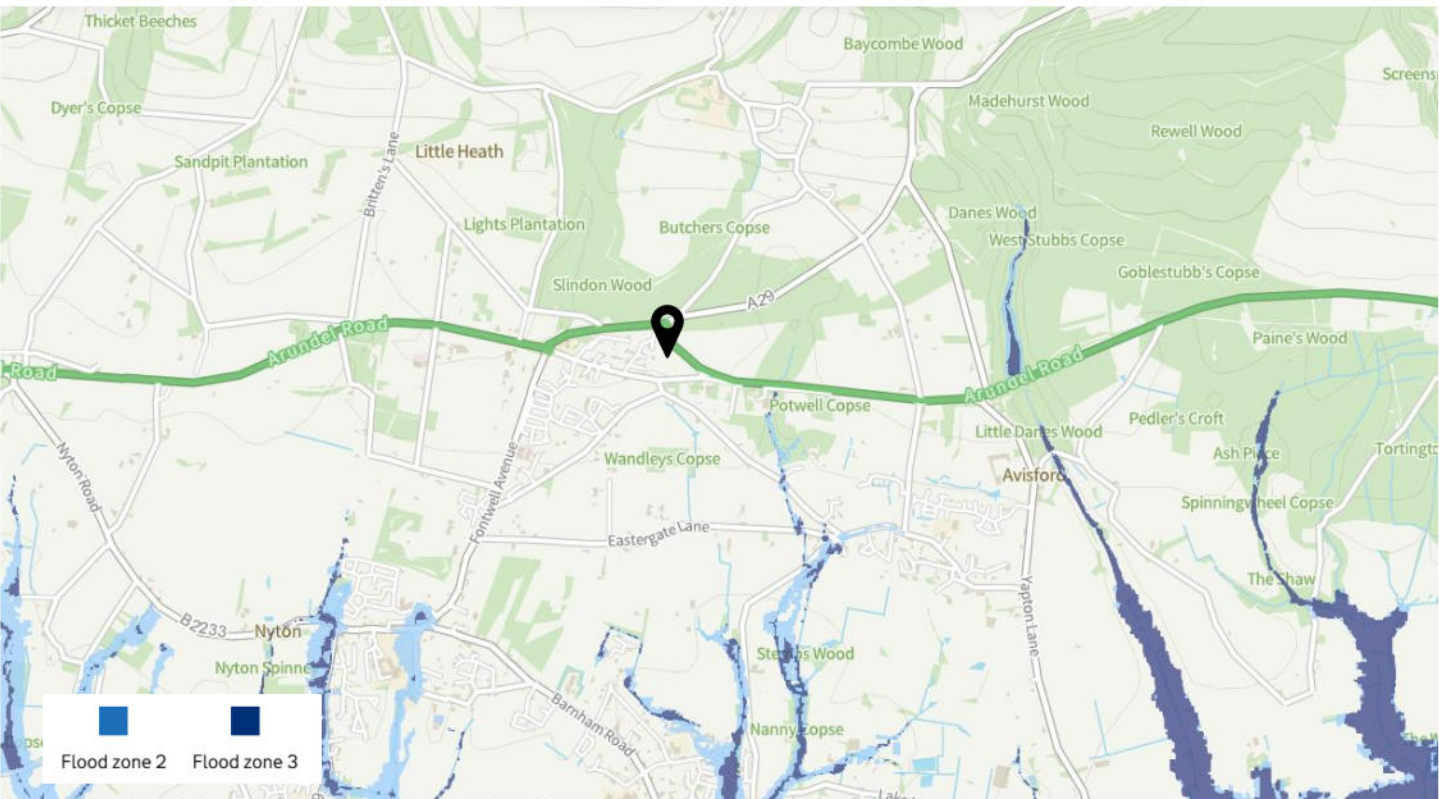


Figure 6. Flood risk map – rivers and sea flooding (Accessed: February 2026).

4.4 Water and Surface Water Runoff

4.4.1 Water Efficiency

The proposed development will target a mains water consumption of less than 110 litres/person/day. This is consistent with Building Regulations Part G(2) requirement and Arun's Policy W DM1.

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).

Rainwater butts will also be provided to all houses to reduce reliance on potable water for landscape irrigation in line with Arun's Design Guide.

4.4.2 Surface water runoff

A Sustainable Urban Drainage system (SuDs) has been integrated into the proposed development to manage surface water generated from the development to ensure that flood risk is not increased elsewhere.

Areas of hardstanding will be constructed as lined porous pavements with any roof areas draining directly into them. Flows from each porous pavement will be connected to the adjacent porous pavement which discharges into a 1.2m deep infiltration basin located in the southeast corner of the site.

Further details are presented in the Flood Risk Assessment and Drainage Strategy prepared by DHA for the planning application.



Figure 7. Proposed SUDs strategy for Arundel Road, prepared by DHA. Areas of permeable shading are shaded in brown. An infiltration basin is proposed to the southeast corner of the site.

4.5 Materials and Waste

4.5.1 Material Selection and Procurement

In order to minimise carbon emissions throughout the buildings' lifecycle, the use of low embodied carbon materials will be prioritised as far as feasible. Additionally, design practices that aim to reduce waste production will be adopted.

Traditional materials will be specified to be in keeping with the characteristics of historical buildings in proximity to the site. Any materials used on site will be selected for longevity and durability as well as recoverability and recyclability at end of life. Any surplus material, which will be kept to a minimum, will be used for on-site repairs whenever possible.

To minimise potential sources of indoor air pollution, low VOC materials, paints and finishes will be prioritised where possible.

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.

4.5.2 Waste Management and Circular Economy

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.

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

4.6 Sustainable Transport

4.6.1 Public Transport

The closest bus stops are located along Arundel Road, approximately 120m from the western boundary of the site. The bus stops are served by Route 85 between Arundel and Chichester, which provides 3 services per day in each direction on Mondays to Fridays. Additional bus services can be accessed from other stops within Fontwell.

The closest railway station to the site is Barnham, approximately 2.6km to the south of the site.

4.6.2 Cycle Parking

Cycle parking will be provided for each dwelling within sheds or similar storage facilities to each rear garden of houses. A communal cycle store is proposed for the apartment block.

4.6.3 Car Parking

Sufficient car parking will be provided onsite, in line with the Arun Parking Standards.

There are good opportunities for the use of electric vehicles as part of the proposed development. A single charging point will be provided for each of the residential dwellings within the site.

Further details are presented in the Transport Assessment and Travel Plan prepared by DHA.

5 Conclusions

Through the adoption of the energy and sustainability strategies presented in this report, the client and design team demonstrated that the proposed development fulfils the relevant policy requirements stipulated by Arun District Council.

The proposal will positively contribute to sustainable development at the site and its surroundings.

Appendix A – Energy calculation assumptions for Arundel Road

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.

Residential elements

Residential Building fabric parameter	Part L 2021 notional	Proposed specification	Unit	Note
Walls				
External walls	0.18	0.18	W/m²K	1
Walls from flats to corridors and stairwells	0.18	0.25	W/m²K	1
Party walls between flats (fully filled cavity with effective sealing on all edges)	0	0	W/m²K	1
Floors				
Ground floors	0.13	0.10	W/m²K	1
Roofs/ceilings				
All roofs (including roofs to terraces)	0.11	0.10	W/m²K	1
Openings				
Entrance doors to flats and houses	1.0	1.0	W/m²K	1
New windows - pane and frame	1.2	1.2	W/m²K	1
Windows solar transmittance factor (g-value)	0.63	0.4	W/m²K	1, 2
Windows frame factor	0.7	0.7	W/m²K	1
Air permeability				
Maximum average air permeability	5	<3.5	m³/m².h	1
Air permeability test required for all homes prior to handover.				

Residential 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 valid reference construction details with psi values below those outlined below. Detailed photographic evidence will be required for all build-ups and junctions for all homes on site during construction.				
E2 lintels	0.05	0.05	W/mK	1
E3 Sill	0.05	0.05	W/mK	1
E4 Jambs	0.05	0.05	W/mK	1
E5 Ground Floor	0.16	0.08	W/mK	1
E5 Ground Floor (to corridor)	0.16	0.08	W/mK	1
E6 Inter floor within dwelling	0	0	W/mK	1
E7 Inter floor between dwelling	0.07	0.07	W/mK	1
E7 Inter floor between dwelling	0.07	0.07	W/mK	1
E10/E11 Eaves	0.04	0.04	W/mK	1
E12/E13 Gables	0.08	0.08	W/mK	1
E24 Eaves (ins. at ceiling level - inverted)	0.24	0.24	W/mK	1
E16 Corner (normal)	0.09	0.09	W/mK	1
E17 Corner (inverted)	-0.09	-0.09	W/mK	1
E18 Party wall between dwellings	0.06	0.06	W/mK	1
P1 Ground Floor (lowest floor)	0.08	0.08	W/mK	1
P2/P3 Inter floor within and between dwellings	0	0	W/mK	1
P5 Roof)	0.08	0.08	W/mK	1
R4 Ridge	0.08	0.08	W/mK	1
R7 Flat ceiling (inverted)	0.04	0.04	W/mK	1
R9 Roof wall (flat ceiling)	0.04	0.04	W/mK	1

Residential Building Services Systems	Proposed specification	Unit	Note
Ventilation – homes with noise constraints for Part O compliance			
Type	MVHR with air tempering coil to all flats		1, 3, 4
Installed Specific Fan Power	<0.75	W/l/s	1, 3, 4
Heat recovery efficiency	>85	%	1, 3, 4
MVHR duct type	Rigid		1, 4
MVHR duct installation specification	Level 1		1, 4
Installer commissioning certificate	Assumed		1, 4
Ventilation – homes with no noise constraints for Part O compliance			
Type	Natural ventilation with mechanical extract		1, 4
Extract fans	To all bathrooms and kitchens		1, 4
Other requirements	Purge fans to ground floor bedrooms with security constraints		1, 3, 4
Heating and hot water			
Type	Air source heat pump		1, 4
COP - space heating	>300	%	1, 4
COP - domestic hot water	>200	%	1, 4
Heat emitter	Underfloor or Radiators		1, 4
Fuel type	Electricity		1, 4
Electricity tariff	Standard		1, 4
Installed to MCS	Yes		1, 4
Heating controls	Time and temperature zone control by arrangement		1, 4
Pump in heated space	Yes		1, 4

Residential Building Services Systems	Proposed specification	Unit	Note
Hot Water			
From main heating system	Yes		1
Insulation	Factory - 80mm		1, 4
Cylinder in heated space	Yes		1, 4
Cylinderstat	Yes		1, 4
Water consumption			
Part G Water consumption	<110	l/p/d	1
Showers flow rate	<8	l/min	1
Photovoltaics			
Capacity of PV system	Not currently assumed	kWp	1, 4
Battery	Not currently assumed		1, 4

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
NB. Please refer to Approved Document L1 2021 for all requirements to comply with Building Regulations Part L.	

Appendix B – SAP output

The table below shows the SAP results for the sample dwellings modelled. The Lean Stage DER has been adjusted to include the PV allowance included in the Notional Building and to enable calculation of savings achievable at Step 1-4 of the energy hierarchy. Planning stage SAP output worksheets for the units highlighted in blue are appended. SAP outputs for all sample units are available on request.

Table 8. Planning stage SAP results.

Plot Reference	SAP 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)
62	1-NW	11.93	11.97	5.02	32.48	31.90
64	1-SE	11.06	11.31	4.82	28.35	28.95
58	G-NW	12.92	11.86	5	38.29	33.27
60	G-SE	11.88	11.14	4.78	33.32	29.93
47	HT01A-D-SE	15.29	15.20	6.03	45.62	45.04
1	HT01A-E	14.08	13.68	5.56	39.04	37.13
48	HT01B-D-SE	14.12	14.40	5.77	44.20	44.57
27	HT01B-SW	12.63	12.80	5.27	36.96	36.81
32	HT03-E	10.46	10.45	4.53	35.96	34.84
11	HT03-NE	10.36	10.38	4.5	35.35	34.49
28	HT03-W	10.46	10.45	4.53	35.96	34.84
49	HT05-NE	10.26	10.46	4.25	34.56	34.17
43	HT05-S	10.26	10.47	4.25	34.34	34.10
12	HT05-W	10.5	10.63	4.3	35.77	34.97
31	HT07-E	11.04	11.31	4.77	43.79	43.87
30	HT07-W	11.8	11.85	4.94	47.19	46.24

Full SAP Calculation Printout



Plot Reference	Lean_ori	Issued on Date	24/02/2026
Assessment Reference	G-NW	Plot Type Ref	
Plot Address		SAP Version	10.2
SAP Rating	85 B	DER	15.06
Environmental	89 B	% DER < TER	12.92
CO ₂ Emissions (t/year)	0.86	DFEE	33.27
Compliance Check	See BREL	TFEE	38.29
% DPER < TPER	-23.81	DFEE < TFEE	13.10
		TPER	67.80
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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	63.1100 (1b)	2.4000 (2b)	151.4640 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.1100		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 151.4640 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	1 * 10 = 10.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	10.0000 / (5) = 0.0660 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.5000 (17)
Infiltration rate	0.2410 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2229 (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	0.2843	0.2787	0.2731	0.2452	0.2397	0.2118	0.2118	0.2062	0.2229	0.2397	0.2508	0.2620 (22b)
Effective ac	0.5404	0.5388	0.5373	0.5301	0.5287	0.5224	0.5224	0.5213	0.5249	0.5287	0.5315	0.5343 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Windows			8.1600	1.1450	9.3435		(27)
Door			2.0000	1.0000	2.0000		(26)
GF			63.1100	0.1000	6.3110	110.0000	6942.1000 (28a)
External Wall 1	45.0000	10.1600	34.8400	0.1800	6.2712	140.0000	4877.6000 (29a)
Corridor wall	3.3100		3.3100	0.2500	0.8275	140.0000	463.4000 (29a)
To balcony	8.5200		8.5200	0.1000	0.8520	9.0000	76.6800 (30)
Total net area of external elements Aum(A, m ²)			119.9400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.6052		(33)
Main dwelling							
Party Wall 1			34.8000	0.0000	0.0000	20.0000	696.0000 (32)
Party Ceiling 1			60.8800			20.0000	1217.6000 (32b)
Internal Wall 1			96.2000			9.0000	865.8000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15139.1800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							239.8856 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				4.0300	0.0500	0.2015	
E3 Sill				1.3800	0.0500	0.0690	
E4 Jamb				7.9600	0.0500	0.3980	

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E5 Ground floor (normal)	18.5000	0.0800	1.4800										
E6 Intermediate floor within a dwelling	0.0000	0.0000	0.0000										
E5 Ground floor (normal)	1.4800	0.0800	0.1184										
E7 Party floor between dwellings (in blocks of flats)	10.3000	0.0700	0.7210										
E11 Eaves (insulation at rafter level)	0.0000	0.0400	0.0000										
E13 Gable (insulation at rafter level)	0.0000	0.0800	0.0000										
E14 Flat roof	0.0000	0.0800	0.0000										
E15 Flat roof with parapet	8.2700	0.3000	2.4810										
E16 Corner (normal)	4.8200	0.0900	0.4338										
E17 Corner (inverted - internal area greater than external area)	2.4100	-0.0900	-0.2169										
E18 Party wall between dwellings	4.8200	0.0600	0.2892										
E18 Party wall between dwellings	4.8200	0.0600	0.2892										
E24 Eaves (insulation at ceiling level - inverted)	0.0000	0.2400	0.0000										
P1 Party wall - Ground floor	14.5000	0.0800	1.1600										
P2 Party wall - Intermediate floor within a dwelling	0.0000	0.0000	0.0000										
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5000	0.0000	0.0000										
P5 Party wall - Roof (insulation at rafter level)	0.0000	0.0800	0.0000										
R4 Ridge (vaulted ceiling)	0.0000	0.0800	0.0000										
R7 Flat ceiling (inverted)	0.0000	0.0400	0.0000										
R9 Roof to wall (flat ceiling)	0.0000	0.0400	0.0000										
E7 Party floor between dwellings (in blocks of flats)	1.4800	0.0700	0.1036										
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				7.5278 (36)									
Point Thermal bridges				0.0000									
Total fabric heat loss		(33) + (36) + (36a) =		33.1330 (37)									
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	27.0109	26.9325	26.8556	26.4946	26.4271	26.1126	26.1126	26.0544	26.2338	26.4271	26.5637	26.7066	(38)
Average = Sum(39)m / 12 =	60.1439	60.0655	59.9886	59.6276	59.5601	59.2457	59.2457	59.1874	59.3668	59.5601	59.6967	59.8396	(39)
												59.6273	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9530	0.9518	0.9505	0.9448	0.9438	0.9388	0.9388	0.9378	0.9407	0.9438	0.9459	0.9482	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
												0.9448	
												31	

4. Water heating energy requirements (kWh/year)													
Assumed occupancy													2.0681 (42)
Hot water usage for mixer showers	58.8942	58.0091	56.7194	54.2518	52.4307	50.3999	49.2456	50.5256	51.9286	54.1091	56.6297	58.6686	(42a)
Hot water usage for baths	25.4497	25.0717	24.5395	23.5581	22.8232	22.0084	21.5683	22.0968	22.6723	23.5442	24.5458	25.3636	(42b)
Hot water usage for other uses	35.8090	34.5069	33.2047	31.9026	30.6004	29.2983	29.2983	30.6004	31.9026	33.2047	34.5069	35.8090	(42c)
Average daily hot water use (litres/day)												110.4480	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	120.1529	117.5877	114.4636	109.7125	105.8544	101.7066	100.1122	103.2228	106.5035	110.8580	115.6824	119.8412	(44)
Energy content (annual)	190.2928	167.4434	175.9263	150.1909	142.5004	125.0602	121.0770	127.8114	131.3295	150.4333	164.8108	187.6424	(45)
Distribution loss (46)m = 0.15 x (45)m	28.5439	25.1165	26.3889	22.5286	21.3751	18.7590	18.1616	19.1717	19.6994	22.5650	24.7216	28.1464	(46)
Water storage loss (or HIU loss):													
Store volume												150.0000	(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												0.9283	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.8683	(55)
Total storage loss	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(56)
If cylinder contains dedicated solar storage	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(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	240.4728	212.7672	226.1063	198.7521	192.6804	173.6214	171.2570	177.9914	179.8907	200.6133	213.3720	237.8224	(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	240.4728	212.7672	226.1063	198.7521	192.6804	173.6214	171.2570	177.9914	179.8907	200.6133	213.3720	237.8224	(64)
12Total per year (kWh/year)												2425.3470	(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)
												0.0000	(64a)
Heat gains from water heating, kWh/month	103.4163	91.9340	98.6395	88.7875	87.5254	80.4315	80.4021	82.6413	82.5161	90.1630	93.6486	102.5351	(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	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.5137	110.1759	99.5137	102.8308	99.5137	102.8308	99.5137	99.5137	102.8308	99.5137	102.8308	99.5137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	180.7168	182.5921	177.8664	167.8061	155.1068	143.1712	135.1975	133.3222	138.0479	148.1082	160.8075	172.7431	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	(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)	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	(71)
Water heating gains (Table 5)	139.0005	136.8065	132.5799	123.3159	117.6416	111.7104	108.0673	111.0770	114.6056	121.1869	130.0675	137.8160	(72)
Total internal gains	476.2519	486.5954	466.9810	450.9738	429.2830	411.7334	396.7995	397.9338	409.5053	425.8297	450.7268	467.0937	(73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Northwest				8.1600	11.2829		0.4000		0.7000	0.7700	17.8650 (81)
Solar gains	17.8650	36.3648	65.5178	107.5990	144.6342	154.1953	144.2466	114.9951	79.8344	44.4407	14.5895 (83)
Total gains	494.1169	522.9602	532.4988	558.5728	573.9172	565.9288	541.0460	512.9289	489.3397	470.2703	481.6832 (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
tau	69.9211	70.0124	70.1021	70.5265	70.6065	70.9812	70.9812	71.0510	70.8364	70.6065	70.4449
alpha	5.6614	5.6675	5.6735	5.7018	5.7071	5.7321	5.7321	5.7367	5.7224	5.7071	5.6963
util living area											
	0.9908	0.9857	0.9751	0.9360	0.8354	0.6461	0.4780	0.5241	0.7664	0.9407	0.9821
											0.9920 (86)
MIT	20.2416	20.3279	20.4659	20.6736	20.8437	20.9274	20.9430	20.9412	20.8984	20.7032	20.4459
Th 2	20.1227	20.1237	20.1248	20.1296	20.1305	20.1347	20.1347	20.1355	20.1331	20.1305	20.1286
util rest of house											
	0.9881	0.9815	0.9675	0.9161	0.7887	0.5685	0.3860	0.4291	0.6944	0.9183	0.9760
MIT 2	19.2397	19.3499	19.5245	19.7825	19.9738	20.0543	20.0642	20.0643	20.0312	19.8221	19.5040
Living area fraction											
	19.6386	19.7393	19.8993	20.1373	20.3202	20.4020	20.4142	20.4135	20.3765	20.1730	19.8791
MIT											
Temperature adjustment											0.0000
adjusted MIT	19.6386	19.7393	19.8993	20.1373	20.3202	20.4020	20.4142	20.4135	20.3765	20.1730	19.8791
											19.6201 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9862	0.9793	0.9651	0.9163	0.7997	0.5932	0.4160	0.4601	0.7160	0.9195	0.9739	0.9880 (94)
Useful gains	487.3176	512.1239	513.9305	511.8429	458.9603	335.7158	225.0877	235.9971	350.3660	432.4279	460.8691	475.8908 (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	922.5252	891.3314	803.8085	670.0548	513.4175	343.7405	225.9727	237.5467	372.6169	570.1665	762.8680	922.7305 (97)
Space heating kWh	323.7945	254.8275	215.6692	113.9126	40.5161	0.0000	0.0000	0.0000	0.0000	102.4775	217.4392	332.4487 (98a)
Space heating requirement - total per year (kWh/year)												1601.0853
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	323.7945	254.8275	215.6692	113.9126	40.5161	0.0000	0.0000	0.0000	0.0000	102.4775	217.4392	332.4487 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1601.0853
Space heating per m2										(98c) / (4) =		25.3698 (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	323.7945	254.8275	215.6692	113.9126	40.5161	0.0000	0.0000	0.0000	0.0000	102.4775	217.4392	332.4487 (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)	350.8066	276.0861	233.6611	123.4156	43.8961	0.0000	0.0000	0.0000	0.0000	111.0266	235.5788	360.1828 (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	240.4728	212.7672	226.1063	198.7521	192.6804	173.6214	171.2570	177.9914	179.8907	200.6133	213.3720	237.8224 (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 (216)
Fuel for water heating, kWh/month	260.5339	230.5170	244.9689	215.3328	208.7545	188.1056	185.5439	192.8401	194.8979	217.3491	231.1723	257.6624 (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	19.2400	15.4351	13.8976	10.1820	7.8648	6.4256	7.1746	9.3258	12.1133	15.8933	17.9514	19.7748 (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 (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 (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 (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 (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 (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 (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 (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)

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Annual totals kWh/year	
Space heating fuel - main system 1	1734.6536 (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	2627.6782 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	155.2782 (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	4603.6100 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	1734.6536	0.2100	364.2773 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	2627.6782	0.2100	551.8124 (264)
Space and water heating			916.0897 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	155.2782	0.1443	22.4114 (268)
Total CO ₂ , kg/year			950.4304 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			15.0600 (273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	1734.6536	1.1300	1960.1586 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	2627.6782	1.1300	2969.2764 (278)
Space and water heating			4929.4350 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	155.2782	1.5338	238.1709 (282)
Total Primary energy kWh/year			5297.7067 (286)
Dwelling Primary energy Rate (DPER)			83.9400 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	63.1100 (1b)	x 2.4000 (2b)	= 151.4640 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.1100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	151.4640 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1320 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3820 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3534 (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)

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Adj infilt rate	0.4506	0.4417	0.4329	0.3887	0.3799	0.3357	0.3357	0.3269	0.3534	0.3799	0.3976	0.4152 (22b)
Effective ac	0.6015	0.5976	0.5937	0.5756	0.5722	0.5564	0.5564	0.5534	0.5624	0.5722	0.5790	0.5862 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Opaque door			2.0000	1.0000	2.0000		(26)
TER Opening Type			8.1600	1.1450	9.3435		(27)
GF			63.1100	0.1300	8.2043		(28a)
External Wall 1	45.0000	10.1600	34.8400	0.1800	6.2712		(29a)
Corridor wall	3.3100		3.3100	0.1800	0.5958		(29a)
To balcony	8.5200		8.5200	0.1100	0.9372		(30)
Total net area of external elements Aum(A, m2)			119.9400				(31)
Fabric heat loss, W/K = Sum (A x U)					27.3520		(33)
Main dwelling							
Party Wall 1			34.8000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							239.8856 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	4.0300	0.0500	0.2015
E3 Sill	1.3800	0.0500	0.0690
E4 Jamb	7.9600	0.0500	0.3980
E5 Ground floor (normal)	18.5000	0.1600	2.9600
E6 Intermediate floor within a dwelling	0.0000	0.0000	0.0000
E5 Ground floor (normal)	1.4800	0.1600	0.2368
E7 Party floor between dwellings (in blocks of flats)	10.3000	0.0700	0.7210
E11 Eaves (insulation at rafter level)	0.0000	0.0400	0.0000
E13 Gable (insulation at rafter level)	0.0000	0.0800	0.0000
E14 Flat roof	0.0000	0.0800	0.0000
E15 Flat roof with parapet	8.2700	0.5600	4.6312
E16 Corner (normal)	4.8200	0.0900	0.4338
E17 Corner (inverted - internal area greater than external area)	2.4100	-0.0900	-0.2169
E18 Party wall between dwellings	4.8200	0.0600	0.2892
E18 Party wall between dwellings	4.8200	0.0600	0.2892
E24 Eaves (insulation at ceiling level - inverted)	0.0000	0.2400	0.0000
P1 Party wall - Ground floor	14.5000	0.0800	1.1600
P2 Party wall - Intermediate floor within a dwelling	0.0000	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	0.0000	0.0800	0.0000
R4 Ridge (vaulted ceiling)	0.0000	0.0800	0.0000
R7 Flat ceiling (inverted)	0.0000	0.0400	0.0000
R9 Roof to wall (flat ceiling)	0.0000	0.0400	0.0000
E7 Party floor between dwellings (in blocks of flats)	1.4800	0.0700	0.1036

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

Point Thermal bridges		(36a) =	11.2764 (36)
Total fabric heat loss	(33) + (36) + (36a) =		38.6284 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30.0653	30.0653	29.8682	29.6751	28.7681	28.5984	27.8083	27.8083	27.6620	28.1126	28.5984	28.9417	29.3006 (38)
Heat transfer coeff	68.6937	68.4967	68.3035	67.3965	67.2268	66.4367	66.4367	66.2904	66.7411	67.2268	67.5701	67.9290 (39)
Average = Sum(39)m / 12 =												67.3957

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.0885	1.0885	1.0854	1.0823	1.0679	1.0652	1.0527	1.0527	1.0504	1.0575	1.0652	1.0707	1.0764 (40)
HLP (average)												1.0679
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.0681 (42)
Hot water usage for mixer showers													
58.8942	58.0091	56.7194	54.2518	52.4307	50.3999	49.2456	50.5256	51.9286	54.1091	56.6297	58.6686	(42a)	
Hot water usage for baths													
25.4497	25.0717	24.5395	23.5581	22.8232	22.0084	21.5683	22.0968	22.6723	23.5442	24.5458	25.3636	(42b)	
Hot water usage for other uses													
35.8090	34.5069	33.2047	31.9026	30.6004	29.2983	29.2983	30.6004	31.9026	33.2047	34.5069	35.8090	(42c)	
Average daily hot water use (litres/day)												110.4480 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
120.1529	117.5877	114.4636	109.7125	105.8544	101.7066	100.1122	103.2228	106.5035	110.8580	115.6824	119.8412	(44)	
Energy conte	190.2928	167.4434	175.9263	150.1909	142.5004	125.0602	121.0770	127.8114	131.3295	150.4333	164.8108	187.6424 (45)	
Energy content (annual)										Total = Sum(45)m =	1834.5183		
Distribution loss (46)m = 0.15 x (45)m													
28.5439	25.1165	26.3889	22.5286	21.3751	18.7590	18.1616	19.1717	19.6994	22.5650	24.7216	28.1464	(46)	
Water storage loss (or HIU loss):													
Store volume												150.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.3938 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												0.7527 (55)	
Total storage loss													
23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)	
If cylinder contains dedicated solar storage													
23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	(61)	
Total heat required for water heating calculated for each month													
236.8877	209.5291	222.5212	195.2827	189.0953	170.1520	167.6719	174.4063	176.4213	197.0282	209.9026	234.2373	(62)	
WWHRS	-26.9240	-23.8118	-24.9343	-20.6466	-19.2419	-16.4654	-15.4337	-16.4122	-17.0358	-20.0833	-22.7519	-26.4254 (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													
209.9638	185.7173	197.5869	174.6361	169.8534	153.6866	152.2382	157.9941	159.3855	176.9449	187.1507	207.8119	(64)	
12Total per year (kWh/year)									Total per year (kWh/year) = Sum(64)m =	2132.9694	2133	(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)	

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Heat gains from water heating, kWh/month
100.5483 89.3435 95.7714 86.0119 84.6573 77.6560 77.5340 79.7732 79.7405 87.2950 90.8731 99.6670 (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	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.5137	110.1759	99.5137	102.8308	99.5137	102.8308	99.5137	99.5137	102.8308	99.5137	102.8308	99.5137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	180.7168	182.5921	177.8664	167.8061	155.1068	143.1712	135.1975	133.3222	138.0479	148.1082	160.8075	172.7431	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	(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)	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	(71)
Water heating gains (Table 5)	135.1456	132.9516	128.7250	119.4610	113.7867	107.8555	104.2124	107.2221	110.7507	117.3320	126.2126	133.9610	(72)
Total internal gains	472.3970	482.7405	463.1261	447.1189	425.4281	407.8785	392.9445	394.0789	405.6503	421.9748	446.8718	463.2388	(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
<hr/>														
Northwest					8.1600	11.2829	0.6300		0.7000		0.7700		28.1374 (81)	
<hr/>														
Solar gains	28.1374	57.2745	103.1905	169.4684	227.7988	242.8577	227.1884	181.1172	125.7392	69.9940	35.4042	22.9784 (83)		
Total gains	500.5344	540.0151	566.3166	616.5874	653.2270	650.7362	620.1329	575.1961	531.3896	491.9688	482.2760	486.2172 (84)		

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.0000 (85)
tau	61.2186	61.3946	61.5682	62.3968	62.5544	63.2982	63.2982	63.4379	63.0096	62.5544	62.2365	61.9077	
alpha	5.0812	5.0930	5.1045	5.1598	5.1703	5.2199	5.2199	5.2292	5.2006	5.1703	5.1491	5.1272	
util living area	0.9916	0.9864	0.9745	0.9298	0.8190	0.6270	0.4664	0.5209	0.7733	0.9456	0.9840	0.9927	(86)
MIT	19.8446	19.9873	20.2206	20.5684	20.8392	20.9693	20.9945	20.9905	20.9115	20.5829	20.1723	19.8283	(87)
Th 2	20.0103	20.0128	20.0153	20.0271	20.0293	20.0396	20.0396	20.0415	20.0357	20.0293	20.0249	20.0202	(88)
util rest of house	0.9891	0.9823	0.9664	0.9076	0.7673	0.5436	0.3672	0.4171	0.6964	0.9236	0.9784	0.9905	(89)
MIT 2	18.6796	18.8624	19.1581	19.5919	19.8949	20.0221	20.0378	20.0381	19.9758	19.6186	19.1072	18.6662	(90)
Living area fraction	19.1435	19.3103	19.5812	19.9807	20.2709	20.3992	20.4188	20.4174	20.3484	20.0026	19.5313	19.1289	(91)
MIT	19.1435	19.3103	19.5812	19.9807	20.2709	20.3992	20.4188	20.4174	20.3484	20.0026	19.5313	19.1289	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1435	19.3103	19.5812	19.9807	20.2709	20.3992	20.4188	20.4174	20.3484	20.0026	19.5313	19.1289	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9861	0.9785	0.9619	0.9064	0.7812	0.5758	0.4068	0.4585	0.7232	0.9229	0.9747	0.9879	(94)
Useful gains	493.5870	528.3864	544.7588	558.8441	510.2950	374.6853	252.2895	263.7409	384.2916	454.0440	470.0775	480.3117	(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	1019.6555	987.0564	893.4901	746.8004	576.1931	385.2823	253.7066	266.3125	417.0238	632.1043	839.9850	1014.1052	(97)
Space heating kWh	391.3949	308.2262	259.4561	135.3286	49.0282	0.0000	0.0000	0.0000	0.0000	132.4769	266.3334	397.1423	(98a)
Space heating requirement - total per year (kWh/year)												1939.3866	
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	391.3949	308.2262	259.4561	135.3286	49.0282	0.0000	0.0000	0.0000	0.0000	132.4769	266.3334	397.1423	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1939.3866	
Space heating per m2										(98c) / (4) =		30.7303	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													92.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	391.3949	308.2262	259.4561	135.3286	49.0282	0.0000	0.0000	0.0000	0.0000	132.4769	266.3334	397.1423	(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)	424.0465	333.9396	281.1008	146.6181	53.1183	0.0000	0.0000	0.0000	0.0000	143.5286	288.5519	430.2733	(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)

13a. Primary energy - Individual heating systems including micro-CHP			
	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	2101.1772	1.1300	2374.3303 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	2571.1489	1.1300	2905.3983 (278)
Space and water heating			5279.7285 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	166.8751	1.5338	255.9586 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-643.7370	1.4971	-963.7223
PV Unit electricity exported	-915.9480	0.4620	-423.1688
Total			-1386.8910 (283)
Total Primary energy kWh/year			4278.8969 (286)
Target Primary Energy Rate (TPER)			67.8000 (287)

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Plot Reference	Green_ori	Issued on Date	24/02/2026
Assessment Reference	G-NW	Plot Type Ref	
Plot Address		SAP Version	10.2
SAP Rating	81 B	DER	5.00
Environmental	96 A	% DER < TER	12.92
CO ₂ Emissions (t/year)	0.29	DFEE	33.27
Compliance Check	See BREL	TFEE	38.29
% DPER < TPER	22.26	TPER	13.10
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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	63.1100 (1b)	2.4000 (2b)	151.4640 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.1100		151.4640 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 151.4640 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	1 * 10 = 10.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	10.0000 / (5) = 0.0660 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.5000 (17)
Infiltration rate	0.2410 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2229 (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	0.2843	0.2787	0.2731	0.2452	0.2397	0.2118	0.2118	0.2062	0.2229	0.2397	0.2508	0.2620 (22b)
Effective ac	0.5404	0.5388	0.5373	0.5301	0.5287	0.5224	0.5224	0.5213	0.5249	0.5287	0.5315	0.5343 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Windows			8.1600	1.1450	9.3435		(27)
Door			2.0000	1.0000	2.0000		(26)
GF			63.1100	0.1000	6.3110	110.0000	6942.1000 (28a)
External Wall 1	45.0000	10.1600	34.8400	0.1800	6.2712	140.0000	4877.6000 (29a)
Corridor wall	3.3100		3.3100	0.2500	0.8275	140.0000	463.4000 (29a)
To balcony	8.5200		8.5200	0.1000	0.8520	9.0000	76.6800 (30)
Total net area of external elements Aum(A, m ²)			119.9400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.6052		(33)
Main dwelling							
Party Wall 1			34.8000	0.0000	0.0000	20.0000	696.0000 (32)
Party Ceiling 1			60.8800			20.0000	1217.6000 (32b)
Internal Wall 1			96.2000			9.0000	865.8000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15139.1799 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							239.8856 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				4.0300	0.0500	0.2015	
E3 Sill				1.3800	0.0500	0.0690	
E4 Jamb				7.9600	0.0500	0.3980	

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E5 Ground floor (normal)	18.5000	0.0800	1.4800										
E6 Intermediate floor within a dwelling	0.0000	0.0000	0.0000										
E5 Ground floor (normal)	1.4800	0.0800	0.1184										
E7 Party floor between dwellings (in blocks of flats)	10.3000	0.0700	0.7210										
E11 Eaves (insulation at rafter level)	0.0000	0.0400	0.0000										
E13 Gable (insulation at rafter level)	0.0000	0.0800	0.0000										
E14 Flat roof	0.0000	0.0800	0.0000										
E15 Flat roof with parapet	8.2700	0.3000	2.4810										
E16 Corner (normal)	4.8200	0.0900	0.4338										
E17 Corner (inverted - internal area greater than external area)	2.4100	-0.0900	-0.2169										
E18 Party wall between dwellings	4.8200	0.0600	0.2892										
E18 Party wall between dwellings	4.8200	0.0600	0.2892										
E24 Eaves (insulation at ceiling level - inverted)	0.0000	0.2400	0.0000										
P1 Party wall - Ground floor	14.5000	0.0800	1.1600										
P2 Party wall - Intermediate floor within a dwelling	0.0000	0.0000	0.0000										
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5000	0.0000	0.0000										
P5 Party wall - Roof (insulation at rafter level)	0.0000	0.0800	0.0000										
R4 Ridge (vaulted ceiling)	0.0000	0.0800	0.0000										
R7 Flat ceiling (inverted)	0.0000	0.0400	0.0000										
R9 Roof to wall (flat ceiling)	0.0000	0.0400	0.0000										
E7 Party floor between dwellings (in blocks of flats)	1.4800	0.0700	0.1036										
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				7.5278 (36)									
Point Thermal bridges				0.0000									
Total fabric heat loss		(33) + (36) + (36a) =		33.1330 (37)									
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	27.0109	26.9325	26.8556	26.4946	26.4271	26.1126	26.1126	26.0544	26.2338	26.4271	26.5637	26.7066	(38)
Average = Sum(39)m / 12 =	60.1439	60.0655	59.9886	59.6276	59.5601	59.2457	59.2457	59.1874	59.3668	59.5601	59.6967	59.8396	(39)
												59.6273	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9530	0.9518	0.9505	0.9448	0.9438	0.9388	0.9388	0.9378	0.9407	0.9438	0.9459	0.9482	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
												0.9448	
												31	

4. Water heating energy requirements (kWh/year)													

Assumed occupancy													2.0681 (42)
Hot water usage for mixer showers													
	58.8942	58.0091	56.7194	54.2518	52.4307	50.3999	49.2456	50.5256	51.9286	54.1091	56.6297	58.6686	(42a)
Hot water usage for baths	25.4497	25.0717	24.5395	23.5581	22.8232	22.0084	21.5683	22.0968	22.6723	23.5442	24.5458	25.3636	(42b)
Hot water usage for other uses	35.8090	34.5069	33.2047	31.9026	30.6004	29.2983	29.2983	30.6004	31.9026	33.2047	34.5069	35.8090	(42c)
Average daily hot water use (litres/day)													110.4480 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	120.1529	117.5877	114.4636	109.7125	105.8544	101.7066	100.1122	103.2228	106.5035	110.8580	115.6824	119.8412	(44)
Energy conte	190.2928	167.4434	175.9263	150.1909	142.5004	125.0602	121.0770	127.8114	131.3295	150.4333	164.8108	187.6424	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													
	28.5439	25.1165	26.3889	22.5286	21.3751	18.7590	18.1616	19.1717	19.6994	22.5650	24.7216	28.1464	(46)
Water storage loss (or HIU loss):													
Store volume													150.0000 (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													0.9283 (52)
Temperature factor from Table 2b													0.5400 (53)
Enter (49) or (54) in (55)													0.8683 (55)
Total storage loss													
	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(56)
If cylinder contains dedicated solar storage													
	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(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	240.4728	212.7672	226.1063	198.7521	192.6804	173.6214	171.2570	177.9914	179.8907	200.6133	213.3720	237.8224	(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	240.4728	212.7672	226.1063	198.7521	192.6804	173.6214	171.2570	177.9914	179.8907	200.6133	213.3720	237.8224	(64)

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6. Solar gains

[Jan]				Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g	Specific data or Table 6c	FF Table 6d	Access factor Table 6d	Gains W
Northwest				8.1600	11.2829		0.4000		0.7000	0.7700	17.8650 (81)
Solar gains	17.8650	36.3648	65.5178	107.5990	144.6342	154.1953	144.2466	114.9951	79.8344	44.4407	14.5895 (83)
Total gains	494.1169	522.9602	532.4988	558.5728	573.9172	565.9288	541.0460	512.9289	489.3397	470.2703	481.6832 (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
tau	69.9211	70.0124	70.1021	70.5265	70.6065	70.9812	70.9812	71.0510	70.8364	70.6065	70.4449
alpha	5.6614	5.6675	5.6735	5.7018	5.7071	5.7321	5.7321	5.7367	5.7224	5.7071	5.6963
util living area											
	0.9908	0.9857	0.9751	0.9360	0.8354	0.6461	0.4780	0.5241	0.7664	0.9407	0.9821
											0.9920 (86)
MIT	20.2416	20.3279	20.4659	20.6736	20.8437	20.9274	20.9430	20.9412	20.8984	20.7032	20.4459
Th 2	20.1227	20.1237	20.1248	20.1296	20.1305	20.1347	20.1347	20.1355	20.1331	20.1305	20.1286
util rest of house											
	0.9881	0.9815	0.9675	0.9161	0.7887	0.5685	0.3860	0.4291	0.6944	0.9183	0.9760
MIT 2	19.2397	19.3499	19.5245	19.7825	19.9738	20.0543	20.0642	20.0643	20.0312	19.8221	19.5040
Living area fraction											
	19.6386	19.7393	19.8993	20.1373	20.3202	20.4020	20.4142	20.4135	20.3765	20.1730	19.8791
Temperature adjustment											
adjusted MIT	19.6386	19.7393	19.8993	20.1373	20.3202	20.4020	20.4142	20.4135	20.3765	20.1730	19.8791
											0.0000
											19.6201 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9862	0.9793	0.9651	0.9163	0.7997	0.5932	0.4160	0.4601	0.7160	0.9195	0.9739	0.9880 (94)
Useful gains	487.3176	512.1239	513.9305	511.8429	458.9604	335.7158	225.0877	235.9971	350.3660	432.4279	460.8691	475.8908 (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	922.5252	891.3314	803.8085	670.0548	513.4175	343.7405	225.9727	237.5467	372.6169	570.1665	762.8680	922.7305 (97)
Space heating kWh	323.7945	254.8275	215.6692	113.9126	40.5161	0.0000	0.0000	0.0000	0.0000	102.4775	217.4392	332.4487 (98a)
Space heating requirement - total per year (kWh/year)												1601.0853
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	323.7945	254.8275	215.6692	113.9126	40.5161	0.0000	0.0000	0.0000	0.0000	102.4775	217.4392	332.4487 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1601.0853
Space heating per m ²										(98c) / (4) =		25.3698 (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	323.7945	254.8275	215.6692	113.9126	40.5161	0.0000	0.0000	0.0000	0.0000	102.4775	217.4392	332.4487 (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)	147.6491	116.2004	98.3444	51.9437	18.4752	0.0000	0.0000	0.0000	0.0000	46.7294	99.1515	151.5954 (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	240.4728	212.7672	226.1063	198.7521	192.6804	173.6214	171.2570	177.9914	179.8907	200.6133	213.3720	237.8224 (64)
Efficiency of water heater (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 (216)
Fuel for water heating, kWh/month	126.2987	111.7475	118.7533	104.3866	101.1977	91.1877	89.9459	93.4829	94.4804	105.3641	112.0651	124.9067 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	19.2400	15.4351	13.8976	10.1820	7.8648	6.4256	7.1746	9.3258	12.1133	15.8933	17.9514	19.7748 (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)

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Annual totals kWh/year	
Space heating fuel - main system 1	730.0891 (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	1273.8167 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	155.2782 (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	2159.1840 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	730.0891	0.1556	113.6094 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	1273.8167	0.1409	179.4553 (264)
Space and water heating			293.0646 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	155.2782	0.1443	22.4114 (268)
Total CO ₂ , kg/year			315.4761 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.0000 (273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	730.0891	1.5761	1150.7096 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	1273.8167	1.5209	1937.3761 (278)
Space and water heating			3088.0858 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	155.2782	1.5338	238.1709 (282)
Total Primary energy kWh/year			3326.2567 (286)
Dwelling Primary energy Rate (DPER)			52.7100 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	63.1100 (1b)	x 2.4000 (2b)	= 151.4640 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.1100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	151.4640 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1320 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3820 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3534 (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	0.4506	0.4417	0.4329	0.3887	0.3799	0.3357	0.3357	0.3269	0.3534	0.3799	0.3976	0.4152 (22b)

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Effective ac 0.6015 0.5976 0.5937 0.5756 0.5722 0.5564 0.5564 0.5534 0.5624 0.5722 0.5790 0.5862 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type			8.1600	1.1450	9.3435			(27)
GF			63.1100	0.1300	8.2043			(28a)
External Wall 1	45.0000	10.1600	34.8400	0.1800	6.2712			(29a)
Corridor wall	3.3100		3.3100	0.1800	0.5958			(29a)
To balcony	8.5200		8.5200	0.1100	0.9372			(30)
Total net area of external elements Aum(A, m2)			119.9400					(31)
Fabric heat loss, W/K = Sum (A x U)					27.3520			(33)
Main dwelling								
Party Wall 1			34.8000	0.0000	0.0000			(32)

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

239.8856 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	4.0300	0.0500	0.2015
E3 Sill	1.3800	0.0500	0.0690
E4 Jamb	7.9600	0.0500	0.3980
E5 Ground floor (normal)	18.5000	0.1600	2.9600
E6 Intermediate floor within a dwelling	0.0000	0.0000	0.0000
E5 Ground floor (normal)	1.4800	0.1600	0.2368
E7 Party floor between dwellings (in blocks of flats)	10.3000	0.0700	0.7210
E11 Eaves (insulation at rafter level)	0.0000	0.0400	0.0000
E13 Gable (insulation at rafter level)	0.0000	0.0800	0.0000
E14 Flat roof	0.0000	0.0800	0.0000
E15 Flat roof with parapet	8.2700	0.5600	4.6312
E16 Corner (normal)	4.8200	0.0900	0.4338
E17 Corner (inverted - internal area greater than external area)	2.4100	-0.0900	-0.2169
E18 Party wall between dwellings	4.8200	0.0600	0.2892
E18 Party wall between dwellings	4.8200	0.0600	0.2892
E24 Eaves (insulation at ceiling level - inverted)	0.0000	0.2400	0.0000
P1 Party wall - Ground floor	14.5000	0.0800	1.1600
P2 Party wall - Intermediate floor within a dwelling	0.0000	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	0.0000	0.0800	0.0000
R4 Ridge (vaulted ceiling)	0.0000	0.0800	0.0000
R7 Flat ceiling (inverted)	0.0000	0.0400	0.0000
R9 Roof to wall (flat ceiling)	0.0000	0.0400	0.0000
E7 Party floor between dwellings (in blocks of flats)	1.4800	0.0700	0.1036

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

11.2764 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 38.6284 (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	30.0653	29.8682	29.6751	28.7681	28.5984	27.8083	27.8083	27.6620	28.1126	28.5984	28.9417	29.3006
Heat transfer coeff	68.6937	68.4967	68.3035	67.3965	67.2268	66.4367	66.4367	66.2904	66.7411	67.2268	67.5701	67.9290
Average = Sum(39)m / 12 =												67.3957

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0885	1.0854	1.0823	1.0679	1.0652	1.0527	1.0527	1.0504	1.0575	1.0652	1.0707	1.0764
HLP (average)												1.0679
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.0681 (42)
Hot water usage for mixer showers												
58.8942	58.0091	56.7194	54.2518	52.4307	50.3999	49.2456	50.5256	51.9286	54.1091	56.6297	58.6686	(42a)
Hot water usage for baths												
25.4497	25.0717	24.5395	23.5581	22.8232	22.0084	21.5683	22.0968	22.6723	23.5442	24.5458	25.3636	(42b)
Hot water usage for other uses												
35.8090	34.5069	33.2047	31.9026	30.6004	29.2983	29.2983	30.6004	31.9026	33.2047	34.5069	35.8090	(42c)
Average daily hot water use (litres/day)												110.4480 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	120.1529	117.5877	114.4636	109.7125	105.8544	101.7066	100.1122	103.2228	106.5035	110.8580	115.6824	119.8412
Energy conte	190.2928	167.4434	175.9263	150.1909	142.5004	125.0602	121.0770	127.8114	131.3295	150.4333	164.8108	187.6424
Energy content (annual)										Total = Sum(45)m =		1834.5183
Distribution loss (46)m = 0.15 x (45)m	28.5439	25.1165	26.3889	22.5286	21.3751	18.7590	18.1616	19.1717	19.6994	22.5650	24.7216	28.1464

Water storage loss (or HIU loss):

Store volume

150.0000 (47)

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

Temperature factor from Table 2b

1.3938 (48)

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

0.5400 (49)

Total storage loss

0.7527 (55)

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325
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(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325
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(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
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(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
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(61)

Total heat required for water heating calculated for each month

236.8877	209.5291	222.5212	195.2827	189.0953	170.1520	167.6719	174.4063	176.4213	197.0282	209.9026	234.2373	234.2373
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(62)

WWHRS	-26.9240	-23.8118	-24.9343	-20.6466	-19.2419	-16.4654	-15.4337	-16.4122	-17.0358	-20.0833	-22.7519	-26.4254
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(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
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(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
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(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
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(63d)

Output from w/h	209.9638	185.7173	197.5869	174.6361	169.8534	153.6866	152.2382	157.9941	159.3855	176.9449	187.1507	207.8119
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(64)

12Total per year (kWh/year)

Total per year (kWh/year) = Sum(64)m = 2132.9694 (64)

Electric shower(s)

2133 (64)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
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(64a)

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

0.0000 (64a)

Heat gains from water heating, kWh/month

100.5483	89.3435	95.7714	86.0119	84.6573	77.6560	77.5340	79.7732	79.7405	87.2950	90.8731	99.6670	99.6670
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(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	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	103.4032	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.5137	110.1759	99.5137	102.8308	99.5137	102.8308	99.5137	99.5137	102.8308	99.5137	102.8308	99.5137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	180.7168	182.5921	177.8664	167.8061	155.1068	143.1712	135.1975	133.3222	138.0479	148.1082	160.8075	172.7431	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	33.3403	(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)	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	-82.7225	(71)
Water heating gains (Table 5)	135.1456	132.9516	128.7250	119.4610	113.7867	107.8555	104.2124	107.2221	110.7507	117.3320	126.2126	133.9610	(72)
Total internal gains	472.3970	482.7405	463.1261	447.1189	425.4281	407.8785	392.9445	394.0789	405.6503	421.9748	446.8718	463.2388	(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	
Northwest	8.1600				11.2829		0.6300		0.7000		0.7700		28.1374 (81)	
Solar gains	28.1374	57.2745	103.1905	169.4684	227.7988	242.8577	227.1884	181.1172	125.7392	69.9940	35.4042	22.9784	(83)	
Total gains	500.5344	540.0151	566.3166	616.5874	653.2270	650.7362	620.1329	575.1961	531.3896	491.9688	482.2760	486.2172	(84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)														
tau	61.2186	61.3946	61.5682	62.3968	62.5544	63.2982	63.2982	63.4379	63.0096	62.5544	62.2365	61.9077	61.9077	
alpha	5.0812	5.0930	5.1045	5.1598	5.1703	5.2199	5.2199	5.2292	5.2006	5.1703	5.1491	5.1272	5.1272	
util living area	0.9916	0.9864	0.9745	0.9298	0.8190	0.6270	0.4664	0.5209	0.7733	0.9456	0.9840	0.9927	0.9927	(86)
MIT	19.8446	19.9873	20.2206	20.5684	20.8392	20.9693	20.9945	20.9905	20.9115	20.5829	20.1723	19.8283	19.8283	(87)
Th 2	20.0103	20.0128	20.0153	20.0271	20.0293	20.0396	20.0396	20.0415	20.0357	20.0293	20.0249	20.0202	20.0202	(88)
util rest of house	0.9891	0.9823	0.9664	0.9076	0.7673	0.5436	0.3672	0.4171	0.6964	0.9236	0.9784	0.9905	0.9905	(89)
MIT 2	18.6796	18.8624	19.1581	19.5919	19.8949	20.0221	20.0378	20.0381	19.9758	19.6186	19.1072	18.6662	18.6662	(90)
Living area fraction									fLA = Living area / (4) =			0.3982	0.3982	(91)
MIT	19.1435	19.3103	19.5812	19.9807	20.2709	20.3992	20.4188	20.4174	20.3484	20.0026	19.5313	19.1289	19.1289	(92)
Temperature adjustment												0.0000	0.0000	
adjusted MIT	19.1435	19.3103	19.5812	19.9807	20.2709	20.3992	20.4188	20.4174	20.3484	20.0026	19.5313	19.1289	19.1289	(93)

8. Space heating requirement

Utilisation	0.9861	0.9785	0.9619	0.9064	0.7812	0.5758	0.4068	0.4585	0.7232	0.9229	0.9747	0.9879	0.9879	(94)
Useful gains	493.5870	528.3864	544.7588	558.8441	510.2950	374.6853	252.2895	263.7409	384.2916	454.0440	470.0775	480.3117	480.3117	(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	4.2000	(96)
Heat loss rate W	1019.6555	987.0564	893.4901	746.8005	576.1932	385.2823	253.7066	266.3125	417.0238	632.1043	839.9850	1014.1052	1014.1052	(97)
Space heating kWh	391.3950	308.2263	259.4561	135.3286	49.0282	0.0000	0.0000	0.0000	0.0000	132.4769	266.3334	397.1423	397.1423	(98a)
Space heating requirement - total per year (kWh/year)												1939.3866	1939.3866	
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	0.0000	(98b)
Space heating contribution - total per year (kWh/year)												0.0000	0.0000	
Space heating kWh	391.3950	308.2263	259.4561	135.3286	49.0282	0.0000	0.0000	0.0000	0.0000	132.4769	266.3334	397.1423	397.1423	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1939.3866	1939.3866	
Space heating per m ²												(98c) / (4) =	30.7303	(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	391.3950	308.2263	259.4561	135.3286	49.0282	0.0000	0.0000	0.0000	0.0000	132.4769	266.3334	397.1423	397.1423	(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	92.3000	(210)
Space heating fuel (main heating system)	424.0465	333.9396	281.1008	146.6182	53.1183	0.0000	0.0000	0.0000	0.0000	143.5286	288.5519	430.2734	430.2734	(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	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	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	0.0000	(215)

Water heating
Water heating requirement

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Efficiency of water heater (217)m	209.9638	185.7173	197.5869	174.6361	169.8534	153.6866	152.2382	157.9941	159.3855	176.9449	187.1507	207.8119 (64)
Fuel for water heating, kWh/month	85.4357	85.1876	84.6716	83.4946	81.6537	79.8000	79.8000	79.8000	79.8000	83.4198	84.8507	79.8000 (216)
Space cooling fuel requirement (221)m	245.7564	218.0097	233.3567	209.1586	208.0168	192.5897	190.7747	197.9876	199.7313	212.1137	220.5648	243.0890 (219)
Pumps and Fa	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)
Lighting	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685 (231)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	20.6770	16.5878	14.9355	10.9424	8.4522	6.9055	7.7104	10.0223	13.0179	17.0802	19.2921	21.2517 (232)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-29.8252	-42.1976	-60.8730	-68.7108	-74.3398	-69.5070	-68.6863	-64.7503	-57.7977	-48.4200	-32.8580	-25.7712 (233a)
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 (234a)
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 (235a)
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 (235c)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	-16.3775	-34.5140	-68.7041	-103.3280	-136.7425	-137.4097	-135.7550	-114.8539	-84.0920	-49.3587	-21.8696	-12.9430 (233b)
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 (234b)
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 (235b)
Annual totals kWh/year	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)
Space heating fuel - main system 1												2101.1773 (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												2571.1489 (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)												166.8751 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1559.6849 (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												3365.5163 (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	2101.1773	0.2100	441.2472 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2571.1489	0.2100	539.9413 (264)
Space and water heating			981.1885 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	166.8751	0.1443	24.0852 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-643.7370	0.1345	-86.5810
PV Unit electricity exported	-915.9480	0.1259	-115.2835
Total			-201.8644 (269)
Total CO2, kg/year			815.3385 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.9200 (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	2101.1773	1.1300	2374.3303 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2571.1489	1.1300	2905.3983 (278)
Space and water heating			5279.7286 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	166.8751	1.5338	255.9586 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-643.7370	1.4971	-963.7223
PV Unit electricity exported	-915.9480	0.4620	-423.1688
Total			-1386.8910 (283)
Total Primary energy kWh/year			4278.8969 (286)
Target Primary Energy Rate (TPER)			67.8000 (287)

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Plot Reference	Lean_ori	Issued on Date	24/02/2026
Assessment Reference	HT05-NE	Plot Type Ref	
Plot Address		SAP Version	10.2
SAP Rating	86 B	DER	12.84
Environmental	88 B	% DER < TER	-25.15
CO ₂ Emissions (t/year)	1.25	DFEE	34.17
Compliance Check	See BREL	% DFEE < TFEE	1.11
% DPER < TPER	-33.03	DPER	71.26
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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	40.5800 (1b)	x 2.4000 (2b)	= 97.3920 (1b) - (3b)
First floor	40.5800 (1c)	x 2.7000 (2c)	= 109.5660 (1c) - (3c)
Second floor	27.9700 (1d)	x 2.7000 (2d)	= 75.5190 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.1300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 282.4770 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	30.0000 / (5) = 0.1062 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.5000 (17)
Infiltration rate	0.2812 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2601 (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	0.3316	0.3251	0.3186	0.2861	0.2796	0.2471	0.2471	0.2406	0.2601	0.2796	0.2926	0.3056 (22b)
Effective ac	0.5550	0.5529	0.5508	0.5409	0.5391	0.5305	0.5305	0.5289	0.5338	0.5391	0.5428	0.5467 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Windows			17.3000	1.1450	19.8092		(27)
Door			2.0000	1.0000	2.0000		(26)
GF			40.6000	0.1000	4.0600	110.0000	4466.0000 (28a)
External Wall 1	91.9800	19.3000	72.6800	0.1800	13.0824	140.0000	10175.2000 (29a)
External Roof 1	56.6000		56.6000	0.1000	5.6600	9.0000	509.4000 (30)
Total net area of external elements A _{um} (A, m ²)			189.1800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.6116		(33)
Main dwelling							
Party Wall 1			64.5000	0.0000	0.0000	20.0000	1290.0000 (32)
Party Ceiling 1			46.9000			20.0000	938.0000 (32b)
Internal Wall 1			200.5900			9.0000	1805.3100 (32c)
Internal Floor 1			68.5100			18.0000	1233.1800 (32d)
Internal Ceiling 1			81.0000			9.0000	729.0000 (32e)
Heat capacity C _m = Sum (A x k)							(28)...(30) + (32) + (32a)...(32e) = 21146.0900 (34)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K							193.7697 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	

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E2 Other lintels (including other steel lintels)	12.3700	0.0500	0.6185											
E3 Sill	9.6600	0.0500	0.4830											
E4 Jamb	26.8600	0.0500	1.3430											
E5 Ground floor (normal)	18.0300	0.0800	1.4424											
E6 Intermediate floor within a dwelling	18.0300	0.0000	0.0000											
E5 Ground floor (normal)	0.0000	0.0800	0.0000											
E7 Party floor between dwellings (in blocks of flats)	0.0000	0.0700	0.0000											
E11 Eaves (insulation at rafter level)	8.6200	0.0400	0.3448											
E13 Gable (insulation at rafter level)	9.4000	0.0800	0.7520											
E14 Flat roof	0.0000	0.0800	0.0000											
E15 Flat roof with parapet	0.0000	0.3000	0.0000											
E16 Corner (normal)	15.6000	0.0900	1.4040											
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000											
E18 Party wall between dwellings	15.6000	0.0600	0.9360											
E18 Party wall between dwellings	0.0000	0.0600	0.0000											
E24 Eaves (insulation at ceiling level - inverted)	0.0000	0.2400	0.0000											
P1 Party wall - Ground floor	9.4000	0.0800	0.7520											
P2 Party wall - Intermediate floor within a dwelling	9.4000	0.0000	0.0000											
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	0.0000	0.0000	0.0000											
P5 Party wall - Roof (insulation at rafter level)	13.1100	0.0800	1.0488											
R4 Ridge (vaulted ceiling)	4.3000	0.0800	0.3440											
R7 Flat ceiling (inverted)	1.5000	0.0400	0.0600											
R9 Roof to wall (flat ceiling)	3.8000	0.0400	0.1520											
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.6805	(36)										
Point Thermal Bridges			0.0000											
Total fabric heat loss		(33) + (36) + (36a) =	54.2921	(37)										
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)														
(38)m	Jan 51.7351	Feb 51.5360	Mar 51.3409	Apr 50.4244	May 50.2530	Jun 49.4547	Jul 49.4547	Aug 49.3069	Sep 49.7622	Oct 50.2530	Nov 50.5998	Dec 50.9625	(38)	
Heat transfer coeff	106.0272	105.8281	105.6330	104.7165	104.5450	103.7468	103.7468	103.5990	104.0543	104.5450	104.8919	105.2546	(39)	
Average = Sum(39)m / 12 =												104.7157		
HLP	Jan 0.9716	Feb 0.9697	Mar 0.9680	Apr 0.9596	May 0.9580	Jun 0.9507	Jul 0.9507	Aug 0.9493	Sep 0.9535	Oct 0.9580	Nov 0.9612	Dec 0.9645	(40)	
HLP (average)												0.9595		
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31		

4. Water heating energy requirements (kWh/year)														

Assumed occupancy													2.8095	(42)
Hot water usage for mixer showers	71.3259	70.2540	68.6921	65.7036	63.4981	61.0386	59.6406	61.1908	62.8900	65.5307	68.5835	71.0526	(42a)	
Hot water usage for baths	30.7957	30.3383	29.6943	28.5068	27.6175	26.6316	26.0990	26.7385	27.4349	28.4899	29.7019	30.6916	(42b)	
Hot water usage for other uses	43.4021	41.8238	40.2456	38.6673	37.0891	35.5108	35.5108	37.0891	38.6673	40.2456	41.8238	43.4021	(42c)	
Average daily hot water use (litres/day)												133.7690	(43)	
Daily hot water use	Jan 145.5237	Feb 142.4162	Mar 138.6319	Apr 132.8776	May 128.2047	Jun 123.1810	Jul 121.2504	Aug 125.0184	Sep 128.9922	Oct 134.2663	Nov 140.1092	Dec 145.1463	(44)	
Energy conte	230.4740	202.7988	213.0721	181.9028	172.5882	151.4654	146.6419	154.7989	159.0603	182.1981	199.6113	227.2641	(45)	
Energy content (annual)										Total = Sum(45)m =		2221.8758		
Distribution loss (46)m = 0.15 x (45)m	34.5711	30.4198	31.9608	27.2854	25.8882	22.7198	21.9963	23.2198	23.8590	27.3297	29.9417	34.0896	(46)	
Water storage loss (or HIU loss):														
Store volume												150.0000	(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												0.9283	(52)	
Temperature factor from Table 2b												0.5400	(53)	
Enter (49) or (54) in (55)												0.8683	(55)	
Total storage loss	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(56)	
If cylinder contains dedicated solar storage	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(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	280.6540	248.1226	263.2521	230.4641	222.7682	200.0266	196.8218	204.9788	207.6216	232.3780	248.1725	277.4440	(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	280.6540	248.1226	263.2521	230.4641	222.7682	200.0266	196.8218	204.9788	207.6216	232.3780	248.1725	277.4440	(64)	
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2812.7045	(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	116.7766	103.6897	110.9905	99.3317	97.5296	89.2112	88.9024	91.6146	91.7366	100.7248	105.2198	115.7093	(65)	

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

Metabolic gains (Table 5), Watts														
(66)m	Jan 140.4751	Feb 140.4751	Mar 140.4751	Apr 140.4751	May 140.4751	Jun 140.4751	Jul 140.4751	Aug 140.4751	Sep 140.4751	Oct 140.4751	Nov 140.4751	Dec 140.4751	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	142.4972	157.7647	142.4972	147.2471	142.4972	147.2471	142.4972	142.4972	147.2471	142.4972	147.2471	142.4972	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.3001	273.1050	266.0368	250.9895	231.9949	214.1427	202.2164	199.4115	206.4797	221.5270	240.5216	258.3737	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	(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)	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	(71)	
Water heating gains (Table 5)	156.9578	154.3001	149.1807	137.9607	131.0881	123.9045	119.4925	123.1379	127.4119	135.3828	146.1385	155.5232	(72)	
Total internal gains	637.8976	653.3123	625.8572	604.3398	573.7228	550.4369	529.3486	530.1891	546.2812	567.5496	602.0497	624.5367	(73)	

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Northeast				7.6000	11.2829		0.4000		0.7000	0.7700	16.6390 (75)
Southeast				1.9400	36.7938		0.4000		0.7000	0.7700	13.8506 (77)
Southwest				7.7600	36.7938		0.4000		0.7000	0.7700	55.4023 (79)
Solar gains	85.8919	151.8325	222.4240	300.2004	358.7089	365.9940	348.7460	303.5857	249.1205	171.7654	72.8543 (83)
Total gains	723.7895	805.1448	848.2813	904.5402	932.4316	916.4309	878.0946	833.7749	795.4017	739.3150	697.3910 (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	55.4001	55.5043	55.6068	56.0935	56.1855	56.6178	56.6178	56.6986	56.4505	56.1855	55.9997	55.8067	
alpha	4.6933	4.7003	4.7071	4.7396	4.7457	4.7745	4.7745	4.7799	4.7634	4.7457	4.7333	4.7204	
util living area	0.9911	0.9842	0.9714	0.9323	0.8428	0.6738	0.5086	0.5540	0.7816	0.9424	0.9831	0.9925 (86)	
MIT	19.9514	20.0835	20.2735	20.5383	20.7603	20.8916	20.9259	20.9215	20.8448	20.5693	20.2201	19.9288 (87)	
Th 2	20.1071	20.1086	20.1101	20.1172	20.1185	20.1246	20.1246	20.1258	20.1223	20.1185	20.1158	20.1130 (88)	
util rest of house	0.9889	0.9804	0.9640	0.9142	0.8013	0.5987	0.4127	0.4566	0.7160	0.9233	0.9782	0.9906 (89)	
MIT 2	18.8730	19.0419	19.2830	19.6160	19.8751	20.0120	20.0375	20.0363	19.9702	19.6596	19.2223	18.8489 (90)	
Living area fraction									fLA = Living area / (4) =				0.1623 (91)
MIT	19.0480	19.2109	19.4438	19.7657	20.0188	20.1548	20.1817	20.1800	20.1121	19.8072	19.3842	19.0242 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.0480	19.2109	19.4438	19.7657	20.0188	20.1548	20.1817	20.1800	20.1121	19.8072	19.3842	19.0242 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9854	0.9753	0.9571	0.9056	0.7960	0.6015	0.4191	0.4629	0.7151	0.9151	0.9729	0.9875 (94)
Useful gains	713.1961	785.2497	811.8535	819.1458	742.2115	551.2142	368.0315	385.9235	568.8169	676.5112	686.8315	688.6876 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.0000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1563.6852	1514.4982	1367.2872	1137.8133	869.6855	576.2877	371.5875	391.6007	625.5867	962.5666	1288.5154	1560.3119 (97)
Space heating kWh	632.7639	490.0550	413.2427	229.4406	94.8407	0.0000	0.0000	0.0000	0.0000	212.8252	433.2124	648.4885 (98a)
Space heating requirement - total per year (kWh/year)												3154.8689
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	632.7639	490.0550	413.2427	229.4406	94.8407	0.0000	0.0000	0.0000	0.0000	212.8252	433.2124	648.4885 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3154.8689
Space heating per m2										(98c) / (4) =		28.9093 (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	632.7639	490.0550	413.2427	229.4406	94.8407	0.0000	0.0000	0.0000	0.0000	212.8252	433.2124	648.4885 (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)	685.5514	530.9371	447.7169	248.5814	102.7526	0.0000	0.0000	0.0000	0.0000	230.5799	469.3525	702.5877 (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	280.6540	248.1226	263.2521	230.4641	222.7682	200.0266	196.8218	204.9788	207.6216	232.3780	248.1725	277.4440 (64)
Efficiency of water heater	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000 (216)
Fuel for water heating, kWh/month	304.0671	268.8219	285.2135	249.6903	241.3523	216.7136	213.2414	222.0789	224.9421	251.7638	268.8760	300.5894 (219)
Space cooling fuel requirement	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	27.5505	22.1020	19.9004	14.5799	11.2619	9.2011	10.2735	13.3539	17.3454	22.7581	25.7052	28.3162 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)

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

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

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

1. Overall dwelling characteristics

2. Ventilation rate

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000	Air changes per hour	
Pressure test		/ (5) =	0.1416	(8)
Pressure Test Method			Yes	
Measured/design AP50			Blower Door	
Infiltration rate			5.0000	(17)
Number of sides sheltered			0.3916	(18)
			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)

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Infiltration rate adjusted to include shelter factor

$$(21) = (18) \times (20) = 0.3622 \quad (21)$$

	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													
	0.4618	0.4528	0.4437	0.3985	0.3894	0.3441	0.3441	0.3351	0.3622	0.3894	0.4075	0.4256	(22b)
Effective ac	0.6067	0.6025	0.5985	0.5794	0.5758	0.5592	0.5592	0.5561	0.5656	0.5758	0.5830	0.5906	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type			17.3000	1.1450	19.8092			(27)
GF			40.6000	0.1300	5.2780			(28a)
External Wall 1	91.9800	19.3000	72.6800	0.1800	13.0824			(29a)
External Roof 1	56.6000		56.6000	0.1100	6.2260			(30)
Total net area of external elements Aum(A, m2)			189.1800					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	46.3956		(33)
Main dwelling								
Party Wall 1			64.5000	0.0000	0.0000			(32)

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

$$193.7697 \quad (35)$$

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element	12.3700	0.0500	0.6185	
E2 Other lintels (including other steel lintels)	9.6600	0.0500	0.4830	
E3 Sill	26.8600	0.0500	1.3430	
E4 Jamb	18.0300	0.1600	2.8848	
E5 Ground floor (normal)	18.0300	0.0000	0.0000	
E6 Intermediate floor within a dwelling	0.0000	0.1600	0.0000	
E5 Ground floor (normal)	0.0000	0.0700	0.0000	
E7 Party floor between dwellings (in blocks of flats)	8.6200	0.0400	0.3448	
E11 Eaves (insulation at rafter level)	9.4000	0.0800	0.7520	
E13 Gable (insulation at rafter level)	0.0000	0.0800	0.0000	
E14 Flat roof	0.0000	0.5600	0.0000	
E15 Flat roof with parapet	15.6000	0.0900	1.4040	
E16 Corner (normal)	0.0000	-0.0900	-0.0000	
E17 Corner (inverted - internal area greater than external area)	15.6000	0.0600	0.9360	
E18 Party wall between dwellings	0.0000	0.0600	0.0000	
E18 Party wall between dwellings	0.0000	0.2400	0.0000	
E24 Eaves (insulation at ceiling level - inverted)	9.4000	0.0800	0.7520	
P1 Party wall - Ground floor	9.4000	0.0000	0.0000	
P2 Party wall - Intermediate floor within a dwelling	0.0000	0.0000	0.0000	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	13.1100	0.0800	1.0488	
P5 Party wall - Roof (insulation at rafter level)	4.3000	0.0800	0.3440	
R4 Ridge (vaulted ceiling)	1.5000	0.0400	0.0600	
R7 Flat ceiling (inverted)	3.8000	0.0400	0.1520	
R9 Roof to wall (flat ceiling)				

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

$$11.1229 \quad (36)$$

Point Thermal bridges

$$(36a) = 0.0000$$

Total fabric heat loss

$$(33) + (36) + (36a) = 57.5185 \quad (37)$$

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	56.5505	56.1645	55.7861	54.0087	53.6762	52.1281	52.1281	51.8414	52.7244	53.6762	54.3489	55.0522	(38)
Heat transfer coeff	114.0690	113.6829	113.3045	111.5272	111.1946	109.6466	109.6466	109.3599	110.2429	111.1946	111.8673	112.5706	(39)
Average = Sum(39)m / 12 =												111.5256	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0453	1.0417	1.0383	1.0220	1.0189	1.0047	1.0047	1.0021	1.0102	1.0189	1.0251	1.0315	(40)
HLP (average)												1.0220	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8095	(42)
Hot water usage for mixer showers	71.3259	70.2540	68.6921	65.7036	63.4981	61.0386	59.6406	61.1908	62.8900	65.5307	68.5835	71.0526	(42a)	
Hot water usage for baths	30.7957	30.3383	29.6943	28.5068	27.6175	26.6316	26.0990	26.7385	27.4349	28.4899	29.7019	30.6916	(42b)	
Hot water usage for other uses	43.4021	41.8238	40.2456	38.6673	37.0891	35.5108	35.5108	37.0891	38.6673	40.2456	41.8238	43.4021	(42c)	
Average daily hot water use (litres/day)													133.7690	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Energy content (annual)	145.5237	142.4162	138.6319	132.8776	128.2047	123.1810	121.2504	125.0184	128.9922	134.2663	140.1092	145.1463	(44)	
Distribution loss (46)m = 0.15 x (45)m	230.4740	202.7988	213.0721	181.9028	172.5882	151.4654	146.6419	154.7989	159.0603	182.1981	199.6113	227.2641	(45)	
Water storage loss (or HIU loss):	34.5711	30.4198	31.9608	27.2854	25.8882	22.7198	21.9963	23.2198	23.8590	27.3297	29.9417	34.0896	(46)	
Store volume													150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													1.3938	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)	
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	277.0689	244.8845	259.6670	226.9947	219.1831	196.5572	193.2368	201.3938	204.1521	228.7930	244.7031	273.8590	(62)	
WWHRS	-32.6072	-28.8381	-30.1976	-25.0048	-23.3036	-19.9410	-18.6915	-19.8766	-20.6318	-24.3226	-27.5545	-32.0034	(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	244.4617	216.0464	229.4694	201.9899	195.8795	176.6162	174.5452	181.5172	183.5204	204.4704	217.1486	241.8556	(64)	
													Total per year (kWh/year) = Sum(64)m =	2467.5204 (64)

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12Total per year (kWh/year)	2468 (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 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											
Heat gains from water heating, kWh/month	113.9085	101.0992	108.1224	96.5562	94.6615	86.4357	86.0343	88.7465	88.9610	97.8568	102.4442 (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	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	142.4972	157.7647	142.4972	147.2471	142.4972	147.2471	142.4972	142.4972	147.2471	142.4972	147.2471	142.4972 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.3001	273.1050	266.0368	250.9895	231.9949	214.1427	202.2164	199.4115	206.4797	221.5270	240.5216	258.3737 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475 (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)	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801 (71)
Water heating gains (Table 5)	153.1029	150.4452	145.3258	134.1058	127.2332	120.0496	115.6376	119.2830	123.5570	131.5279	142.2836	151.6683 (72)
Total internal gains	634.0427	649.4574	622.0023	600.4849	569.8678	546.5820	525.4937	526.3342	542.4263	563.6947	598.1948	620.6818 (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							
															Northeast		7.6000	11.2829	0.6300	0.7000	0.7700	26.2064	(75)						
															Southeast		1.9400	36.7938	0.6300	0.7000	0.7700	21.8147	(77)						
															Southwest		7.7600	36.7938	0.6300	0.7000	0.7700	87.2587	(79)						
															Solar gains		135.2798	239.1362	350.3178	472.8156	564.9664	576.4406	549.2750	478.1475	392.3647	270.5305	163.6192	114.7455	(83)
															Total gains		769.3224	888.5936	972.3202	1073.3005	1134.8343	1123.0225	1074.7687	1004.4817	934.7910	834.2252	761.8140	735.4273	(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	51.4944	51.6693	51.8418	52.6680	52.8255	53.5713	53.5713	53.7118	53.2816	52.8255	52.5079	52.1798
alpha	4.4330	4.4446	4.4561	4.5112	4.5217	4.5714	4.5714	4.5808	4.5521	4.5217	4.5005	4.4787
util living area	0.9892	0.9789	0.9582	0.8984	0.7789	0.5954	0.4425	0.4901	0.7267	0.9238	0.9790	0.9911 (86)
MIT	19.6009	19.8243	20.1287	20.5263	20.8152	20.9592	20.9915	20.9867	20.8997	20.5254	20.0058	19.5739 (87)
Th 2	20.0458	20.0487	20.0516	20.0651	20.0676	20.0794	20.0794	20.0816	20.0748	20.0676	20.0625	20.0571 (88)
util rest of house	0.9865	0.9737	0.9478	0.8737	0.7295	0.5203	0.3529	0.3972	0.6553	0.8998	0.9730	0.9888 (89)
MIT 2	18.4180	18.7027	19.0866	19.5799	19.9057	20.0532	20.0760	20.0757	20.0019	19.5906	18.9449	18.3917 (90)
Living area fraction	18.6100	18.8848	19.2557	19.7335	20.0533	20.2002	20.2245	20.2236	20.1476	19.7423	19.1171	18.5836 (92)
MIT	18.6100	18.8848	19.2557	19.7335	20.0533	20.2002	20.2245	20.2236	20.1476	19.7423	19.1171	18.5836 (93)
Temperature adjustment												0.0000
adjusted MIT	18.6100	18.8848	19.2557	19.7335	20.0533	20.2002	20.2245	20.2236	20.1476	19.7423	19.1171	18.5836 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9808	0.9653	0.9368	0.8634	0.7287	0.5305	0.3673	0.4119	0.6614	0.8895	0.9648	0.9839 (94)
Ext temp.	754.5848	857.7629	910.8505	926.7285	826.9830	595.7989	394.7547	413.7058	618.2270	742.0819	735.0154	723.5615 (95)
Heat loss rate W	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)
Space heating kWh	1632.3256	1589.8276	1445.2776	1208.2256	928.8452	614.0482	397.4172	418.1449	666.7003	1016.5697	1344.3179	1619.1679 (97)
Space heating requirement - total per year (kWh/year)	653.0391	491.9475	397.6138	202.6779	75.7855	0.0000	0.0000	0.0000	0.0000	204.2189	438.6978	666.3312 (98a)
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)	653.0391	491.9475	397.6138	202.6779	75.7855	0.0000	0.0000	0.0000	0.0000	204.2189	438.6978	666.3312 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3130.3117
Space heating per m2												(98c) / (4) = 28.6842 (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	653.0391	491.9475	397.6138	202.6779	75.7855	0.0000	0.0000	0.0000	0.0000	204.2189	438.6978	666.3312 (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)	707.5180	532.9875	430.7842	219.5860	82.1078	0.0000	0.0000	0.0000	0.0000	221.2556	475.2956	721.9189 (211)
Space heating efficiency (main heating system 2)												

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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	(212)
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	(213)
Water heating requirement	244.4617	216.0464	229.4694	201.9899	195.8795	176.6162	174.5452	181.5172	183.5204	204.4704	217.1486	241.8556 (64)
Efficiency of water heater (217)m	86.1534	85.8456	85.2804	84.0674	82.1219	79.8000	79.8000	79.8000	79.8000	84.0570	85.6034	79.8000 (216)
Fuel for water heating, kWh/month	283.7516	251.6687	269.0763	240.2713	238.5229	221.3236	218.7284	227.4651	229.9754	243.2520	253.6681	280.5401 (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	29.6081	23.7527	21.3867	15.6688	12.1030	9.8883	11.0408	14.3512	18.6408	24.4578	27.6250	30.4310 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-39.3623	-56.2272	-81.8598	-93.2318	-101.5024	-95.0386	-93.8219	-88.0791	-78.1312	-64.7939	-43.5177	-33.9420 (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	-20.0548	-42.4246	-84.7775	-128.0116	-169.9512	-171.0579	-169.0913	-142.8933	-104.3402	-60.9503	-26.8625	-15.8448 (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												3391.4536 (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												2958.2435 (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)												238.9543 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2005.7682 (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												4668.8833 (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	3391.4536	0.2100	712.2053 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2958.2435	0.2100	621.2311 (264)
Space and water heating			1333.4364 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	238.9543	0.1443	34.4885 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-869.5080	0.1343	-116.7989
PV Unit electricity exported	-1136.2601	0.1257	-142.8643
Total			-259.6632 (269)
Total CO2, kg/year			1120.1910 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.2600 (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	3391.4536	1.1300	3832.3426 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2958.2435	1.1300	3342.8151 (278)
Space and water heating			7175.1577 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	238.9543	1.5338	366.5161 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-869.5080	1.4964	-1301.1644
PV Unit electricity exported	-1136.2601	0.4615	-524.4009
Total			-1825.5653 (283)
Total Primary energy kWh/year			5846.2094 (286)
Target Primary Energy Rate (TPER)			53.5700 (287)

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Plot Reference	Green_ori	Issued on Date	24/02/2026
Assessment Reference	HT05-NE	Plot Type Ref	
Plot Address		SAP Version	10.2
SAP Rating	81 B	DER	4.25
Environmental	96 A	% DER < TER	58.58
CO ₂ Emissions (t/year)	0.42	DFEE	34.17
Compliance Check	See BREL	TFEE	34.56
% DPER < TPER	16.96	TPER	53.57
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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	40.5800 (1b)	x 2.4000 (2b)	= 97.3920 (1b) - (3b)
First floor	40.5800 (1c)	x 2.7000 (2c)	= 109.5660 (1c) - (3c)
Second floor	27.9700 (1d)	x 2.7000 (2d)	= 75.5190 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.1300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 282.4770 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1062 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.5000 (17)
Infiltration rate	0.2812 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2601 (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	0.3316	0.3251	0.3186	0.2861	0.2796	0.2471	0.2471	0.2406	0.2601	0.2796	0.2926	0.3056 (22b)
Effective ac	0.5550	0.5529	0.5508	0.5409	0.5391	0.5305	0.5305	0.5289	0.5338	0.5391	0.5428	0.5467 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Windows			17.3000	1.1450	19.8092		(27)
Door			2.0000	1.0000	2.0000		(26)
GF			40.6000	0.1000	4.0600	110.0000	4466.0000 (28a)
External Wall 1	91.9800	19.3000	72.6800	0.1800	13.0824	140.0000	10175.2005 (29a)
External Roof 1	56.6000		56.6000	0.1000	5.6600	9.0000	509.4000 (30)
Total net area of external elements A _{um} (A, m ²)			189.1800				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	44.6116	(33)
Main dwelling							
Party Wall 1			64.5000	0.0000	0.0000	20.0000	1290.0000 (32)
Party Ceiling 1			46.9000			20.0000	938.0000 (32b)
Internal Wall 1			200.5900			9.0000	1805.3100 (32c)
Internal Floor 1			68.5100			18.0000	1233.1800 (32d)
Internal Ceiling 1			81.0000			9.0000	729.0000 (32e)
Heat capacity C _m = Sum (A x k)							(28)...(30) + (32) + (32a)...(32e) = 21146.0904 (34)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K							193.7697 (35)
List of Thermal Bridges							
K1 Element					Length	Psi-value	Total

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E2 Other lintels (including other steel lintels)	12.3700	0.0500	0.6185											
E3 Sill	9.6600	0.0500	0.4830											
E4 Jamb	26.8600	0.0500	1.3430											
E5 Ground floor (normal)	18.0300	0.0800	1.4424											
E6 Intermediate floor within a dwelling	18.0300	0.0000	0.0000											
E5 Ground floor (normal)	0.0000	0.0800	0.0000											
E7 Party floor between dwellings (in blocks of flats)	0.0000	0.0700	0.0000											
E11 Eaves (insulation at rafter level)	8.6200	0.0400	0.3448											
E13 Gable (insulation at rafter level)	9.4000	0.0800	0.7520											
E14 Flat roof	0.0000	0.0800	0.0000											
E15 Flat roof with parapet	0.0000	0.3000	0.0000											
E16 Corner (normal)	15.6000	0.0900	1.4040											
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000											
E18 Party wall between dwellings	15.6000	0.0600	0.9360											
E18 Party wall between dwellings	0.0000	0.0600	0.0000											
E24 Eaves (insulation at ceiling level - inverted)	0.0000	0.2400	0.0000											
P1 Party wall - Ground floor	9.4000	0.0800	0.7520											
P2 Party wall - Intermediate floor within a dwelling	9.4000	0.0000	0.0000											
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	0.0000	0.0000	0.0000											
P5 Party wall - Roof (insulation at rafter level)	13.1100	0.0800	1.0488											
R4 Ridge (vaulted ceiling)	4.3000	0.0800	0.3440											
R7 Flat ceiling (inverted)	1.5000	0.0400	0.0600											
R9 Roof to wall (flat ceiling)	3.8000	0.0400	0.1520											
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.6805	(36)										
Point Thermal Bridges			0.0000											
Total fabric heat loss		(33) + (36) + (36a) =	54.2921	(37)										
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)														
(38)m	Jan 51.7351	Feb 51.5360	Mar 51.3409	Apr 50.4244	May 50.2530	Jun 49.4547	Jul 49.4547	Aug 49.3069	Sep 49.7622	Oct 50.2530	Nov 50.5998	Dec 50.9625	(38)	
Heat transfer coeff	106.0272	105.8281	105.6330	104.7165	104.5450	103.7468	103.7468	103.5990	104.0543	104.5450	104.8919	105.2546	(39)	
Average = Sum(39)m / 12 =												104.7157		
HLP	Jan 0.9716	Feb 0.9697	Mar 0.9680	Apr 0.9596	May 0.9580	Jun 0.9507	Jul 0.9507	Aug 0.9493	Sep 0.9535	Oct 0.9580	Nov 0.9612	Dec 0.9645	(40)	
HLP (average)												0.9595		
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31		

4. Water heating energy requirements (kWh/year)														

Assumed occupancy													2.8095	(42)
Hot water usage for mixer showers	71.3259	70.2540	68.6921	65.7036	63.4981	61.0386	59.6406	61.1908	62.8900	65.5307	68.5835	71.0526	(42a)	
Hot water usage for baths	30.7957	30.3383	29.6943	28.5068	27.6175	26.6316	26.0990	26.7385	27.4349	28.4899	29.7019	30.6916	(42b)	
Hot water usage for other uses	43.4021	41.8238	40.2456	38.6673	37.0891	35.5108	35.5108	37.0891	38.6673	40.2456	41.8238	43.4021	(42c)	
Average daily hot water use (litres/day)												133.7690	(43)	
Daily hot water use	Jan 145.5237	Feb 142.4162	Mar 138.6319	Apr 132.8776	May 128.2047	Jun 123.1810	Jul 121.2504	Aug 125.0184	Sep 128.9922	Oct 134.2663	Nov 140.1092	Dec 145.1463	(44)	
Energy conte	230.4740	202.7988	213.0721	181.9029	172.5882	151.4654	146.6419	154.7989	159.0603	182.1981	199.6113	227.2641	(45)	
Energy content (annual)										Total = Sum(45)m =		2221.8758		
Distribution loss (46)m = 0.15 x (45)m	34.5711	30.4198	31.9608	27.2854	25.8882	22.7198	21.9963	23.2198	23.8590	27.3297	29.9417	34.0896	(46)	
Water storage loss (or HIU loss):														
Store volume												150.0000	(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												0.9283	(52)	
Temperature factor from Table 2b												0.5400	(53)	
Enter (49) or (54) in (55)												0.8683	(55)	
Total storage loss	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(56)	
If cylinder contains dedicated solar storage	26.9176	24.3126	26.9176	26.0493	26.9176	26.0493	26.9176	26.9176	26.0493	26.9176	26.0493	26.9176	(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	280.6540	248.1226	263.2521	230.4641	222.7682	200.0266	196.8218	204.9788	207.6216	232.3780	248.1725	277.4440	(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	280.6540	248.1226	263.2521	230.4641	222.7682	200.0266	196.8218	204.9788	207.6216	232.3780	248.1725	277.4440	(64)	
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2812.7045	(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)	
												0.0000	(64a)	
Heat gains from water heating, kWh/month	116.7766	103.6897	110.9905	99.3317	97.5296	89.2112	88.9024	91.6146	91.7366	100.7248	105.2198	115.7093	(65)	

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

Metabolic gains (Table 5), Watts	Jan 140.4751	Feb 140.4751	Mar 140.4751	Apr 140.4751	May 140.4751	Jun 140.4751	Jul 140.4751	Aug 140.4751	Sep 140.4751	Oct 140.4751	Nov 140.4751	Dec 140.4751	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	142.4972	157.7648	142.4972	147.2471	142.4972	147.2471	142.4972	142.4972	147.2471	142.4972	147.2471	142.4972	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.3001	273.1050	266.0368	250.9895	231.9949	214.1427	202.2164	199.4115	206.4797	221.5270	240.5216	258.3737	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	(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)	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	(71)	
Water heating gains (Table 5)	156.9578	154.3001	149.1807	137.9607	131.0881	123.9045	119.4925	123.1379	127.4119	135.3828	146.1385	155.5232	(72)	
Total internal gains	637.8976	653.3124	625.8572	604.3398	573.7228	550.4369	529.3486	530.1891	546.2812	567.5496	602.0497	624.5367	(73)	

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Northeast				7.6000	11.2829		0.4000		0.7000	0.7700	16.6390 (75)
Southeast				1.9400	36.7938		0.4000		0.7000	0.7700	13.8506 (77)
Southwest				7.7600	36.7938		0.4000		0.7000	0.7700	55.4023 (79)
Solar gains	85.8919	151.8325	222.4240	300.2004	358.7089	365.9940	348.7460	303.5857	249.1205	171.7654	72.8543 (83)
Total gains	723.7895	805.1448	848.2813	904.5402	932.4316	916.4309	878.0946	833.7749	795.4017	739.3150	697.3910 (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	55.4001	55.5043	55.6068	56.0935	56.1855	56.6178	56.6178	56.6986	56.4505	56.1855	55.9997	55.8067
alpha	4.6933	4.7003	4.7071	4.7396	4.7457	4.7745	4.7745	4.7799	4.7634	4.7457	4.7333	4.7204
util living area	0.9911	0.9842	0.9714	0.9323	0.8428	0.6738	0.5086	0.5540	0.7816	0.9424	0.9831	0.9925 (86)
MIT	19.9514	20.0835	20.2735	20.5383	20.7603	20.8916	20.9259	20.9215	20.8448	20.5693	20.2201	19.9288 (87)
Th 2	20.1071	20.1086	20.1101	20.1172	20.1185	20.1246	20.1246	20.1258	20.1223	20.1185	20.1158	20.1130 (88)
util rest of house	0.9889	0.9804	0.9640	0.9142	0.8013	0.5987	0.4127	0.4566	0.7160	0.9233	0.9782	0.9906 (89)
MIT 2	18.8730	19.0419	19.2830	19.6160	19.8751	20.0120	20.0375	20.0363	19.9702	19.6596	19.2223	18.8489 (90)
Living area fraction										fLA = Living area / (4) =		0.1623 (91)
MIT	19.0480	19.2109	19.4438	19.7657	20.0188	20.1548	20.1817	20.1800	20.1121	19.8072	19.3842	19.0242 (92)
Temperature adjustment												0.0000
adjusted MIT	19.0480	19.2109	19.4438	19.7657	20.0188	20.1548	20.1817	20.1800	20.1121	19.8072	19.3842	19.0242 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9854	0.9753	0.9571	0.9056	0.7960	0.6015	0.4191	0.4629	0.7151	0.9151	0.9729	0.9875 (94)
Useful gains	713.1961	785.2497	811.8535	819.1458	742.2115	551.2142	368.0315	385.9235	568.8169	676.5113	686.8315	688.6876 (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	1563.6852	1514.4982	1367.2872	1137.8133	869.6855	576.2877	371.5875	391.6007	625.5867	962.5667	1288.5154	1560.3119 (97)
Space heating kWh	632.7639	490.0550	413.2427	229.4406	94.8407	0.0000	0.0000	0.0000	0.0000	212.8252	433.2124	648.4885 (98a)
Space heating requirement - total per year (kWh/year)												3154.8690
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	632.7639	490.0550	413.2427	229.4406	94.8407	0.0000	0.0000	0.0000	0.0000	212.8252	433.2124	648.4885 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3154.8690
Space heating per m2										(98c) / (4) =		28.9093 (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	632.7639	490.0550	413.2427	229.4406	94.8407	0.0000	0.0000	0.0000	0.0000	212.8252	433.2124	648.4885 (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)	288.5380	223.4633	188.4372	104.6241	43.2470	0.0000	0.0000	0.0000	0.0000	97.0475	197.5433	295.7084 (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	280.6540	248.1226	263.2521	230.4641	222.7682	200.0266	196.8218	204.9788	207.6216	232.3780	248.1725	277.4440 (64)
Efficiency of water heater	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	147.4023	130.3165	138.2627	121.0421	117.0001	105.0560	103.3728	107.6569	109.0449	122.0473	130.3427	145.7164 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	27.5505	22.1020	19.9004	14.5799	11.2619	9.2011	10.2735	13.3539	17.3454	22.7581	25.7052	28.3162 (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)

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

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

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

1. Overall dwelling characteristics

2. Ventilation rate

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000	Air changes per hour	
Pressure test		/ (5) =	0.1416	(8)
Pressure Test Method			Yes	
Measured/design AP50			Blower Door	
Infiltration rate			5.0000	(17)
Number of sides sheltered			0.3916	(18)
			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3622	(21)

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Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
Effective ac	0.4618	0.4528	0.4437	0.3985	0.3894	0.3441	0.3441	0.3351	0.3622	0.3894	0.4075	0.4256 (22b)
	0.6067	0.6025	0.5985	0.5794	0.5758	0.5592	0.5592	0.5561	0.5656	0.5758	0.5830	0.5906 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Opaque door			2.0000	1.0000	2.0000		(26)
TER Opening Type			17.3000	1.1450	19.8092		(27)
GF			40.6000	0.1300	5.2780		(28a)
External Wall 1	91.9800	19.3000	72.6800	0.1800	13.0824		(29a)
External Roof 1	56.6000		56.6000	0.1100	6.2260		(30)
Total net area of external elements Aum(A, m2)			189.1800				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	46.3956	(33)
Main dwelling							
Party Wall 1			64.5000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							193.7697 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	12.3700	0.0500	0.6185
E3 Sill	9.6600	0.0500	0.4830
E4 Jamb	26.8600	0.0500	1.3430
E5 Ground floor (normal)	18.0300	0.1600	2.8848
E6 Intermediate floor within a dwelling	18.0300	0.0000	0.0000
E5 Ground floor (normal)	0.0000	0.1600	0.0000
E7 Party floor between dwellings (in blocks of flats)	0.0000	0.0700	0.0000
E11 Eaves (insulation at rafter level)	8.6200	0.0400	0.3448
E13 Gable (insulation at rafter level)	9.4000	0.0800	0.7520
E14 Flat roof	0.0000	0.0800	0.0000
E15 Flat roof with parapet	0.0000	0.5600	0.0000
E16 Corner (normal)	15.6000	0.0900	1.4040
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000
E18 Party wall between dwellings	15.6000	0.0600	0.9360
E18 Party wall between dwellings	0.0000	0.0600	0.0000
E24 Eaves (insulation at ceiling level - inverted)	0.0000	0.2400	0.0000
P1 Party wall - Ground floor	9.4000	0.0800	0.7520
P2 Party wall - Intermediate floor within a dwelling	9.4000	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	0.0000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	13.1100	0.0800	1.0488
R4 Ridge (vaulted ceiling)	4.3000	0.0800	0.3440
R7 Flat ceiling (inverted)	1.5000	0.0400	0.0600
R9 Roof to wall (flat ceiling)	3.8000	0.0400	0.1520
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.1229 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 57.5185 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	56.5505	56.1645	55.7861	54.0087	53.6762	52.1281	52.1281	51.8414	52.7244	53.6762	54.3489	55.0522 (38)
Average = Sum(39)m / 12 =	114.0690	113.6829	113.3045	111.5272	111.1946	109.6466	109.6466	109.3599	110.2429	111.1946	111.8673	112.5706 (39)
												111.5256

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0453	1.0417	1.0383	1.0220	1.0189	1.0047	1.0047	1.0021	1.0102	1.0189	1.0251	1.0315 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8095 (42)
Hot water usage for mixer showers													
71.3259	70.2540	68.6921	65.7036	63.4981	61.0386	59.6406	61.1908	62.8900	65.5307	68.5835	71.0526	71.0526 (42a)	
Hot water usage for baths													
30.7957	30.3383	29.6943	28.5068	27.6175	26.6316	26.0990	26.7385	27.4349	28.4899	29.7019	30.6916	30.6916 (42b)	
Hot water usage for other uses													
43.4021	41.8238	40.2456	38.6673	37.0891	35.5108	35.5108	37.0891	38.6673	40.2456	41.8238	43.4021	43.4021 (42c)	
Average daily hot water use (litres/day)													133.7690 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
145.5237	142.4162	138.6319	132.8776	128.2047	123.1810	121.2504	125.0184	128.9922	134.2663	140.1092	145.1463	145.1463 (44)	
Energy conte	230.4740	202.7988	213.0721	181.9029	172.5882	151.4654	146.6419	154.7989	159.0603	182.1981	199.6113	227.2641	(45)
Energy content (annual)										Total = Sum (45)m =		2221.8758	
Distribution loss (46)m = 0.15 x (45)m													
34.5711	30.4198	31.9608	27.2854	25.8882	22.7198	21.9963	23.2198	23.8590	27.3297	29.9417	34.0896	34.0896 (46)	
Water storage loss (or HIU loss):													
Store volume													150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.3938 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.7527 (55)
Total storage loss													
23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	(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													
277.0689	244.8845	259.6670	226.9947	219.1831	196.5572	193.2368	201.3938	204.1521	228.7930	244.7031	273.8590	273.8590 (62)	
WWHRS	-32.6072	-28.8381	-30.1976	-25.0048	-23.3036	-19.9410	-18.6915	-19.8766	-20.6318	-24.3226	-27.5545	-32.0034	(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													
244.4617	216.0464	229.4694	201.9899	195.8795	176.6162	174.5452	181.5172	183.5204	204.4704	217.1486	241.8556	241.8556 (64)	
12Total per year (kWh/year)													
Electric shower(s)									Total per year (kWh/year) = Sum (64)m =		2467.5205	2467.5205 (64)	
											2468	2468 (64)	

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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 =											
Heat gains from water heating, kWh/month	113.9085	101.0992	108.1224	96.5562	94.6615	86.4357	86.0343	88.7465	88.9610	97.8568	102.4442 (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	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751	140.4751 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	142.4972	157.7648	142.4972	147.2471	142.4972	147.2471	142.4972	142.4972	147.2471	142.4972	147.2471	142.4972 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.3001	273.1050	266.0368	250.9895	231.9949	214.1427	202.2164	199.4115	206.4797	221.5270	240.5216	258.3737 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475	37.0475 (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)	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801	-112.3801 (71)
Water heating gains (Table 5)	153.1029	150.4452	145.3258	134.1058	127.2332	120.0496	115.6376	119.2830	123.5570	131.5279	142.2836	151.6683 (72)
Total internal gains	634.0427	649.4574	622.0023	600.4849	569.8679	546.5820	525.4937	526.3342	542.4263	563.6947	598.1948	620.6818 (73)

6. Solar gains

[Jan]	Area		Solar flux		Specific data		Specific data		Access factor		Gains	
	m2		Table 6a		or Table 6b		or Table 6c		Table 6d		W	
Northeast	7.6000		11.2829		0.6300		0.7000		0.7700		26.2064 (75)	
Southeast	1.9400		36.7938		0.6300		0.7000		0.7700		21.8147 (77)	
Southwest	7.7600		36.7938		0.6300		0.7000		0.7700		87.2587 (79)	
Solar gains	135.2798	239.1362	350.3178	472.8156	564.9664	576.4406	549.2750	478.1475	392.3647	270.5305	163.6192	114.7455 (83)
Total gains	769.3224	888.5936	972.3202	1073.3005	1134.8343	1123.0225	1074.7687	1004.4818	934.7910	834.2252	761.8140	735.4273 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
51.4944	51.6693	51.8418	52.6680	52.8255	53.5713	53.5713	53.7118	53.2816	52.8255	52.5079	52.1798	52.1798
alpha	4.4330	4.4446	4.4561	4.5112	4.5217	4.5714	4.5714	4.5808	4.5521	4.5217	4.5005	4.4787
util living area												
0.9892	0.9789	0.9582	0.8984	0.7789	0.5954	0.4425	0.4901	0.7267	0.9238	0.9790	0.9911	0.9911 (86)
MIT	19.6009	19.8243	20.1287	20.5263	20.8152	20.9592	20.9915	20.9867	20.8997	20.5254	20.0058	19.5739 (87)
Th 2	20.0458	20.0487	20.0516	20.0651	20.0676	20.0794	20.0794	20.0816	20.0748	20.0676	20.0625	20.0571 (88)
util rest of house												
0.9865	0.9737	0.9478	0.8737	0.7295	0.5203	0.3529	0.3972	0.6553	0.8998	0.9730	0.9888	0.9888 (89)
MIT 2	18.4180	18.7027	19.0866	19.5799	19.9057	20.0532	20.0760	20.0757	20.0019	19.5906	18.9449	18.3917 (90)
Living area fraction												
fLA = Living area / (4) =												0.1623 (91)
MIT	18.6100	18.8848	19.2557	19.7335	20.0533	20.2002	20.2245	20.2236	20.1476	19.7423	19.1171	18.5836 (92)
Temperature adjustment												
adjusted MIT	18.6100	18.8848	19.2557	19.7335	20.0533	20.2002	20.2245	20.2236	20.1476	19.7423	19.1171	18.5836 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9808	0.9653	0.9368	0.8634	0.7287	0.5305	0.3673	0.4119	0.6614	0.8895	0.9648	0.9839 (94)
Useful gains	754.5848	857.7629	910.8505	926.7285	826.9830	595.7989	394.7547	413.7059	618.2271	742.0819	735.0154	723.5615 (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	1632.3256	1589.8277	1445.2777	1208.2256	928.8452	614.0482	397.4172	418.1449	666.7003	1016.5698	1344.3179	1619.1680 (97)
Space heating kWh	653.0391	491.9475	397.6138	202.6779	75.7855	0.0000	0.0000	0.0000	0.0000	204.2189	438.6978	666.3312 (98a)
Space heating requirement - total per year (kWh/year)												3130.3118
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	653.0391	491.9475	397.6138	202.6779	75.7855	0.0000	0.0000	0.0000	0.0000	204.2189	438.6978	666.3312 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3130.3118
Space heating per m2											(98c) / (4) =	28.6842 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
653.0391	491.9475	397.6138	202.6779	75.7855	0.0000	0.0000	0.0000	0.0000	0.0000	204.2189	438.6978	666.3312 (98)
Space heating efficiency (main heating system 1)												
92.3000	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)												
707.5180	532.9876	430.7842	219.5861	82.1078	0.0000	0.0000	0.0000	0.0000	0.0000	221.2556	475.2956	721.9190 (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	0.0000 (212)
Space heating fuel (main heating system 2)												

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Space heating	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	244.4617	216.0464	229.4694	201.9899	195.8795	176.6162	174.5452	181.5172	183.5204	204.4704	217.1486	241.8556 (64)
Efficiency of water heater	86.1534	85.8456	85.2804	84.0674	82.1219	79.8000	79.8000	79.8000	79.8000	84.0570	85.6034	79.8000 (216)
Fuel for water heating, kWh/month	283.7516	251.6687	269.0763	240.2713	238.5229	221.3236	218.7284	227.4651	229.9754	243.2520	253.6681	280.5401 (217)
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	7.0685	7.3041	7.0685	7.3041	7.0685 (231)
Lighting	29.6081	23.7527	21.3867	15.6688	12.1030	9.8883	11.0408	14.3512	18.6408	24.4578	27.6250	30.4310 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-39.3623	-56.2272	-81.8598	-93.2318	-101.5024	-95.0386	-93.8219	-88.0791	-78.1312	-64.7939	-43.5177	-33.9420 (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	-20.0548	-42.4246	-84.7775	-128.0116	-169.9513	-171.0579	-169.0914	-142.8934	-104.3402	-60.9503	-26.8625	-15.8448 (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												3391.4538 (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												2958.2435 (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)												238.9543 (232)
Energy saving/generation technologies (Appendices M, N and Q)												
PV generation												-2005.7683 (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												4668.8833 (238)

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

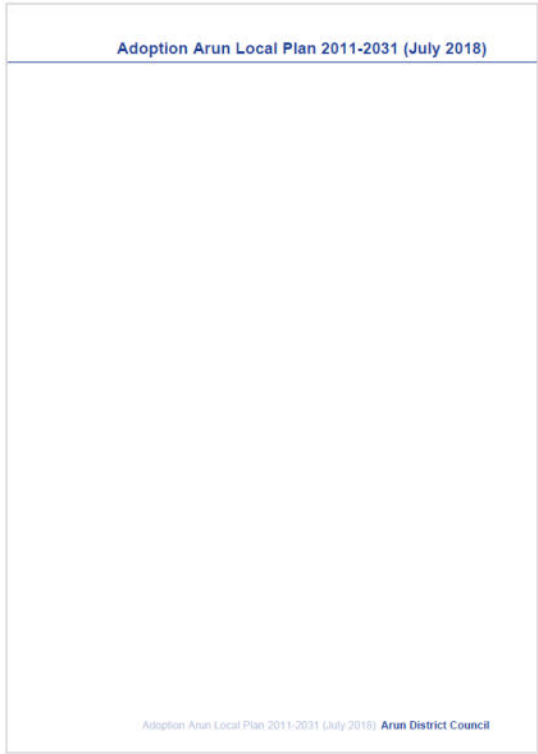
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3391.4538	0.2100	712.2053 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2958.2435	0.2100	621.2311 (264)
Space and water heating			1333.4364 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	238.9543	0.1443	34.4885 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-869.5080	0.1343	-116.7989
PV Unit electricity exported	-1136.2602	0.1257	-142.8643
Total			-259.6632 (269)
Total CO2, kg/year			1120.1910 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.2600 (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	3391.4538	1.1300	3832.3427 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2958.2435	1.1300	3342.8151 (278)
Space and water heating			7175.1579 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	238.9543	1.5338	366.5162 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-869.5080	1.4964	-1301.1644
PV Unit electricity exported	-1136.2602	0.4615	-524.4009
Total			-1825.5653 (283)
Total Primary energy kWh/year			5846.2095 (286)
Target Primary Energy Rate (TPER)			53.5700 (287)

Appendix C – Arun District Council’s policies

Adoption Arun Local Plan 2011-2031 (2018)



The Local Plan sets out the vision for the future of Arun and guides development to achieve that vision. The Local Plan encourages sustainable development and manage future growth whilst ensuring that change across the District is appropriate to meet local need. The energy and carbon policies within the Local Plan relevant to the proposed development at Land North of Arundel Road are summarised below.

Policy ECC SP1 Adapting to climate change

The Council will support development which is located and appropriately designed to adapt to impacts arising from climate change such as the increased probability of tidal and fluvial flooding; water stress; health impacts as a result of extreme temperatures and a decline in the quality of habitats and richness of biodiversity.

Developments must be designed to take account of the following issues:

- Location (in relation to flood risk and vulnerability to coastal erosion);
- Water efficiency;
- Shade, cooling, ventilation, solar gain;
- Connectivity to the green infrastructure network;
- Layout and massing;
- Resilience of buildings and building materials to extreme weather events; and
- Capacity of drainage systems and incorporation of Sustainable urban Drainage Systems (SuDS)

Policy ECC SP2 Energy and climate change mitigation

All new residential will be expected to be energy efficient and to demonstrate how they will:

- Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;
- Use design and layout to promote energy efficiency; and
- Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider ‘allowable solutions’ where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.

Policy T DM1 Sustainable Travel and Public Rights of Way

New development must ensure ease of movement, prioritising safe pedestrian and cycle access to the green infrastructure network and access to public transport and community transport services where a need has been identified. Access to alternative modes of transport including public transport services, the public right of way and cycle networks, must be available and accessible to all members of the community.

Proposals for all new development must:

- Be located within easy access of established public transport service(s), existing pedestrian and cycle networks, the committed and aspirational cycle networks and the green infrastructure network which links the development with key destinations including places of work, education, leisure and town centres;
- Where applicable, contribute to the extension of public transport services to serve the development and community transport services to ensure that a wide range of transport services are available to all residents;
- Make provision for cycling and pedestrian facilities to meet the County Council Parking Standards, including cycle storage, convenient and secure cycle parking in association with retail and educational uses and sufficient secure parking and changing/showering facilities at places of work;
- Contribute towards the provision of a joined up cycle network and Public Rights of Way network.

Policy ENV DM5 Development and biodiversity

Development schemes shall, in the first instance, seek to achieve a net gain in biodiversity and protect existing habitats on site. They shall also however incorporate elements of biodiversity including

green walls, roofs, bat and bird boxes as well as landscape features minimising adverse impacts on existing habitats (whether designated or not). Development schemes shall also be appropriately designed to facilitate the emergence of new habitats through the creation of links between habitat areas and open spaces. Together, these provide a network of green spaces which serve to reconnect isolated sites and facilitate species movement.

Where there is evidence of a protected species on a proposed development site, planning applications shall include a detailed survey of the subject species, with details of measures to be incorporated into the development scheme to avoid loss of the species. This involves consideration of any impacts that will affect the species directly or indirectly, whether within the application site or in an area outside of the site, which may be indirectly affected by the proposals. All surveys shall be carried out at an appropriate time of year and shall be undertaken by a qualified and, where appropriate, suitably licensed person.

All developments shall have regard to Natural England’s standing advice for protected species.

Policy W SP1 Water

Arun District Council will encourage water efficiency measures in order to protect the District’s water resources and enhance the quality of the water environment which supports a range of habitats and ecosystems. Development will be encouraged to make active use of surface water as a design feature and permitted where it identifies measures to improve and enhance waterbodies, coastal habitats or provides additional flood relief.

The Council will also support development that:

- is appropriately located, taking account of flood risk and promotes the incorporation of appropriate mitigation measures into new development, particularly Sustainable Drainage Systems that reduces the creation

- and flow of surface water and improves water quality;
- reduces the risk to homes and places of work from flooding whilst increasing biodiversity;
- delivers a range of community benefits including enhancing the quality of life and providing greater resistance to the impact of climate change.

Policy W DM1 Water supply and quality

To ensure that all new development of two dwellings or more are water efficient and reduce pressure on water abstraction sites, it must include measures that meet the optional standards of 110 l/person/day.

Policy W DM3 Sustainable Urban Drainage Systems

To increase the levels of water capture and storage and improve water quality, all development must identify opportunities to incorporate a range of Sustainable Urban Drainage Systems (SUDS), appropriate to the size of development, at an early stage of the design process.

Proposals for both major and minor development proposals must incorporate SUDS within the private areas of the development in order to provide source control features to the overall SUDS design. These features include:

- Green roofs
- Permeable driveways and parking
- Soakaways
- Water harvesting and storage features including water butts.

Proposals for major development must also integrate SUDS within public open spaces and roads, reflecting discussion with the appropriate bodies. SUDS must therefore be integrated into the overall design of a development and must:

- Contribute positively to the appearance of the area, integrating access to allow maintenance of existing watercourses and the system.

- Effectively manage water (including its quality)
- Accommodate and enhance biodiversity by making connections to existing Green Infrastructure assets and
- Provide amenity for local residents (ensuring a safe environment)
- Retain the existing drainage network of the site and the wider area,
- Be maintained in perpetuity, supported through a Maintenance and Management Plan/Regime, including its financing, agreed with the Local Planning Authority.

In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:

- Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SUDS manual produced by CIRIA.
- Undertake up to six months groundwater monitoring within the winter period.
- Undertake winter percolation testing in accordance with BRE365.
- The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.
- The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas

Policy WM DM1 Waste Management

Proposals for development anticipated to cost over £300,000 must identify the volume and type of materials to be demolished and/or excavated as part of the development. Opportunities for the re-use and recovery of materials on site must be demonstrated and off-site disposal of waste must be minimised and managed.

New residential development will be permitted provided that:

- It is designed to ensure that kerbside collection is possible for municipal waste vehicles
- Where appropriate, communal recycling bins and safe bin storage areas are available to residents of flats.

Policy QE DM1 Noise pollution

Residential development likely to experience noise from road, rail or air must:

- Be supported by a noise exposure category (NEC) assessment and designed to ensure that residents will not be adversely affected by noise.
- Consider both the likely level of exposure at the time of application and any increase that might be reasonably expected in the foreseeable future.

Policy QE DM2 Light pollution

Planning permission for proposals which involve outdoor lighting must be accompanied by a lighting scheme prepared according to the latest national design guidance and relevant British Standards publications. Outdoor lighting schemes will be considered against the following criteria:

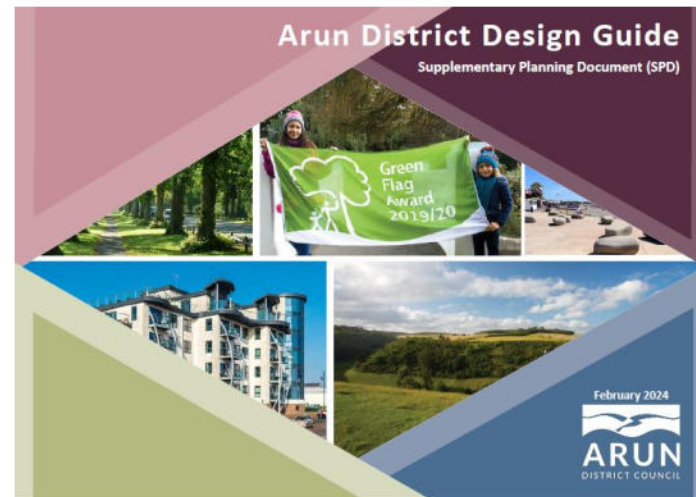
- No adverse impact on neighbouring uses or the wider landscape, particularly with regard the South Downs International Dark Sky Reserve designation;
- Light levels being the minimum required for security and working purposes;
- Minimising the potential glare and spillage; and
- The degree to which outdoor lighting can be powered by on-site renewable sources.

Policy QE DM3 Air pollution

All major development proposals will be required to assess the likely impacts of the development on air quality and mitigate any negative impacts by:

- Ensuring the development is located within easy reach of established public transport services;
- Maximising provision for cycling and pedestrian facilities;
- Encouraging the use of cleaner transport fuels on site, through the inclusion of electric car charging points; and
- Contributing towards the improvement of the highway network where the development is predicted to result in increased congestion on the highway network.
- Development proposed nearby any Air Quality Management Area (AQMA) declared within the District within the Plan period, will require an air quality assessment to identify likely impacts of development upon the designated area. Developers will be required to ensure delivery of the actions set out within any Air Quality Action Plan.

Arun District Design Guide SPD (2024)



The Climate Change and Sustainability Section of Arun's Design Guide SPD provides additional guidance on energy and sustainability standards required to be met by developments. Energy and sustainability guidance relevant to the proposed development are summarised below.

Maximise energy efficiency and minimise whole life carbon

All new development must be designed to reduce energy demand and carbon emissions in line with national and local standards including the Arun Local Plan.

Approaches to design must demonstrate that each step of the energy hierarchy has been followed whilst also ensuring the incorporation of low and zero carbon (LZC) technologies and clear commitments to comprehensive energy monitoring and transparency of performance.

Passive design should be the first step, considering form and orientation, effective insulation, air-tightness and utilising natural ventilation where this can avoid the risk of overheating, both today and in the future.

Large development should consider others in proximity with which a heat network could be established to meet energy demand.

Reduce, re-use and recover materials and protect the District's water resources.

Circular economy principles aim to reduce the impact of resource consumption through promotion of natural and bio-based materials, designing out waste, pre-fabrication and effective deconstruction, and building in capacity for future adaptability. The approach aims to retain maximum residual environmental and financial value of building elements at the end of their life, moving away from the 'take-make-dispose' linear economy. Appropriate facilities to manage operational waste should be integrated, while ensuring that these do not negatively impact their setting.

The consumption of potable water should be minimised in developments through all viable measures. The approach should follow the water hierarchy, with low-flow technology water fittings, and rainwater harvesting and grey water recycling systems integrated where viable. The placement of features such as water storage tanks must not impact negatively on buildings or the street scene, which may be achieved by placing these underground, although this is not appropriate for all locations (e.g. on the coastal plain).

Designs should be informed by winter ground water monitoring.

Design for resilience and adaptability to climate change to ensure the future-proofing of developments.

Adapting the built environment has a key role to play in the global response to climate change. This involves futureproofing development to be resilient to impacts including flooding, overheating and resource scarcity. These impacts will be intensified by population growth, meaning that developments will need to adapt to changing requirements, such as those for heating and cooling.

Future proofing ensures resilience to extreme weather events with minimal consumption of resources and interventions, through either capacity integrated now or the opportunity to improve adaptive capacity in the future. This should include designing in access for maintenance and replacement of building systems and making

allowances for the incorporation of future technologies.

Incorporate Sustainable Drainage Systems (SuDS) and other flood risk mitigation.

New developments should seek to reduce flood risk through incorporation of Sustainable Drainage Systems (SuDS), which can take a variety of forms including permeable hard surfacing, water harvesting, storage features, green roofs, attenuation ponds and soakaways. These should be integrated with the overall Landscaping Strategy and existing natural features on site, seeking to provide additional recreational and wildlife habitat benefits where possible, while reducing impermeable surface cover.

Incorporate air, noise and light pollution mitigation.

Controlling pollution is essential to maintaining and enhancing the quality of the environment. This includes air pollution during the construction and the operation of developments through emissions from transport, combustion systems, cigarette smoke, building materials and biological pollutants, including mould.

Internal air pollution can be mitigated through the removal of sources of pollutants from near building openings and use of filters in mechanical ventilation systems to prevent them from entering occupied spaces. Outdoor air pollution can be avoided through the removal of, or limits placed on the source of pollutants. Both indoor and outdoor air pollution can be further alleviated through use of natural vegetation

The impact of noise from developments during their construction and operation on residents and wildlife also requires mitigation. Development may be limited in noise sensitive areas and measures must be installed to attenuate noise at its source to a level that complies with BS 8233:2014. Wildlife and views of the night sky also require protection from artificial lighting at night, in alignment with the LP Guidance notes for the Reduction of Obtrusive Light, 2011.

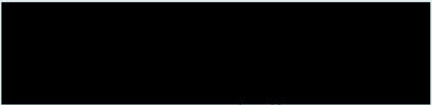
Promote the highest standards of health and well-being.

There are a number of factors that contribute to the health and well-being of building users, including adequate provision of daylight while avoiding glare, and levels of noise appropriate to the setting (e.g. higher levels of background noise may be appropriate in urban areas than rural). Variation in audible and visual environments and amenity space provides choice and flexibility of use. Providing building users with flexibility and choice, including some control over heating and cooling is critical.

Materials containing chemicals known or suspected to be hazardous to human health should be avoided and the availability of clean and fresh air maximised. Introducing internal and external planting can help to passively regulate air quality and temper humidity. The application of biophilic design (e.g. incorporation of plants, natural lighting, natural materials, images of nature, water features, etc.) is also integral to providing connection to the natural environment. This has proven positive effects including reducing stress, blood pressure and heart rates.

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