



The PES

Energy & Sustainability Statement

March 2024

Fortis Green Tennis Club

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Version Control

V1	29-09-23	

1.0 Executive Summary

The proposed development project at the Fortis Green Tennis Club involves the redevelopment of the site to provide a detached three storey block containing a new clubhouse with apartments above and a terrace of houses, one new tennis court, refurbishment of two of the existing tennis courts, creation of a vehicular access off Cherry Tree Road, with associated landscaping, car parking, cycle storage, and refuse storage.

It has been designed to achieve the highest of environmental performance standards following the Energy Hierarchy as set down by the London Plan and the London Borough of Haringey's local plan policies.

The report takes on board the latest GLA guidance on writing energy statements (June 2022) as well as taking into account matters raised within the London Plan 2021. Guidance now seeks a minimum on-site improvement over Part L 2021 at 35%, with a benchmark improvement over Part L 2021 at 50%.

A 'Lean, Clean, Green, Be Seen' has been adopted and the development achieves an improvement in build fabric at over **14%** at the "Be Lean" stage and an overall improvement (DER/TER) in regulated emissions at over **81%** above Part L 2021 standard, through the adoption of very high standards of insulation, heat pump driven heating and hot water systems and a roof mounted PV arrays.

2.0 The Site & Proposal

The site is located on the south side of Southern Road, to the rear of existing dwellings.

The proposal is for the redevelopment of the site to provide a detached three storey block containing a new clubhouse with apartments above and a terrace of houses, one new tennis court, refurbishment of two of the existing tennis courts, creation of a vehicular access off Cherry Tree Road, with associated landscaping, car parking, cycle storage, and refuse storage.

2.1 Local Planning Context

The project sits within the London Borough of Haringey and specific planning guidance has been taken into account; the most relevant policy documents are the Local Plan: Strategic Policies 2013 (with alterations 2017) and the Development Management DPD (Adopted July 2017).

Key Strategy Policy SP4: Working towards a Low Carbon Haringey, requires:-

Over the life time of the Local Plan, reducing energy use in buildings and working towards a low carbon borough will be one of the key challenges facing Haringey. The Council will promote the measures outlined below to reduce carbon emissions from new and existing buildings.

1. In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:

a. From 2011 onwards, all new residential development will achieve a minimum 25% reduction in total (regulated) CO₂ emissions in line with Code for Sustainable Homes Level 4 energy standards, and should aim to achieve Level 6. All new residential development shall be zero carbon from 2016 onwards; and

b. From 2011 onwards all new non-residential development shall be built to at least BREEAM "very good" standard and should aim to achieve BREEAM "excellent" or the current nationally agreed standard. All new non-residential development shall be zero carbon from 2019.

2. The Council will promote low- and zero-carbon energy generation through the following measures:

a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;

b. Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;

c. Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and

d. All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy regeneration, which can include connections to local sources of decentralised renewable energy

The key DM policy is Policy DM21: Sustainable Design, Layout and Construction

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

Proposals should:

a Apply the energy hierarchy to minimise energy use in order to meet, and if possible exceed, minimum carbon dioxide reduction requirements;

b Apply the cooling hierarchy to reduce the potential for overheating and limit reliance on mechanical air conditioning systems;

c Maximise opportunities to enhance biodiversity on-site, including through appropriate landscaping, Sustainable Drainage Systems, living roofs and green walls

d Wherever possible, use building materials with high environmental performance ratings; and

e Seek opportunities for locally sourced labour.

B The Council will support appropriate measures to sustainably retrofit existing homes and non-residential buildings.

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

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

Accordingly, this report will be informed by, and be compliant with all of the above policy requirements as well as following the London Plan guideline for the production of Energy Assessments:-

2.2 The London Plan

Chapter 9 deals with Sustainable Infrastructure:-

Policy SI2 Minimising greenhouse gas emissions

Major development should be net zero-carbon.¹⁵¹ This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) be lean: use less energy and manage demand during operation

- 2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
- 3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
- 4) be seen: monitor, verify and report on energy performance.

B Major development should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy and will be expected to monitor and report on energy performance.

C In meeting the zero-carbon target a minimum on-site reduction of at least 35 per cent beyond Building Regulations is expected. Residential development should aim to achieve 10 per cent, and non-residential development should aim to achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided:

- 1) through a cash in lieu contribution to the relevant borough's carbon offset fund, and/or
- 2) off-site provided that an alternative proposal is identified and delivery is certain.

Policy SI3 - Energy infrastructure

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

- 1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
- 2) heat loads from existing buildings that can be connected to future phases of a heat network
- 3) major heat supply plant including opportunities to utilise heat from energy from waste plants
- 4) secondary heat sources, including both environmental and waste heat
- 5) opportunities for low and ambient temperature heat networks
- 6) possible land for energy centres and/or energy storage
- 7) possible heating and cooling network routes
- 8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
- 9) infrastructure and land requirements for electricity and gas supplies
- 10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
- 11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

- 1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
 - a) connect to local existing or planned heat networks
 - b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
 - c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
 - d) use ultra-low NOx gas boilers
- 2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
- 3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

Policy SI4

Managing heat risk

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

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

- 1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
- 2) minimise internal heat generation through energy efficient design
- 3) manage the heat within the building through exposed internal thermal mass and high ceilings
- 4) provide passive ventilation
- 5) provide mechanical ventilation
- 6) provide active cooling systems.

Policy SI5 Water infrastructure

C Development proposals should:

- 1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)
- 2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)
- 3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.

Policy SI12 Flood risk management

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

E Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.

F Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.

G Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat.

Policy SI13 - Sustainable drainage

A Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

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

- 1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
- 2) rainwater infiltration to ground at or close to source
- 3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens) It is noted that the proposed non-domestic development is greater than 1,000m² and would be considered major development.

- 4) rainwater discharge direct to a watercourse (unless not appropriate)
- 5) controlled rainwater discharge to a surface water sewer or drain
- 6) controlled rainwater discharge to a combined sewer.

C Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

D Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

The project at the Fortis Green Tennis Club would be considered a non-major residential/mixed use scheme and this report is informed accordingly.

The design team at utilising SAP10.2 emissions data and Part L 2021, in line with the latest GLA guidance.

The GLA Part L 2021 reporting spreadsheet is attached at **Appendix D**.

3.0 Baseline energy results

The first stage of the Mayor's Energy Hierarchy is to consider the baseline energy model.

The following section details the baseline energy requirements for the development – the starting point when considering the energy hierarchy.

3.1 New Build Dwellings

The baseline emission levels – the Target Emission Rate (TER) - is obtained by applying the design to a reference 'notional' building the characteristics of which are set by regulations – SAP10.2; The new Part L Building Regulations 2021 came into force in June 2022 and introduced a completely new notional dwelling as detailed below:-

Element or system	Reference value for target setting
Opening areas (windows, roof windows, rooflights and doors)	Same as for actual dwelling not exceeding a total area of openings of 25% of total floor area ⁽²⁾
External walls including semi-exposed walls	$U = 0.18 \text{ W/(m}^2\text{K)}$
Party walls	$U = 0$
Floors	$U = 0.13 \text{ W/(m}^2\text{K)}$
Roofs	$U = 0.11 \text{ W/(m}^2\text{K)}$
Opaque door (less than 30% glazed area)	$U = 1.0 \text{ W/(m}^2\text{K)}$
Semi-glazed door (30–60% glazed area)	$U = 1.0 \text{ W/(m}^2\text{K)}$
Windows and glazed doors with greater than 60% glazed area	$U = 1.2 \text{ W/(m}^2\text{K)}$ Frame factor = 0.7
Roof windows	$U = 1.2 \text{ W/(m}^2\text{K)}$, when in vertical position (for correction due to angle, see specification in SAP 10 Appendix R)
Rooflights	$U = 1.7 \text{ W/(m}^2\text{K)}$, when in horizontal position (for correction due to angle, see specification in SAP 10 Appendix R)
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	$5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump 2013 or later, in heated space Design flow temperature = 55 °C
Boiler	Efficiency, SEDBUK 2009 = 89.5%
Heating system controls	Boiler interlock, ErP Class V Either: – single storey dwelling in which the living area is greater than 70% of the total floor area: programmer and room thermostat – any other dwelling: time and temperature zone control, thermostatic radiator valves
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98
Hot water cylinder	If cylinder, declared loss factor = $0.85 \times (0.2 + 0.051 \text{ V}^{1/3}) \text{ kWh/day}$ where V is the volume of the cylinder in litres
Lighting	Fixed lighting capacity (lm) = 185 x total floor area Efficacy of all fixed lighting = 80 lm/W
Air conditioning	None
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 x number of storeys in block) System facing south-east or south-west

NOTE:
1. For a dwelling connected to an existing district heat network, an alternative notional building is used. See paragraph 1.8 and SAP 10.
2. See SAP 10 for details.

SAP first creates the notional reference building, based upon the same shape and form as the proposed dwelling and applies the above characteristics as defined in SAP10.2, prior to applying the actual construction and HVAC solution of the proposed dwellings to generate the Dwelling Emission Rate (DER).

3.2 Commercial Space

The energy requirements for space heating, water heating and ventilation within the new clubhouse have been calculated using the National Calculation Method (NCM) in line with AD L2 of the Building Regulations 2021.

The Government approved assessment methodology is the Simplified Building Energy Model (SBEM), The PES Ltd use an advanced modelling software - Design Builder - which enables accurate SBEM models to be created, as well as heat loss and cooling load calculations and full M&E design to be undertaken.

To consider the subject building performance against The Building Regulations (Approved Document L2) SBEM first creates the notional reference building, the characteristics of which are defined within NCM and the minimum fabric values and fixed services efficiencies set down by AD L2.

In order to establish the baseline, the HVAC solution has been assumed as a low temperature hot water (LTHW) heating system, via centralised gas fired boilers and natural ventilation. Domestic Hot Water (DHW) will be supplied from the same boilers via appropriately sized calorifiers and a secondary circulation loop.

This creates the Target Emission Rate (TER) and should be considered as stage 'zero' of the energy hierarchy as described earlier and sets the benchmark for the worst performing, but legally permissible, development against which, SBEM assesses the "actual" design, fabric values, heating lighting and ventilation systems and creates the Building Emissions Rate (BER).

Once all of the baseline emission rates have been calculated in line with the above Government approved methodologies, they are considered as stage 'zero' of the energy hierarchy as described earlier and Target Emission Rate sets the benchmark for the worst performing, but legally permissible, development.

For the project at the Fortis Green tennis club, a sample of 4 dwellings has been selected to offer a representative selection to enable an accurate figure for emissions/m² which can then be applied to the full gross internal residential floor area.

3.3 Unregulated Energy Use

The baseline un-regulated energy use for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

$$\text{Appliances} = E_A = 207.8 \times (\text{TFA} \times N)^{0.4714}$$

$$\text{Cooking} = (119 + 24N)/\text{TFA}$$

N = no of occupant SAP table 1B

TFA – Total Floor Areas

The unregulated energy use for the commercial spaces is obtained from the “equipment” outputs in the “energy consumption at end use” table on the rear of the BRUKL output.

The emissions associated with unregulated energy use per sqm is summarised in Table 1 below.

Table 1 – Unregulated Energy Use

Unit	CO ₂ emissions - Unregulated Energy Use SAP10.2 Kg
UNIT 2	342
UNIT 3	342
UNIT 7	121
UNIT 8	189
Commercial	969

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 3.1 above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Haringey policies.

3.4 Baseline Results

The baseline building results have been calculated in line with SAP10.2 emission standards and are presented in Table 2 below. The Baseline SAP and SBEM outputs (which summarise the key data) are attached at **Appendix A**, with the GLA Part L 2021 reporting spreadsheet attached at **Appendix D**.

Table 2 – Baseline energy consumption and CO2 emissions

Unit	Target Emission Rate (regulated energy use) Kg/annum	Unregulated Energy Use Kg/annum	Total baseline emissions Kg
UNIT 2	1,388	342	1,730
UNIT 3	1,346	342	1,688
UNIT 7	754	121	875
UNIT 8	1,031	189	1,219
Commercial	2,261	969	3,230
Development Total	9,293	3,012	12,305

4.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Chapter 9 of The London Plan, requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimizing associated carbon dioxide emissions.

This section sets out the measures included within the design of the development, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO₂ produced by the building after the energy efficiency measures have been included. From these figures the overall reduction in CO₂ emissions, as a result of passive design measures, can be calculated. To achieve reductions in energy demand the following measures have been included within the design and specification of the building:

4.1 Passive Design

The National Planning Policy Framework emphasises the need to take account of climate change over the longer term and plan new developments to avoid increased vulnerability to the range of impacts arising from climate change. The UK Climate Impacts Programme 2009 projections suggest that by the 2080's the UK is likely to experience summer temperatures that are up to 4.2°C higher than they are today.

Accordingly, designers are to ensure buildings are designed and constructed to be comfortable in higher temperatures, without resorting to energy intensive air conditioning.

In line with current GLA Guidance, the project at The Fortis Green Tennis Club has had been designed to ensure the building is not vulnerable to overheating; to instigate consideration of the risk of overheating with the proposed development, the design team have followed the guidance within the London Plan, which consider the control of overheating using the Cooling Hierarchy:-

1. minimise internal heat generation through energy efficient design

The project will be designed to best practice thermal insulation levels as noted, full details of which are noted under 4.3 below.

Not only does good insulation assist in reducing heat losses in the winter, but it also has a significant impact on preventing heat travelling through the build fabric during the summer.

2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and wall

The development site is located on a south facing plot within an areas of low rise suburban townscape.

There will be some topographical solar shading for the houses to the south of the development from existing mature trees.

The proposed development has flats orientated predominantly to the south, east and west, giving the livings areas the benefit of large, glazed areas introducing natural daylight and attracting useful solar gain.

These same large, glazed area are afforded protection from excessive solar gain during the summer months by the common use of shading via inset balconies and shading from balconies above.

Across the scheme, the glazing to the secondary spaces – bedrooms and bathrooms – is much reduced glazing in keeping with the reduced heat demand associated.

Glazing specification has been a significant consideration as part of the overheating risk mitigation and the specified new glazing will achieve a low g-value at circa 0.5 in order to further assist in reducing overheating risk from excessive solar gain.

A green roof at top floor levels will also aid local evaporative cooling.

3. manage the heat within the building through exposed internal thermal mass and high ceilings

All flats and houses are designed with floor to ceiling heights at circa 2.4m.

The new build structure is expected to be a traditional brick and block; offering significant thermal mass able to absorb heat during the summer months, which can then be ventilated during the evening or overnight.

4. passive ventilation

All glazing is designed to have opening areas to introduce high levels of natural “purge” ventilation to further assist in the reduction of overheating risks in appropriate areas.

5. mechanical ventilation

Although the strategy above would enable a natural ventilation strategy and this will be the strategy assumed for the proposed development.

4.2 Heating System

The “notional” heating system considered under the “be lean – use less energy” section of the Energy Hierarchy, will consist of high efficiency condensing gas boilers providing under floor heating and domestic hot water to the dwellings and clubhouse

- High efficiency boiler – (92% SEDBUK efficiency) & load compensation.
- High insulated primary and secondary pipework to prevent distribution heat losses.

To increase the efficiency in the use of the heating system, the following controls will be used to eliminate needless firing of the boilers.

- Boilers fitted with weather compensation and delayed start thermostats.

In line with the latest GLA guidance, the clubhouse will assume the use of heat pump driven LTHW systems, using the “baseline” criteria set out under section 3.3 above.

4.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated U-values exceed the Building Regulations minima, with specific guidance taken from the design team: -

- New wall constructions will be of a brick/block construction and will target a U-Value of $0.15\text{W/m}^2\text{k}$ or better.
- New flat roof constructions are to be of a flat warm-roof type, achieving a U-Value of $0.11\text{W/m}^2\text{k}$
- The newly laid floors will achieve a minimum u value of $0.12\text{W/m}^2\text{k}$ subject to perimeter/area ratios

All of the above standards are at Passivhaus minimum fabric standards or better and aligns with the LETI guidance;

LETI (Low Energy Transformation Initiative) is a network of over 1,000 built environment professionals who are working together to put London (and the UK) on the path to a zero carbon future

The guidance document published in 2019 set out performance standards for fabric, operational carbon and embedded carbon to enable new building to contribute the London’s emission reduction targets.

Glazing

- The new glazing for windows and doors for the residential units will be triple glazed with an area weighted average U-Value of $1.0\text{W/m}^2\text{K}$ or better, whilst the clubhouse will have new double glazing installed.

Air Tightness

- The project be tested to $4\text{m}^3/\text{hr}/\text{m}^2$ in line with best practice for naturally ventilated dwellings.

Construction Details

- Heat loss via non-repeating thermal bridging within the new build elements will be minimised by the use of Accredited Construction Details for these new build units. An overall Y-Value <0.04 is targeted.

4.4 Ventilation

As noted above, the residential and clubhouse accommodation is to naturally ventilated via background ventilation, opening windows and wet room extraction.

4.5 Waste Water Heat Recovery

The residential element of the project is to employ waste water heat recovery technology, harvesting in excess of 35% of heat from the showers that would be otherwise lost to the mains drain.

4.6 Lighting and appliances

The development will incorporate high efficiency light fittings utilising LED lamps.

Common/circulation areas and BoH areas in the clubhouse will also have an absence detection system to ensure lights cannot be left on when not in occupation.

The use of LED lighting will also minimise the internal gains commonly associated with tungsten and fluorescent lighting systems and thereby further reduce the potential for the flats to overheat.

External lighting will utilise daylight controls to ensure lights are not active during the day.

4.7 Energy efficiency results

The above data has been used to update the SAP & SBEM models, the Dwelling & Building Emission Rate outputs of which are attached at **Appendix B**, whilst Table 3 sets out the total emissions using SAP10.2 data.

Table 3 – Energy Efficient emission levels

Unit	Emission Rate (regulated energy use) Kg/annum	Unregulated Energy Use Kg/annum	Total “be lean” emissions Kg
UNIT 2	1,189	342	1,531
UNIT 3	1,146	342	1,488
UNIT 7	634	121	755
UNIT 8	876	189	1,065
Commercial	1,567	969	2,536
Development Total	7,907	3,012	10,919

The results show that the energy efficiency measures introduced have resulted in the reduction in regulated and unregulated CO₂ emissions from the development of **11.26%**.

Regulated emissions have been reduced by **14.91%** via the passive design measures highlighted above.

The total Part L Fabric Energy Efficiency Standard (FEES) for the development – set out in Table 4 below:-

Table 4 – Residential FEES

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (percent)
Development Total	38.17	32.35	15%

5.0 Supplying Energy Efficiently

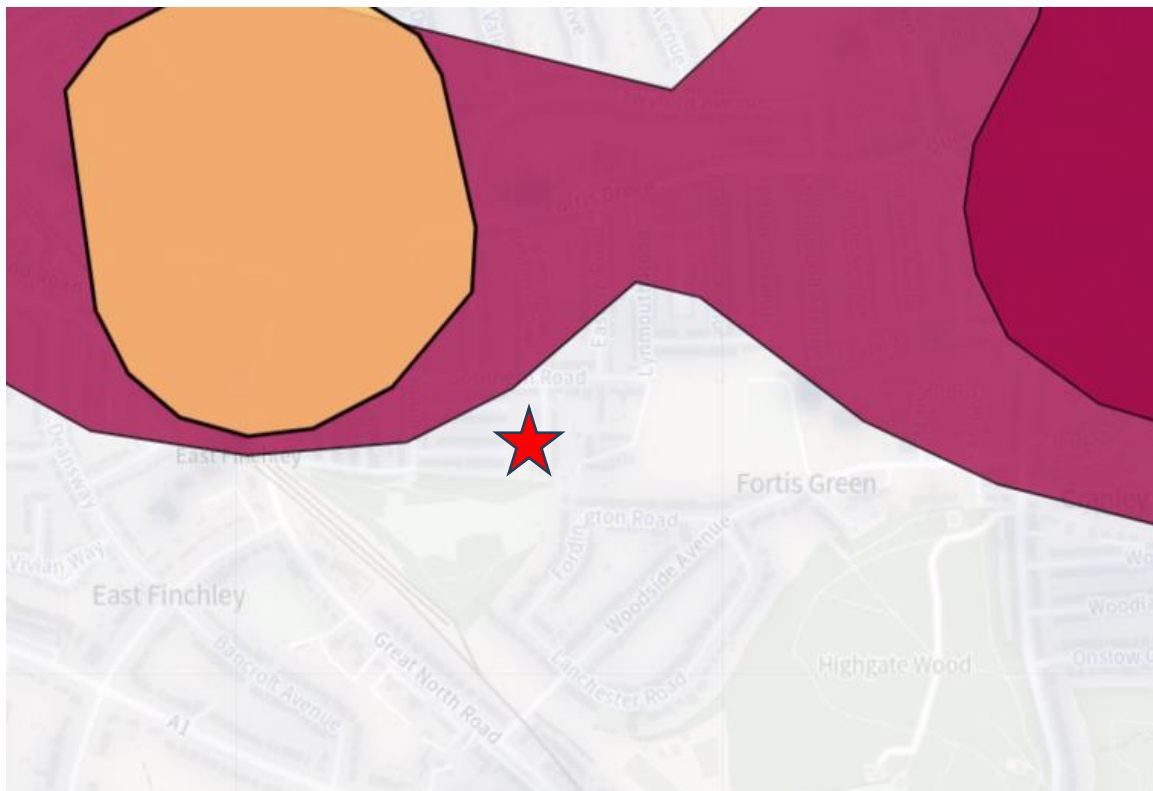
5.1 Community Heating/Combined Heat and Power (CHP)

The London Plan, Chapter 9, requires that major developments exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.

Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.

Therefore, this report must consider the availability of heat networks in the Haringey area.

The map below shows the location of the site, and it is located in heat network priority area (HNPA), but remote from any Potential Heat Network Project Areas.



Extract from London Heat Map

Clearly, there will be limited opportunity for a viable DEN to service the proposed project area, however, the proposed LTHW heating systems would be compatible with a DEN connection, should one become available in the future

However, consideration must be given to onsite community systems/CHP.

5.2 On-site CHP/District Heating

The heat production facility for a district heating scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP is, as a rule of thumb, only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual baseline heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

The key benefit from running a CHP engine is that it produces electricity, which can displace grid supplied electricity, which has significant carbon savings. It is for this reason that CHP is designed to run for as many hours of the year as possible.

GLA Guidance states developments providing a substantial coincidence of demand for heat and power for the majority of hours in the year (5,000 hours per annum) and the heat to power ratio is low (e.g. 1:1), will still be expected to include on-site CHP as part of their energy strategy to meet the London Plan CO₂ reduction targets.

A small scale residential development – at 8 units and a small commercial space – simply does not provide the constant heat demand required and as such, the potential use of on-site community networks/CHP is dismissed

6.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, wave's tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the sun's energy through photosynthesis.

The energy efficiency measures and the sourcing the energy efficiently outlined above have the most significant impact on the heating and hot water energy requirements for the development, and the associated reduction in energy consumption.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

6.1 Government incentives

6.1.1 Smart Export Guarantee (SEG)

Introduced in 2020, the SEG will enable solar photovoltaic (PV), wind, hydro and anaerobic digestion (AD) installations up to 5MW and micro-combined heat and power (micro-CHP) up to 50kW will be able to receive an export tariff under the policy.

The SEG is a market-led initiative, requiring electricity supply licensees to offer export tariffs to eligible generators. Suppliers are free to set their own SEG compliant tariff price (provided it is above zero pence at all times) and decide how their tariffs work.

Installation owners are able to shop around and select the Licensee of their choice based upon an offer of the most appropriate tariff.

Payment are made against metered exports only.

6.1.1 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally withdrawn for all new projects in March 2022.

6.2 Wind turbines

Wind turbines come in two main types' - horizontal axis and vertical axis. The more traditional horizontal axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is surrounded by similar height buildings in all directions. To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings and the proposed project at the Fortis Green Tennis Club itself.

It is inconceivable that any wind turbines of this size would be considered acceptable in this location.

6.3 Solar Energy

The proposed development has areas of flat roof that could accommodate solar panels orientated to the south.

In general, the roofs will have an unrestricted aspect, so there is scope therefore to site solar photovoltaic (PV) or water heating equipment at roof level.

6.3.1 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Both collector types can capture heat whether the sky is overcast or clear. Depending on location, approximately 900–1100 kWh of solar energy falls on each m² of unshaded UK roof surface annually. The usable energy output per m² of solar panel as a result of this amount of insolation ranges from between 380 – 550 kWh/yr.

Solar hot water systems are of course, displacing heat pumps for DHW provision (as noted below), and due to the efficiency as a source of energy, solar thermal systems tend to have a very poor pay back model unless there is a reliable and consistent demand for hot water; a medium size residential scheme simply does not provide this.

Accordingly, given the limited roof space available and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and offer a greater return in terms of a return on investment.

6.3.2 Photovoltaics (PV)

A 1kWp (1 kilowatt peak) system in the UK could be expected to produce between 790-800kWh of electricity per year based upon a south east orientation according to SAP2005 methodology used by the Microgeneration Certification Scheme (MCS). The figure given in the London Renewables Toolkit is 783 kWh per year for a development in London.

Despite the withdrawal of the Feed in Tariff, the returns on PV installations are still able to achieve 6-7% returns via the reduction in (ever more expensive) electricity consumption.

Accordingly, the design team are proposing to utilise the available roof space to install a 6 panel PV array on each of the houses and a 16 panel PV array on the separate apartment block, utilising high power 440w panels, a total 20.24kWp array generating some 17,712kWh/annum.

6.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel – which can be very bulky items. There also needs to be a local source of biomass fuel that can be delivered on a regular basis. There are also issues with fuel storage and delivery which mitigate against this technology.

Additionally, a boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating. However, biomass releases high levels of NO_x emissions and particulate matters, as well as other pollutants and would therefore have to be considered carefully against the high standard of air quality requirements within Haringey's Borough wide AQMA. Accordingly, the use of biomass is not considered appropriate for this project.

6.5 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a 'heat pump'. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by 'condensing' the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under-floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

The available land area aside from the new development is given over to new and the refurbished tennis courts, as such there is insufficient land available for the location of ground collector loops.

6.6 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid based electricity, so calculations base the benefits on SAP10.2 emissions data

Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 100% of the space heating/hot water demand, then the system would reduce the overall CO₂ emissions by approximately 70%. The table below demonstrates, on the assumption of a demand of 1000Kwh/year for heating and hot water.

Table 5 – Air Source Heat Pump Performance

Type of Array	Energy Consumption (kWh/yr.)	Emission factor (kgCO ₂ /h)	Total CO ₂ emissions (kg/annum)
90% efficient gas boiler	11111	0.210	2333
320% efficient ASHP	2813	0.136	383
100% efficient immersion (back-up)	1000	0.136	136

A theoretical carbon saving of 77%

With the above data in mind, clearly an ASHP could be an option and the “be green” proposals include the use of air source heat pumps to provide the heat source for the projects heating and DHW requirements.

Overall system efficiency has been advised at a minimum 330% and this figure has been used for the communal heating systems within the final energy calculations.

6.7 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the use the above noted air source heat pump system to deliver the heating and hot water demands to the development, as well as a roof mounted 46panel PV array, a total 20.24kWp array generating some 17,712kWh/annum.

The final table – Table 6 – summarises the final outputs from the SAP & SBEM models; attached at **Appendix C**.

Table 6 – “Be Green” emission levels

Unit	Emission Rate (regulated energy use) Kg/annum	Unregulated Energy Use Kg/annum	Total baseline emissions Kg
UNIT 2	243	342	585
UNIT 3	232	342	574
UNIT 7	176	121	297
UNIT 8	198	189	386
Commercial	1,538	969	2,508
Development Total	1,744	3,012	4,756

The data at Table 6 confirms that overall emissions – including unregulated energy use - have been reduced by **61.35%** over and above the baseline model, with a **56.44%**

reduction in emissions directly from the use of energy generating and renewable technologies, i.e. over and above the energy efficient model.

Excluding the un-regulated use, i.e. considering emissions controlled under AD Part L, then the final reduction in BER/TER equates to **81%**.

The Energy Use Intensity and space heating demand of the development are also reported – Table 7 below

Table 7 – Energy and Heat Demands

Building Type	Energy Use Intensity (kWh/m ² /year)	Space Heating (kWh/m ² /year)
Residential	32.96	32.20
Commercial	138.76	19.20

7.0 Sustainable Design & Construction

The Sustainability credentials of the proposed residential development at the Fortis Green Tennis Club project are set out below; based on the environmental assessment criteria developed by the Building Research Establishment.

Materials

The principal issue when considering the environmental impact of new construction materials is the embodied carbon – i.e. the carbon cost extraction of raw material, transport to factory, manufacturing, transport to site and erection on site.

Additional carbon costs are occurred through maintenance and repairs as well as end of life (deconstruction/demolition).

The design team will seek out construction techniques with a lower embodied carbon contents; steel work and lightweight concrete floor slabs.

It is recognised that concrete utilised to form the floor slabs has a significant embodied CO₂e content, the majority of which comes from the cement, which makes up about 10% of concrete by volume, but accounts for around 75-90% of its embodied impact.

The team will aspire to utilise concrete with a significant recyclable content; concrete with a minim 30% GGBS content; higher if such product can be sourced at the time.

Emissions of CO₂ associated with calcium carbonate decomposition during concrete production are partly reversible through carbonation.

The mix design of structural concrete purposefully limits carbonation of the surface layer, preventing corrosion of any embedded steel reinforcement, which might otherwise be affected during the building's life. There is, however, a greater degree of carbonation during the end-of-life stage, when concrete is crushed for reuse as an aggregate. The crushing process substantially increases the material's surface area, allowing CO₂ to be more readily absorbed.

It is generally acknowledged that the concrete carbonisation process will remove up to 30% of the up-front embodied CO₂e during the buildings lifespan, including end of life.

Other significant measure considered to reduce the project CO₂e content include:-

- Structural Steels with a 30% recycled content
- Plasterboard with a significant recycled content – subject to market availability

In addition to the above low carbon strategy, the development will source all materials form supplier that can demonstrate that materials are sourced responsibly in line with recognised Environmental Management Systems (FCS, BES6001 etc.)

The principle contractor will be required to produce a site waste management plan and sustainable procure plan, in line with BREEAM standards – this will include a pre-demolition audit to identify demolition/strip-out materials to reuse on-site or salvage appropriate materials to enable their reuse or recycling off-site in order to align with the principles of the circular economy.

The procurement plan will follow the waste hierarchy Reduce; Reuse & Recycle.

The SWMP will inform the adoption of good practice waste minimisation in design. This will set targets to minimise the generation of non-hazardous construction waste using the sustainable procurement plan to avoid over-ordering and to use just-in-time delivery policies.

The project will target a figure in excess of 97% of construction waste diverted from landfill.

Operational waste and recycling – appropriate internal and external storage space will be provided to ensure that residents can sort, store and dispose of waste and recyclable materials in line with Barnet's collection policies.

Pollution

The contractor will also monitor the use of energy and water use during the construction phase and incorporate best site practices to reduce the potential for air (dust) and ground water pollution.

The completed development will use zero emission heat pump systems for heating and hot water.

The main contractor will be required to register the site with the Considerate Constructors Scheme and achieve a best practice score of 25 or more.

To avoid the issue of noise pollution, the development will comply with Building Regulations Part E, providing a good level of sound insulation between the proposed development and surrounding buildings.

Energy

The development will incorporate renewables technologies as noted in the main report above - air source heat pumps and roof mounted PV.

The new homes will also be supplied with a Home User Guide offering practical advice on how to use the home economically and efficiently, including specific advice on how to reduce unregulated energy uses.

This will be further enhanced by the installation of smart energy metering, enabling occupants to accurately assess their energy usage and thereby, manage it.

Water

The development minimise water use as far as practicable by incorporating appropriate water efficiency and water recycling measures. The applicants will ensure that all dwellings meet the required level of 105 litres maximum daily allowable usage per person in accordance with the former Level 4 of the Code for Sustainable Homes.

Sustainable Urban Drainage (SuDs)

The existing site is currently made up of existing buildings, tennis courts - accordingly, the applicants will employ attenuation measures to reduce the levels of surface water run-off.

A formal FRA/SuDs report has been prepared under separate cover.

Ecology and Biodiversity

The development will consider the landscaping and planting regime and any other opportunities to achieve an overall improvement in the levels of fauna and flora utilising indigenous species where possible and appropriate.

It is expected to achieve an uplift in net biodiversity.

8.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO₂ reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, following the guidance from the GLA (June 2022), the total amount of CO₂ emissions would be **12,305Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 4, the total amount of CO₂ emissions would be reduced to **10,919Kg/year**.

There is also a requirement to reduce CO₂ emissions across the development using renewable or low-carbon energy sources. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that the most suitable solution to meeting reduction in CO₂ emissions would be via the use of heat pump driven heating and hot water systems and the generation of electricity on site via an 20.24kwp PV array.

This has been used in the SAP & SBEM models (reproduced at **Appendix C**) for the development which have also been detailed above in Table 6, which show a final gross emission level of **4,756Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **61.35%**.

In addition, the final SAP outputs at Appendix C demonstrate that the building achieves an overall improvement in regulated emissions over the Building Regulations Part L standards for regulated emissions of minimum of 81%.

The GLA Part L 2021 Spreadsheet is attached at **Appendix D**.

Tables 10 - 14 Demonstrate how the Fortis Green Tennis Club project complies with the London Plan requirements and the GLA guidance relating to zero carbon development based up SAP10.2 emissions data.

Table 10 – Carbon Emission Reductions – Domestic Buildings

Key	Tonnes/annum
Baseline CO ₂ emissions (Part L 2021 of the Building Regulations Compliant Development)	41.8
CO ₂ emissions after energy demand reduction (be lean)	35.1
CO ₂ emissions after energy demand reduction (be lean) AND heat network (be clean)	35.1
CO ₂ emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	5.9

Table 11 – Regulated Emissions Savings – Domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO ₂ per annum)	%
Savings from energy demand reduction	1.4	15%
Savings from heat network	0.0	0%
Savings from renewable energy	6.2	66%
Total Cumulative Savings	7.5	81%
	(Tonnes CO ₂)	
Carbon Shortfall	1.7	
Cumulative savings for off-set payment	52	
Cash-in-lieu Contribution	£4,971	

Table 12 – Carbon Emission Reductions – Non-domestic Buildings

Key	Tonnes/annum
Baseline CO ₂ emissions (Part L 2013 of the Building Regulations Compliant Development)	2.3
CO ₂ emissions after energy demand reduction (be lean)	1.6
CO ₂ emissions after energy demand reduction (be lean) AND heat network (be clean)	1.6
CO ₂ emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	1.5

Table13 – Regulated Emissions Savings – Non-domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO ₂ per annum)	%
Savings from energy demand reduction	0.7	31%
Savings from heat network	0.0	0%
Savings from renewable energy	0.0	1%
Total Cumulative Savings	0.7	32%
	(Tonnes CO ₂)	
Carbon Shortfall	1.5	
Cumulative savings for off-set payment	46	
Cash-in-lieu Contribution	£4,385	

Table 14: Site wide regulated carbon dioxide emissions and savings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ savings (Tonnes CO ₂ /year)	Percentage Saving (%)
Part L 2021 baseline	11.6		
Be lean	9.5	2.1	18%
Be clean	9.5	0.0	0%
Be green	3.3	6.2	54%
Total Savings	-	8.3	72%
	-	CO₂ savings off-set (Tonnes CO₂)	-
Off-set	-	98.5	-

Appendix A

Baseline/Un-regulated Energy Use:-

SAP & SBEM Outputs & Target/Building Emission Rates

Property Reference	Unit 3			Issued on Date	27/09/2023
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	88 B	DER	10.49	TER	9.65
Environmental	90 B	% DER < TER			-8.70
CO ₂ Emissions (t/year)	1.28	DFEE	30.75	TFEE	35.45
Compliance Check	See BREL	% DFEE < TFEE			13.25
% DPER < TPER	-15.74	DPER	58.24	TPER	50.32
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

2023-09-27



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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 399.5550 (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	5 * 10 = 50.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) = 0.1251 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3251 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2764 (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	0.3524	0.3455	0.3386	0.3040	0.2971	0.2625	0.2625	0.2556	0.2764	0.2971	0.3109	0.3247 (22b)
Effective ac	0.5621	0.5597	0.5573	0.5462	0.5441	0.5345	0.5345	0.5327	0.5382	0.5441	0.5483	0.5527 (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
DOOR			2.3500	1.0000	2.3500		(26)
G (Uw = 1.00)			29.5500	0.9615	28.4135		(27)
FR RL			1.1500	0.9615	1.1058		(27a)
GF			49.6600	0.1200	5.9592	110.0000	5462.6000 (28a)
EW	104.7000	31.9000	72.8000	0.1500	10.9200	60.0000	4368.0000 (29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361	9.0000	436.5900 (30)

Total net area of external elements Aum(A, m2)	204.0200												(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	54.0845											(33)
PW	150.4500	0.0000								45.0000	6770.2500		(32)
IW	245.5400									9.0000	2209.8600		(32c)
IF	89.8300									18.0000	1616.9400		(32d)
IF	89.8300									9.0000	808.4700		(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21672.7100											(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K													(35)
Thermal bridges (User defined value 0.030 * total exposed area)													(36)
Point Thermal bridges													(36a) =
Total fabric heat loss	(33) + (36) + (36a) =	60.2051											(37)

End of Day Calculation Summary													
ed monthly (38)m = 0.33 x (25)m x (5)													
(38)m	74.1123	73.7944	73.4829	72.0195	71.7457	70.4711	70.4711	70.2350	70.9620	71.7457	72.2995	72.8786	(38)
Heat transfer coeff	134.3174	133.9996	133.6880	132.2246	131.9508	130.6762	130.6762	130.4402	131.1671	131.9508	132.5047	133.0838	(39)
Average = Sum(39)m / 12 =													132.2233
HLP	0.9629	0.9606	0.9584	0.9479	0.9460	0.9368	0.9368	0.9351	0.9403	0.9460	0.9499	0.9541	(40)
HLP (average)													0.9479
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333	(42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577	(42b)
Hot water usage for other uses	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939	(42c)
Average daily hot water use (litres/day)													137.1222 (43)
Daily hot water use	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848	(44)
Energy conte	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610	(45)
Energy content (annual)													Total = Sum(45)m = 2277.5713
Distribution loss (46)m = 0.15 x (45)m	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199	(62)
WWHRS	-65.1476	-57.6171	-60.3333	-49.9584	-46.5594	-39.8412	-37.3448	-39.7124	-41.2212	-48.5953	-55.0526	-63.9412	(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	222.0627	196.2926	209.0387	185.8192	181.3138	164.7359	163.9318	169.9257	171.1414	189.1289	198.8775	219.9787	(64)
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 2272.2469 (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	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	157.4062	174.2711	157.4062	162.6531	157.4062	162.6531	157.4062	157.4062	162.6531	157.4062	162.6531	157.4062	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	(71)
Water heating gains (Table 5)	122.7061	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356	(72)
Total internal gains	658.6853	676.0306	645.8422	622.3955	588.4015	562.8877	539.4917	540.0239	557.7276	580.8439	618.8183	643.5884	(73)

[illegible]

(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	(231)
Lighting	35.8880	28.7907	25.9228	18.9922	14.6701	11.9856	13.3826	17.3952	22.5946	29.6453	33.4843	36.8854	(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 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												4071.9568	(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												2669.2830	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												289.6368	(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												7071.8766	(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	4071.9568	0.2100	855.1109	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2669.2830	0.2100	560.5494	(264)
Space and water heating			1415.6604	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	289.6368	0.1443	41.8035	(268)
Total CO2, kg/year			1463.1511	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.4900	(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	4071.9568	1.1300	4601.3112	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2669.2830	1.1300	3016.2898	(278)
Space and water heating			7617.6010	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	289.6368	1.5338	444.2546	(282)
Total Primary energy kWh/year			8123.8803	(286)
Dwelling Primary energy Rate (DPER)			58.2400	(287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b)	-
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c)	-

Second floor
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 139.4900
Dwelling volume 40.1700 (1d) x 2.9000 (2d) = 116.4930 (1d) - (4)
(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 399.5550 (5)

2. Ventilation rate

Number of open chimneys 0 * 80 = 0.0000 (6a)
Number of flues attached to solid fuel boiler 0 * 20 = 0.0000 (6b)
Number of flues attached to other heater 0 * 10 = 0.0000 (6c)
Number of blocked chimneys 0 * 20 = 0.0000 (6d)
Number of intermittent extract fans 0 * 35 = 0.0000 (6e)
Number of passive vents 0 * 20 = 0.0000 (6f)
Number of flueless gas fires 4 * 10 = 40.0000 (7a)
0 * 10 = 0.0000 (7b)
0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.1001 (8)
Pressure test Yes
Pressure Test Method Blower Door
Measured/design AP50 5.0000 (17)
Infiltration rate 0.3501 (18)
Number of sides sheltered 2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2976 (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	0.3794	0.3720	0.3646	0.3274	0.3199	0.2827	0.2827	0.2753	0.2976	0.3199	0.3348	0.3497	(22b)
Effective ac	0.5720	0.5692	0.5664	0.5536	0.5512	0.5400	0.5400	0.5379	0.5443	0.5512	0.5560	0.5611	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.20)			29.5500	1.1450	33.8359			(27)
FR RL			1.1500	2.0221	2.3254			(27a)
GF			49.6600	0.1300	6.4558			(28a)
EW	104.7000	31.9000	72.8000	0.1800	13.1040			(29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361			(30)
Total net area of external elements Aum(A, m2)			204.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.4071			(33)
PW			150.4500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 155.3711 (35)

List of Thermal Bridges	K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525		
E3 Sill	9.0500	0.0500	0.4525		
E4 Jamb	19.0600	0.0500	0.9530		
E5 Ground floor (normal)	27.8800	0.1600	4.4608		
E14 Flat roof	27.8800	0.0800	2.2304		
E16 Corner (normal)	9.8000	0.0900	0.8820		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				9.4312	(36)
Point Thermal bridges				(36a) =	0.0000
Total fabric heat loss				(33) + (36) + (36a) =	72.8383 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	75.4180	75.0494	74.6882	72.9913	72.6738	71.1959	71.1959	70.9223	71.7652	72.6738	73.3161	73.9875	(38)
Heat transfer coeff	148.2563	147.8878	147.5265	145.8297	145.5122	144.0343	144.0343	143.7606	144.6035	145.5122	146.1544	146.8259	(39)
Average = Sum(39)m / 12 =												145.8281	
HLP	1.0628	1.0602	1.0576	1.0454	1.0432	1.0326	1.0326	1.0306	1.0367	1.0432	1.0478	1.0526	(40)
HLP (average)												1.0454	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333	(42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577	(42b)

Hot water usage for other uses												
	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939 (42c)
Average daily hot water use (litres/day)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)
Energy conte	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)
Energy content (annual)										Total = Sum(45)m =		2277.5713
Distribution loss (46)m = 0.15 x (45)m												
	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)
Water storage loss:												
Total storage loss												
Ув'язування балансу	2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199 (62)
WWHRS	-33.4244	-29.5608	-30.9544	-25.6314	-23.8876	-20.4408	-19.1600	-20.3747	-21.1488	-24.9321	-28.2451	-32.8054 (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												
	253.7859	224.3489	238.4176	210.1461	203.9856	184.1363	182.1166	189.2634	191.2138	212.7921	225.6850	251.1145 (64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2567.0059 (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												
	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993 (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	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)
Lighting gains	(calculated in Appendix L, equation L9 or L9a), also see Table 5											
	155.7883	172.4799	155.7883	160.9812	155.7883	160.9812	155.7883	155.7883	160.9812	155.7883	160.9812	155.7883 (67)
Appliances gains	(calculated in Appendix L, equation L13 or L13a), also see Table 5											
	308.8314	312.8361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)
Cooking gains	(calculated in Appendix L, equation L15 or L15a), also see Table 5											
	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (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)											
	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)
Water heating gains	(Table 5)											
	122.7061	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356 (72)
Total internal gains	657.0674	674.2394	644.2243	620.7236	586.7836	561.2159	537.8739	538.4060	556.0558	579.2260	617.1465	641.9705 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	15.2500	10.6334	0.6300	0.7000	0.7700	49.5580 (74)
East	0.9500	19.6403	0.6300	0.7000	0.7700	5.7022 (76)
South	13.3500	46.7521	0.6300	0.7000	0.7700	190.7453 (78)
North	1.1500	26.0000	0.6300	0.7000	1.0000	11.8673 (82)

Solar gains	257.8728	442.9017	621.0513	803.5038	937.3563	948.7063	906.9851	803.2339	683.0340	493.0417	309.4067	220.4098 (83)
Total gains	914.9402	1117.1411	1265.2756	1424.2275	1524.1399	1509.9222	1444.8590	1341.6399	1239.0898	1072.2677	926.5532	862.3803 (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	40.6067	40.7079	40.8076	41.2824	41.3725	41.7970	41.7970	41.8765	41.6324	41.3725	41.1907	41.0023
alpha	3.7071	3.7139	3.7205	3.7522	3.7582	3.7865	3.7865	3.7918	3.7755	3.7582	3.7460	3.7335
util living area	0.9841	0.9671	0.9368	0.8649	0.7405	0.5700	0.4275	0.4752	0.6978	0.9009	0.9706	0.9871 (86)
MIT	19.2322	19.5397	19.9283	20.3994	20.7467	20.9308	20.9819	20.9731	20.8496	20.3827	19.7244	19.1824 (87)
Th 2	20.0313	20.0335	20.0356	20.0456	20.0475	20.0563	20.0563	20.0579	20.0529	20.0475	20.0437	20.0397 (88)
util rest of house	0.9808	0.9606	0.9241	0.8383	0.6925	0.4985	0.3405	0.3850	0.6297	0.8753	0.9636	0.9844 (89)
MIT 2	17.9654	18.3550	18.8423	19.4216	19.8171	20.0080	20.0478	20.0444	19.9361	19.4162	18.5996	17.9076 (90)
Living area fraction									fLA = Living area / (4) =			0.2694 (91)
MIT	18.3067	18.6741	19.1349	19.6850	20.0676	20.2566	20.2995	20.2946	20.1822	19.6766	18.9026	18.2511 (92)

8. Space heating requirement

Full SAP Calculation Printout

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

Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2454.5699 (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	5578.7124 (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	4634.9981	0.2100	973.3496 (261)
Επιπλέον Κατανάλωση Ενέργειας Community systems			0.0000 (373)
Space and water heating	3051.0420	0.2100	640.7188 (264)
Pumps, fans and electric keep-hot	86.0000	0.1387	1614.0684 (265)
Energy for lighting	261.2423	0.1443	11.9293 (267)
			37.7053 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	0.1345	-138.2176
PV Unit electricity exported	-1426.6745	0.1258	-179.4705
Total			-317.6881 (269)
Total CO2, kg/year			1346.0149 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.6500 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4634.9981	1.1300	5237.5478 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)			
Space and water heating	3051.0420	1.1300	3447.6775 (278)
Pumps, fans and electric keep-hot	86.0000	1.5128	8685.2253 (279)
Energy for lighting	261.2423	1.5338	130.1008 (281)
			400.7021 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	1.4970	-1538.7175
PV Unit electricity exported	-1426.6745	0.4618	-658.7722
Total			-2197.4897 (283)
Total Primary energy kWh/year			7018.5385 (286)
Target Primary Energy Rate (TPER)			50.3200 (287)

Property Reference	Unit 7			Issued on Date	27/09/2023
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	85 B	DER	16.05	TER	15.28
Environmental	89 B	% DER < TER			-5.04
CO ₂ Emissions (t/year)	0.71	DFEE	35.84	TFEE	41.35
Compliance Check	See BREL	% DFEE < TFEE			13.33
% DPER < TPER	-10.47	DPER	88.86	TPER	80.44
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

Energy Saving Calculation Function



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)
Ground floor	49.3200 (1b)	x 2.8000 (2b)	= 138.0960 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 138.0960 (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) =	Air changes per hour
Pressure test		20.0000 / (5) = 0.1448 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		4.0000 (17)
Number of sides sheltered		0.3448 (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) =	0.3190 (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	0.4067	0.3987	0.3907	0.3509	0.3429	0.3030	0.3030	0.2950	0.3190	0.3429	0.3588	0.3748 (22b)
Effective ac	0.5827	0.5795	0.5763	0.5616	0.5588	0.5459	0.5459	0.5435	0.5509	0.5588	0.5644	0.5702 (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
G (Uw = 1.00)			12.8900	0.9615	12.3942		(27)
EF			5.3300	0.1200	0.6396	110.0000	586.3000 (28b)
EW	57.9300	12.8900	45.0400	0.1500	6.7560	60.0000	2702.4000 (29a)
SW	18.5900		18.5900	0.1500	2.7885	60.0000	1115.4000 (29a)
FR	11.3900		11.3900	0.1100	1.2529	9.0000	102.5100 (30)
Total net area of external elements Aum(A, m ²)			93.2400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.8312		(33)
PW			14.2500	0.0000	0.0000	45.0000	641.2500 (32)

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heating season)
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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	41.5562	41.6599	41.7621	42.2487	42.3411	42.7762	42.7762	42.8577	42.6075	42.3411	42.1547	41.9617
alpha	3.7704	3.7773	3.7841	3.8166	3.8227	3.8517	3.8517	3.8572	3.8405	3.8227	3.8103	3.7974
util living area	0.9665	0.9382	0.8908	0.7954	0.6590	0.4939	0.3628	0.3978	0.6015	0.8357	0.9416	0.9716 (86)
MIT	19.8183	20.0446	20.3152	20.6101	20.7994	20.8899	20.9127	20.9098	20.8557	20.5978	20.1618	19.7800 (87)
Th 2	19.9266	19.9290	19.9313	19.9423	19.9443	19.9539	19.9539	19.9557	19.9502	19.9443	19.9402	19.9358 (88)
util rest of house	0.9592	0.9256	0.8692	0.7579	0.6026	0.4203	0.2788	0.3108	0.5257	0.7960	0.9274	0.9654 (89)
MIT 2	18.5701	18.8525	19.1838	19.5366	19.7405	19.8326	19.8484	19.8488	19.8032	19.5350	19.0118	18.5293 (90)
Living area fraction	fLA = Living area / (4) =											0.5146 (91)
MIT	19.2124	19.4660	19.7660	20.0890	20.2854	20.3767	20.3961	20.3948	20.3448	20.0819	19.6036	19.1729 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.0624	19.3160	19.6160	19.9390	20.1354	20.2267	20.2461	20.2448	20.1948	19.9319	19.4536	19.0229 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9519	0.9170	0.8619	0.7578	0.6134	0.4400	0.3026	0.3353	0.5442	0.7954	0.9196	0.9587 (94)
Useful gains	447.8523	513.8544	541.3462	526.0929	446.1498	312.8520	206.7014	216.8837	330.2983	425.1959	433.7271	428.1259 (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												
Space heating	867.6931	845.2197	767.1218	638.2068	486.6190	321.2896	208.1951	219.1224	349.3959	538.3345	715.7988	862.8305 (97)
kWh	312.3616	222.6774	167.9770	80.7220	30.1091	0.0000	0.0000	0.0000	0.0000	84.1752	203.0916	323.4202 (98a)
Space heating requirement - total per year (kWh/year)												1424.5342
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												
	312.3616	222.6774	167.9770	80.7220	30.1091	0.0000	0.0000	0.0000	0.0000	84.1752	203.0916	323.4202 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1424.5342
Space heating per m2												
										(98c) / (4) =		28.8835 (99)

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

[illegible]

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)
Space heating fuel - main system 1												1543.3740	(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												2115.0973	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												121.7076	(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												3821.1789	(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	1543.3740	0.2100	324.1085	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2115.0973	0.2100	444.1704	(264)
Space and water heating			768.2790	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	121.7076	0.1443	17.5662	(268)
Total CO2, kg/year			791.5323	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.0500	(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	1543.3740	1.1300	1744.0126	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2115.0973	1.1300	2390.0600	(278)
Space and water heating			4134.0725	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	121.7076	1.5338	186.6792	(282)
Total Primary energy kWh/year			4382.7765	(286)
Dwelling Primary energy Rate (DPER)			88.8600	(287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	49.3200 (1b)	x 2.8000 (2b)	= 138.0960 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.3200		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	138.0960 (5)	

Assumed occupancy												1.6701 (42)
Hot water usage for mixer showers	52.2216	51.4368	50.2932	48.1051	46.4904	44.6897	43.6661	44.8011	46.0452	47.9786	50.2136	52.0215 (42a)
Hot water usage for baths	22.5802	22.2449	21.7726	20.9019	20.2499	19.5270	19.1364	19.6054	20.1160	20.8896	21.7782	22.5039 (42b)
Hot water usage for other uses	31.7335	30.5795	29.4256	28.2716	27.1177	25.9638	25.9638	27.1177	28.2716	29.4256	30.5795	31.7335 (42c)
Average daily hot water use (litres/day)												97.9306 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.5352	104.2612	101.4914	97.2787	93.8580	90.1804	88.7663	91.5241	94.4328	98.2937	102.5714	106.2588 (44)
Energy conte	168.7258	148.4665	155.9885	133.1696	126.3509	110.8873	107.3552	113.3260	116.4451	133.3837	146.1318	166.3756 (45)

Energy content (annual)												Total = Sum(45)m =	1626.6059
Distribution loss (46)m = 0.15 x (45)m													
	25.3089	22.2700	23.3983	19.9754	18.9526	16.6331	16.1033	16.9989	17.4668	20.0076	21.9198	24.9563	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	47.9730	47.8290	44.4725	45.2343	46.6397	46.5696	50.0894	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	219.6847	194.4939	206.9474	181.1427	174.1799	155.3598	152.5895	159.9657	163.0146	183.4731	195.4468	217.3345	(62)
WWHRS	-23.8735	-21.1139	-22.1093	-18.3074	-17.0618	-14.5999	-13.6851	-14.5527	-15.1056	-17.8079	-20.1742	-23.4314	(63a)
Energy saving calculation function													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
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													
	195.8112	173.3800	184.8381	162.8353	157.1181	140.7599	138.9044	145.4130	147.9090	165.6652	175.2727	193.9031	(64)
												Total per year (kWh/year) = Sum(64)m =	1981.8100 (64)
													1982 (64)
12Total per year (kWh/year)													
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000 (64a)
Heat gains from water heating, kWh/month													
	68.8410	60.8720	64.6059	56.2722	53.9689	47.9881	47.0042	49.3408	50.3604	56.8724	60.9176	68.0596	(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	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	73.3719	81.2331	73.3719	75.8176	73.3719	75.8176	73.3719	73.3719	75.8176	73.3719	75.8176	73.3719	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	145.4679	146.9774	143.1735	135.0755	124.8532	115.2456	108.8272	107.3177	111.1216	119.2196	129.4419	139.0495	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	(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)													
	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	(71)
Water heating gains (Table 5)													
	92.5283	90.5833	86.8359	78.1558	72.5389	66.6502	63.1777	66.3183	69.9450	76.4414	84.6077	91.4780	(72)
Total internal gains													
	362.4196	369.8453	354.4328	340.1003	321.8154	305.7649	293.4282	295.0593	304.9356	320.0844	340.9188	354.9508	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W		
East				7.4700	19.6403	0.6300	0.7000		0.7700		44.8373	(76)	
South				4.8600	46.7521	0.6300	0.7000		0.7700		69.4399	(78)	
Solar gains	114.2772	201.4359	289.3130	374.3978	428.7983	428.4902	412.0483	371.9359	319.3277	226.7395	138.2168	96.8745	(83)
Total gains	476.6968	571.2813	643.7458	714.4981	750.6136	734.2551	705.4765	666.9952	624.2633	546.8239	479.1356	451.8253	(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	39.3334	39.4503	39.5655	40.1157	40.2204	40.7148	40.7148	40.8077	40.5229	40.2204	40.0092	39.7908	
alpha	3.6222	3.6300	3.6377	3.6744	3.6814	3.7143	3.7143	3.7205	3.7015	3.6814	3.6673	3.6527	
util living area													
	0.9706	0.9453	0.9023	0.8137	0.6828	0.5178	0.3830	0.4197	0.6277	0.8529	0.9488	0.9752	(86)
MIT													
	19.3735	19.6859	20.0713	20.5057	20.7975	20.9461	20.9863	20.9808	20.8887	20.4912	19.8632	19.3258	(87)
Th 2	19.8304	19.8334	19.8364	19.8504	19.8531	19.8653	19.8653	19.8676	19.8606	19.8531	19.8477	19.8422	(88)
util rest of house													
	0.9637	0.9332	0.8810	0.7753	0.6225	0.4358	0.2876	0.3212	0.5450	0.8128	0.9352	0.9693	(89)
MIT 2													
	17.9876	18.3780	18.8514	19.3707	19.6860	19.8331	19.8604	19.8600	19.7859	19.3723	18.6156	17.9357	(90)
Living area fraction													
	18.7008	19.0510	19.4792	19.9547	20.2580	20.4058	20.4398	20.4367	20.3534	19.9481	19.2576	18.6510	(91)
MIT													
	18.7008	19.0510	19.4792	19.9547	20.2580	20.4058	20.4398	20.4367	20.3534	19.9481	19.2576	18.6510	(92)
Temperature adjustment													
	18.7008	19.0510	19.4792	19.9547	20.2580	20.4058	20.4398	20.4367	20.3534	19.9481	19.2576	18.6510	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
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Utilisation	0.9550	0.9232	0.8734	0.7791	0.6448	0.4758	0.3365	0.3715	0.5823	0.8165	0.9266	0.9613 (94)
Useful gains	455.2484	527.3902	562.2401	556.6977	484.0069	349.3595	237.3678	247.7981	363.5137	446.5060	443.9667	434.3442 (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	932.8267	913.9329	835.8067	702.1177	542.1262	363.3179	240.2866	252.0370	393.1805	592.1786	774.2193	925.3203 (97)
Space heating kWh	355.3182	259.7567	203.5335	104.7024	43.2407	0.0000	0.0000	0.0000	0.0000	108.3804	237.7819	365.2862 (98a)
Space heating requirement - total per year (kWh/year)												1678.0002
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	355.3182	259.7567	203.5335	104.7024	43.2407	0.0000	0.0000	0.0000	0.0000	108.3804	237.7819	365.2862 (98c)
Space heating contribution - total per year (kWh/year)												1678.0002
Energy saving calculation Summary												(98c) / (4) = 34.0227 (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 %)												92.4000 (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	355.3182	259.7567	203.5335	104.7024	43.2407	0.0000	0.0000	0.0000	0.0000	108.3804	237.7819	365.2862 (98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000 (210)
Space heating fuel (main heating system)	384.5436	281.1220	220.2744	113.3143	46.7973	0.0000	0.0000	0.0000	0.0000	117.2948	257.3397	395.3314 (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	195.8112	173.3800	184.8381	162.8353	157.1181	140.7599	138.9044	145.4130	147.9090	165.6652	175.2727	193.9031 (64)
Efficiency of water heater	85.6413	85.2455	84.5884	83.4597	82.0122	80.3000	80.3000	80.3000	80.3000	83.4943	85.0355	85.7167 (216)
Fuel for water heating, kWh/month	228.6412	203.3890	218.5147	195.1065	191.5789	175.2925	172.9819	181.0872	184.1955	198.4149	206.1170	226.2139 (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	15.2452	12.2303	11.0120	8.0679	6.2319	5.0915	5.6849	7.3895	9.5982	12.5933	14.2241	15.6689 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-23.5221	-33.3990	-48.3728	-54.8549	-59.6001	-55.8510	-55.2119	-51.9250	-46.1567	-38.4490	-25.9630	-20.3127 (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)	-12.5850	-26.5506	-52.8908	-79.5922	-105.3591	-105.8528	-104.5574	-88.4343	-64.7290	-37.9643	-16.8063	-9.9422 (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)
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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1816.0175 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.3000
Water heating fuel used												2381.5331 (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)												123.0377 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1218.8823 (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												3187.7060 (238)

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

Revision Rate (TER)

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1816.0175	1.1300	2052.0998 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2381.5331	1.1300	2691.1324 (278)
Space and water heating			4743.2322 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	123.0377	1.5338	188.7193 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-513.6182	1.4967	-768.7293
PV Unit electricity exported	-705.2640	0.4620	-325.8034
Total			-1094.5327 (283)
Total Primary energy kWh/year			3967.5195 (286)
Target Primary Energy Rate (TPER)			80.4400 (287)

Property Reference	Unit 8		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	85 B	DER	14.58	TER	13.40
Environmental	88 B	% DER < TER			-8.81
CO ₂ Emissions (t/year)	1	DFEE	38.31	TFEE	43.59
Compliance Check	See BREL	% DFEE < TFEE			12.11
% DPER < TPER	-15.13	DPER	80.85	TPER	70.22
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

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)
Ground floor	76.9200 (1b)	x 2.8000 (2b)	= 215.3760 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.9200		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3760 (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) =	Air changes per hour
Pressure test	30.0000 / (5) = 0.1393 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	4.0000 (17)
Number of sides sheltered	0.3393 (18)
	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3393 (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	0.4326	0.4241	0.4156	0.3732	0.3647	0.3223	0.3223	0.3138	0.3393	0.3647	0.3817	0.3987 (22b)
Effective ac	0.5936	0.5899	0.5864	0.5696	0.5665	0.5519	0.5519	0.5492	0.5576	0.5665	0.5728	0.5795 (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
G (Uw = 1.00)			20.9900	0.9615	20.1827		(27)
EF			3.1900	0.1200	0.3828	110.0000	350.9000 (28b)
EW	86.9300	20.9900	65.9400	0.1500	9.8910	60.0000	3956.4000 (29a)
SW	22.4000		22.4000	0.1500	3.3600	60.0000	1344.0000 (29a)
FR	76.9200		76.9200	0.1100	8.4612	9.0000	692.2800 (30)
Total net area of external elements Aum(A, m ²)			189.4400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.2777		(33)
PF			73.7300			40.0000	2949.2000 (32d)

heating season)

(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)

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													5418.3676 (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	2726.2849	0.2100	572.5198	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2452.2490	0.2100	514.9723	(264)
Space and water heating			1087.4921	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	198.8336	0.1443	28.6978	(268)
Total CO2, kg/year			1121.8772	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.5800	(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	2726.2849	1.1300	3080.7019	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2452.2490	1.1300	2771.0414	(278)
Space and water heating			5851.7433	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	198.8336	1.5338	304.9777	(282)
Total Primary energy kWh/year			6218.7458	(286)
Dwelling Primary energy Rate (DPER)			80.8500	(287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	76.9200	2.8000	215.3760	(1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.9200			(4)
Dwelling volume				(5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
Energy conte	131.5736	128.7643	125.3430	120.1403	115.9155	111.3734	109.6276	113.0341	116.6268	121.3953	126.6782	131.2324 (44)
Energy content (annual)	208.3805	183.3587	192.6476	164.4661	156.0445	136.9465	132.5851	139.9599	143.8126	164.7323	180.4763	205.4782 (45)
Distribution loss	(46)m = 0.15 × (45)m									Total = Sum(45)m =		2008.8881

	31.2571	27.5038	28.8971	24.6699	23.4067	20.5420	19.8878	20.9940	21.5719	24.7098	27.0714	30.8217 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	259.3394	229.3861	243.6065	213.7812	207.0034	186.2616	183.5440	190.9188	193.1276	215.6912	229.7914	256.4371 (62)
WWHRS	-29.4823	-26.0744	-27.3036	-22.6085	-21.0703	-18.0300	-16.9002	-17.9717	-18.6545	-21.9916	-24.9138	-28.9363 (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)
Energy gain calculation function	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)
	229.8571	203.3117	216.3029	191.1727	185.9331	168.2316	166.6438	172.9471	174.4731	193.6996	204.8775	227.5007 (64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				2334.9508 (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	82.0262	72.4736	76.7950	67.0137	64.6245	57.8635	56.8243	59.2764	60.1464	67.5132	72.3371	81.0612 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.3751	118.8796	107.3751	110.9543	107.3751	110.9543	107.3751	107.3751	110.9543	107.3751	110.9543	107.3751 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	212.8832	215.0923	209.5255	197.6745	182.7148	168.6548	159.2618	157.0527	162.6195	174.4705	189.4302	203.4902 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091 (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)	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729 (71)
Water heating gains (Table 5)	110.2503	107.8476	103.2192	93.0746	86.8609	80.3660	76.3767	79.6726	83.5367	90.7436	100.4682	108.9533 (72)
Total internal gains	492.5360	503.8469	482.1471	463.7308	438.9782	419.0024	402.0410	403.1278	416.1379	434.6165	462.8801	481.8460 (73)

6. Solar gains												

[Jan]				Area	Solar flux							
				m2	Table 6a		g		FF		Access	Gains
					W/m2		Specific data	Specific data		factor		W
							or Table 6b	or Table 6c		Table 6d		
North				5.9600	10.6334		0.6300	0.7000		0.7700		19.3682 (74)
South				8.0100	46.7521		0.6300	0.7000		0.7700		114.4472 (78)
West				5.2600	19.6403		0.6300	0.7000		0.7700		31.5722 (80)

Solar gains	165.3876	286.2106	403.3673	519.2179	599.0903	602.4102	577.6073	516.8858	443.3290	319.5119	198.9190	141.0027 (83)
Total gains	657.9236	790.0575	885.5145	982.9487	1038.0685	1021.4125	979.6483	920.0136	859.4668	754.1284	661.7991	622.8486 (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, n11,m (see Table 9a)												
Jan	29.1771	29.2758	29.3732	29.8395	29.9283	30.3492	30.3492	30.4284	30.1857	29.9283	29.7491	29.5639
alpha	2.9451	2.9517	2.9582	2.9893	2.9952	3.0233	3.0233	3.0286	3.0124	2.9952	2.9833	2.9709
util living area	0.9608	0.9345	0.8949	0.8166	0.7003	0.5464	0.4148	0.4542	0.6527	0.8501	0.9381	0.9659 (86)
MIT	18.8257	19.1794	19.6326	20.1868	20.6094	20.8693	20.9576	20.9437	20.7666	20.2048	19.4310	18.7774 (87)
Th 2	19.8323	19.8357	19.8391	19.8551	19.8581	19.8721	19.8721	19.8747	19.8667	19.8581	19.8520	19.8457 (88)
util rest of house	0.9534	0.9226	0.8757	0.7835	0.6465	0.4675	0.3165	0.3540	0.5770	0.8152	0.9248	0.9595 (89)
MIT 2	17.3417	17.7854	18.3486	19.0262	19.5078	19.7819	19.8528	19.8470	19.6891	19.0677	18.1185	17.2891 (90)
Living area fraction									fLA = Living area / (4) =			0.4875 (91)
MIT	18.0652	18.4650	18.9746	19.5920	20.0448	20.3120	20.3914	20.3817	20.2144	19.6220	18.7584	18.0147 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0652	18.4650	18.9746	19.5920	20.0448	20.3120	20.3914	20.3817	20.2144	19.6220	18.7584	18.0147 (93)

8. Space heating requirement												

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9384	0.9050	0.8586	0.7749	0.6559	0.4995	0.3628	0.4005	0.6018	0.8069	0.9087	0.9456 (94)

Full SAP Calculation Printout

0.0000 (201)

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (202)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	92.4000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

[illegible]

Water heating requirement	229.8571	203.3117	216.3029	191.1727	185.9331	168.2316	166.6438	172.9471	174.4731	193.6996	204.8775	227.5007 (64)
Efficiency of water heater												80.3000 (216)
(217)m	86.2564	85.9702	85.4870	84.5894	83.1822	80.3000	80.3000	80.3000	80.3000	84.5257	85.7739	86.3106 (217)
Fuel for water heating, kwh/month	266.4813	236.4908	253.0244	226.0007	223.5252	209.5039	207.5265	215.3762	217.2766	229.1606	238.8577	263.5837 (219)

Space cooling fuel requirement													(21)
(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	22.3104	17.8983	16.1154	11.8068	9.1199	7.4511	8.3195	10.8140	14.0463	18.4296	20.8161	22.9305	(232)

Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-35.9147	-50.6015	-72.6995	-81.7097	-88.0918	-82.2222	-81.1990	-76.6534	-68.6430	-57.8319	-39.4694	-31.0535	(233a)

[illegible][illegible]

(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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														

Electricity generated by wind turbines (Appendix M) (negative quantity)

(233b)m	-20.3983	-42.8965	-85.2323	-127.9754	-169.1804	-169.9728	-167.9791	-142.2525	-104.2957	-61.3432	-27.2340	-16.1323 (233b)
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Electricity generated by wind turbines (Appendix M) (negative quantity)

[illegible][illegible][illegible]

Annual totals kWh/year	
Space heating fuel - main system 1	3112.8265 (211)

Space heating fuel - main system 1	0.0000 (213)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)

Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2786.8076	(210)

Water heating fuel used	2786.8076 (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)	180.0580 (232)

Energy saving/generation technologies (appendices A, B and C)	
PV generation	-1900.9819 (233)

Wind generation	0.0000 (234)
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Hydro-electric generation (Appendix N)	0.0000 (235a)
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Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
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Appendix Q - special features	
Energy saved on generated	-0.0000 (236)

Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)

Energy used	0.0000 (237)
Total delivered energy for all uses	4264.7102 (238)

Total delivered energy for all uses	4204.7102 (236)
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	Energy	Emission factor	Emissions
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Energy	Emission factor	Emissions
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	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	3112.8265	0.2100	653.6936 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2786.8076	0.2100	585.2296 (264)
Space and water heating			1238.9232 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	180.0580	0.1443	25.9879 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-766.0894	0.1346	-103.1121
PV Unit electricity exported	-1134.8924	0.1259	-142.8877
Total			-245.9998 (269)
Total CO2, kg/year			1030.8406 (272)
Energy saving/generation technologies			13.4000 (273)

Energy 101

Energy 101

Energy 101

Energy saving/generation technologies

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	3112.8265	1.1300	3517.4940 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2786.8076	1.1300	3149.0926 (278)
Space and water heating			6666.5866 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	180.0580	1.5338	276.1789 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-766.0894	1.4974	-1147.1745
PV Unit electricity exported	-1134.8924	0.4622	-524.4967
Total			-1671.6712 (283)
Total Primary energy kWh/year			5401.1951 (286)
Target Primary Energy Rate (TPER)			70.2200 (287)

Property Reference	Unit 2		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	88 B	DER	10.80	TER	9.95
Environmental	89 B	% DER < TER	-8.54		
CO ₂ Emissions (t/year)	1.31	DFEE	32.10	TFEE	36.78
Compliance Check	See BREL	% DFEE < TFEE	12.73		
% DPER < TPER	-15.40	DPER	59.90	TPER	51.91
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

 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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 399.5550 (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	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.1251 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3251 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2764 (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	0.3524	0.3455	0.3386	0.3040	0.2971	0.2625	0.2625	0.2556	0.2764	0.2971	0.3109	0.3247 (22b)
Effective ac	0.5621	0.5597	0.5573	0.5462	0.5441	0.5345	0.5345	0.5327	0.5382	0.5441	0.5483	0.5527 (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
DOOR			2.3500	1.0000	2.3500		(26)
G (Uw = 1.00)			29.5500	0.9615	28.4135		(27)
FR RL			1.1500	0.9615	1.1058		(27a)
GF			49.6600	0.1200	5.9592	110.0000	5462.6000 (28a)
EW	125.1800	31.9000	93.2800	0.1500	13.9920	60.0000	5596.8000 (29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361	9.0000	436.5900 (30)

Total net area of external elements Aum(A, m2)	224.5000												(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	57.1565											(33)
PW	129.9700	0.0000											(32)
IW	245.5400								9.0000			2209.8600	(32c)
IF	89.8300								18.0000			1616.9400	(32d)
IF	89.8300								9.0000			808.4700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21979.9100											(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												157.5734	(35)
Thermal bridges (User defined value 0.030 * total exposed area)												6.7350	(36)
Point Thermal bridges												0.0000	(36a)
Total fabric heat loss	(33) + (36) + (36a) =	63.8915											(37)

End of Day Calculation Summary													
ed monthly (38)m = 0.33 x (25)m x (5)													
(38)m	74.1123	73.7944	73.4829	72.0195	71.7457	70.4711	70.4711	70.2350	70.9620	71.7457	72.2995	72.8786	(38)
Heat transfer coeff	138.0038	137.6860	137.3744	135.9110	135.6372	134.3626	134.3626	134.1266	134.8535	135.6372	136.1911	136.7702	(39)
Average = Sum(39)m / 12 =												135.9097	
HLP	Jan 0.9893	Feb 0.9871	Mar 0.9848	Apr 0.9743	May 0.9724	Jun 0.9632	Jul 0.9632	Aug 0.9615	Sep 0.9668	Oct 0.9724	Nov 0.9764	Dec 0.9805	(40)
HLP (average)												0.9743	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9161 (42)
Hot water usage for mixer showers													
73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333	72.8333	(42a)
Hot water usage for baths													
31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577	31.4577	(42b)
Hot water usage for other uses													
44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939	44.4939	(42c)
Average daily hot water use (litres/day)												137.1222	(43)
Daily hot water use	Jan 149.1716	Feb 145.9861	Mar 142.1069	Apr 136.2084	May 131.4183	Jun 126.2686	Jul 124.2897	Aug 128.1522	Sep 132.2257	Oct 137.6320	Nov 143.6214	Dec 148.7848	(44)
Energy conte	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610	(45)
Energy content (annual)										Total = Sum(45)m =		2277.5713	
Distribution loss (46)m = 0.15 x (45)m	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199	283.9199	(62)
WWHRS	-65.1476	-57.6171	-60.3333	-49.9584	-46.5594	-39.8412	-37.3448	-39.7124	-41.2212	-48.5953	-55.0526	-63.9412	(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	222.0627	196.2926	209.0387	185.8192	181.3138	164.7359	163.9318	169.9257	171.1414	189.1289	198.8775	219.9787	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2272.2469	(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	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan 145.8054	Feb 145.8054	Mar 145.8054	Apr 145.8054	May 145.8054	Jun 145.8054	Jul 145.8054	Aug 145.8054	Sep 145.8054	Oct 145.8054	Nov 145.8054	Dec 145.8054	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	157.4062	174.2711	157.4062	162.6531	157.4062	162.6531	157.4062	157.4062	162.6531	157.4062	162.6531	157.4062	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	(71)
Water heating gains (Table 5)	122.7061	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356	(72)
Total internal gains	658.6853	676.0306	645.8422	622.3955	588.4015	562.8877	539.4917	540.0239	557.7276	580.8439	618.8183	643.5884	(73)

[illegible]

(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	(231)
Lighting	35.8880	28.7907	25.9228	18.9922	14.6701	11.9856	13.3826	17.3952	22.5946	29.6453	33.4843	36.8854	(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 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												4280.8124	(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												2665.9476	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												289.6368	(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												7277.3967	(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	4280.8124	0.2100	898.9706	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2665.9476	0.2100	559.8490	(264)
Space and water heating			1458.8196	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	289.6368	0.1443	41.8035	(268)
Total CO2, kg/year			1506.3103	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.8000	(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	4280.8124	1.1300	4837.3180	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2665.9476	1.1300	3012.5208	(278)
Space and water heating			7849.8387	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	289.6368	1.5338	444.2546	(282)
Total Primary energy kWh/year			8356.1181	(286)
Dwelling Primary energy Rate (DPER)			59.9000	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.6600	(1b)	x	2.7000	(2b)	= 134.0820 (1b) -
First floor	49.6600	(1c)	x	3.0000	(2c)	= 148.9800 (1c) -

Second floor
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 139.4900
Dwelling volume 40.1700 (1d) x 2.9000 (2d) = 116.4930 (1d) - (4)
(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 399.5550 (5)

2. Ventilation rate

Number of open chimneys 0 * 80 = 0.0000 (6a)
Number of flues attached to solid fuel boiler 0 * 20 = 0.0000 (6b)
Number of flues attached to other heater 0 * 10 = 0.0000 (6c)
Number of blocked chimneys 0 * 20 = 0.0000 (6d)
Number of intermittent extract fans 0 * 35 = 0.0000 (6e)
Number of passive vents 0 * 20 = 0.0000 (6f)
Number of flueless gas fires 4 * 10 = 40.0000 (7a)
0 * 10 = 0.0000 (7b)
0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.1001 (8)
Pressure test Yes
Pressure Test Method Blower Door
Measured/design AP50 5.0000 (17)
Infiltration rate 0.3501 (18)
Number of sides sheltered 2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2976 (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	0.3794	0.3720	0.3646	0.3274	0.3199	0.2827	0.2827	0.2753	0.2976	0.3199	0.3348	0.3497 (22b)
Effective ac	0.5720	0.5692	0.5664	0.5536	0.5512	0.5400	0.5400	0.5379	0.5443	0.5512	0.5560	0.5611 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.3500	1.0000	2.3500		(26)
TER Opening Type (Uw = 1.20)			29.5500	1.1450	33.8359		(27)
FR RL			1.1500	2.0221	2.3254		(27a)
GF			49.6600	0.1300	6.4558		(28a)
EW	125.1800	31.9000	93.2800	0.1800	16.7904		(29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361		(30)
Total net area of external elements Aum(A, m2)			224.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0935		(33)
PW			129.9700	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 157.5734 (35)

List of Thermal Bridges				
K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525	
E3 Sill	9.0500	0.0500	0.4525	
E4 Jamb	19.0600	0.0500	0.9530	
E5 Ground floor (normal)	27.8800	0.1600	4.4608	
E14 Flat roof	27.8800	0.0800	2.2304	
E16 Corner (normal)	9.8000	0.0900	0.8820	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				9.4312 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	76.5247 (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	75.4180	75.0494	74.6882	72.9913	72.6738	71.1959	71.1959	70.9223	71.7652	72.6738	73.3161	73.9875 (38)
Heat transfer coeff	151.9427	151.5742	151.2129	149.5161	149.1986	147.7207	147.7207	147.4470	148.2899	149.1986	149.8408	150.5123 (39)
Average = Sum(39)m / 12 =												149.5145
HLP	1.0893	1.0866	1.0840	1.0719	1.0696	1.0590	1.0590	1.0570	1.0631	1.0696	1.0742	1.0790 (40)
HLP (average)												1.0719
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333 (42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577 (42b)

Hot water usage for other uses												
Average daily hot water use (litres/day)	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939 (42c)
												137.1222 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)
Distribution loss (46)m = 0.15 x (45)m	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)
Total storage loss	Total = Sum(45)m =											2277.5713
Water storage loss:	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)
Total storage loss												
Energy gain calculation Summary	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (59)
Total heat required for water heating calculated for each month	287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199 (62)
WWHRS	-33.4244	-29.5608	-30.9544	-25.6314	-23.8876	-20.4408	-19.1600	-20.3747	-21.1488	-24.9321	-28.2451	-32.8054 (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	253.7859	224.3489	238.4176	210.1461	203.9856	184.1363	182.1166	189.2634	191.2138	212.7921	225.6850	251.1145 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2567.0059 (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	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993 (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	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	155.7883	172.4799	155.7883	160.9812	155.7883	160.9812	155.7883	155.7883	160.9812	155.7883	160.9812	155.7883 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (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)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)
Water heating gains (Table 5)	122.7061	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356 (72)
Total internal gains	657.0674	674.2394	644.2243	620.7236	586.7836	561.2159	537.8739	538.4060	556.0558	579.2260	617.1465	641.9705 (73)
6. Solar gains												
[Jan]			Area		Solar flux		g		FF		Access	Gains
			m2		Table 6a		Specific data		Specific data		factor	W
					W/m2		or Table 6b		or Table 6c		Table 6d	
North			15.2500		10.6334		0.6300		0.7000		0.7700	49.5580 (74)
East			0.9500		19.6403		0.6300		0.7000		0.7700	5.7022 (76)
South			13.3500		46.7521		0.6300		0.7000		0.7700	190.7453 (78)
North			1.1500		26.0000		0.6300		0.7000		1.0000	11.8673 (82)
Solar gains	257.8728	442.9017	621.0513	803.5038	937.3563	948.7063	906.9851	803.2339	683.0340	493.0417	309.4067	220.4098 (83)
Total gains	914.9402	1117.1411	1265.2756	1424.2275	1524.1399	1509.9222	1444.8590	1341.6399	1239.0898	1072.2677	926.5532	862.3803 (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	40.1831	40.2808	40.3770	40.8353	40.9222	41.3316	41.3316	41.4083	41.1729	40.9222	40.7468	40.5650
alpha	3.6789	3.6854	3.6918	3.7224	3.7281	3.7554	3.7554	3.7606	3.7449	3.7281	3.7165	3.7043
util living area	0.9849	0.9687	0.9399	0.8710	0.7500	0.5809	0.4372	0.4855	0.7081	0.9057	0.9720	0.9877 (86)
MIT	19.1950	19.5008	19.8917	20.3698	20.7290	20.9241	20.9798	20.9701	20.8380	20.3563	19.6908	19.1453 (87)
Th 2	20.0096	20.0118	20.0139	20.0239	20.0257	20.0345	20.0345	20.0361	20.0311	20.0257	20.0220	20.0180 (88)
util rest of house	0.9817	0.9624	0.9275	0.8447	0.7016	0.5072	0.3466	0.3919	0.6388	0.8804	0.9652	0.9851 (89)
MIT 2	17.9023	18.2901	18.7808	19.3695	19.7797	19.9818	20.0252	20.0213	19.9056	19.3680	18.5413	17.8446 (90)
Living area fraction	fLA = Living area / (4) =											0.2694 (91)
MIT	18.2505	18.6163	19.0801	19.6390	20.0354	20.2357	20.2823	20.2769	20.1568	19.6343	18.8510	18.1951 (92)

Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2454.5699 (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	5775.1310 (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	4833.6354	0.2100	1015.0634 (261)
Επιπλέον Κατανάλωση Ενέργειας ΕΠΙΠΛΕΟΝ ΚΑΤΑΝΑΛΩΣΗ ΕΝΕΡΓΕΙΑΣ Community systems			0.0000 (373)
Space and water heating	3048.8232	0.2100	640.2529 (264)
Pumps, fans and electric keep-hot	86.0000	0.1387	1655.3163 (265)
Energy for lighting	261.2423	0.1443	11.9293 (267)
			37.7053 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	0.1345	-138.2176
PV Unit electricity exported	-1426.6745	0.1258	-179.4705
Total			-317.6881 (269)
Total CO2, kg/year			1387.2628 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.9500 (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	4833.6354	1.1300	5462.0080 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)			
Space and water heating	3048.8232	1.1300	3445.1703 (278)
Pumps, fans and electric keep-hot	86.0000	1.5128	8907.1783 (279)
Energy for lighting	261.2423	1.5338	130.1008 (281)
			400.7021 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	1.4970	-1538.7175
PV Unit electricity exported	-1426.6745	0.4618	-658.7722
Total			-2197.4897 (283)
Total Primary energy kWh/year			7240.4915 (286)
Target Primary Energy Rate (TPER)			51.9100 (287)

Project name

Fortis Green Tennis Club

As designed

Date: Fri Sep 22 15:21:58 2023

Administrative information**Building Details**Address: Fortis Green Tennis Club, 31 Southern Road,
London, N2 9LH**Certifier details**

Name: Neil Ingham

Telephone number:

Address: Holborn Tower, 137-144 High Holborn London,
WC1V 6PL**Certification tool**

Calculation engine: SBEM

Calculation engine version: v6.1.e.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.2.0

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 87.2**The CO₂ emission and primary energy rates of the building must not exceed the targets**

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	17.31
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	13.68
Target primary energy rate (TPER), kWh _{PE} /m ² annum	187.13
Building primary energy rate (BPER), kWh _{PE} /m ² annum	148.41
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.18	0.25	Block 1 - WC-Showers_P_8
Floors	0.18	0.11	0.12	Block 1 - WC-Showers_S_3
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	-	-	No heat loss flat roofs
Windows** and roof windows	1.6	1.3	1.3	Block 1 - Bar area_G_7
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	1	1	Block 1 - Bar area_D_6
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]
U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]
U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	4

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Notional ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.81	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- via ASHP

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.002
Standard value	N/A	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
Block 1 - WC-Showers	0.2	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
Block 1 - Plant		130	-	-
Block 1 - Store		130	-	-
Block 1 - Stores		130	-	-
Block 1 - WC-Showers		130	-	-
Block 1 - Bar area		130	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block 1 - Bar area	YES (+24.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	130.6	130.6
External area [m ²]	346.5	346.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	4	3
Average conductance [W/K]	97.73	113.55
Average U-value [W/m ² K]	0.28	0.33
Alpha value* [%]	25.04	19.31

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area Building Type

Retail/Financial and Professional Services
 Restaurants and Cafes/Drinking Establishments/Takeaways
 Offices and Workshop Businesses
 General Industrial and Special Industrial Groups
 Storage or Distribution
 Hotels
 Residential Institutions: Hospitals and Care Homes
 Residential Institutions: Residential Schools
 Residential Institutions: Universities and Colleges
 Secure Residential Institutions
 Residential Spaces
 Non-residential Institutions: Community/Day Centre
 Non-residential Institutions: Libraries, Museums, and Galleries
 Non-residential Institutions: Education
 Non-residential Institutions: Primary Health Care Building
 Non-residential Institutions: Crown and County Courts
100 General Assembly and Leisure, Night Clubs, and Theatres
 Others: Passenger Terminals
 Others: Emergency Services
 Others: Miscellaneous 24hr Activities
 Others: Car Parks 24 hrs
 Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	6.94	7.68
Cooling	0	0
Auxiliary	1.62	9.08
Lighting	4.46	3.99
Hot water	84.8	118.87
Equipment*	54.56	54.56
TOTAL**	97.83	139.62

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	13.05
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>13.05</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	358.61	313.56
Primary energy [kWh _{PE} /m ²]	148.41	187.13
Total emissions [kg/m ²]	13.68	17.31

HVAC Systems Performance									
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling									
	Actual	280.4	211.8	0	0	0	0	0	0
	Notional	284.9	229.7	0	0	0	0	----	----
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas									
	Actual	98.8	193.3	10.4	0	2.4	2.64	0	2.81
	Notional	109.3	104.1	11.5	0	3.3	2.64	0	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Appendix B

Energy Efficient Design:-

SAP & SBEM Outputs & Dwelling/Building Emission Rates

Property Reference	Unit 3		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green		Prop Type Ref	Fortis Green	
Property					
SAP Rating	88 B	DER	10.49	TER	9.65
Environmental	90 B	% DER < TER			-8.70
CO ₂ Emissions (t/year)	1.28	DFEE	30.75	TFEE	35.45
Compliance Check	See BREL	% DFEE < TFEE			13.25
% DPER < TPER	-15.74	DPER	58.24	TPER	50.32
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 399.5550 (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	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.1251 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3251 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2764 (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	0.3524	0.3455	0.3386	0.3040	0.2971	0.2625	0.2625	0.2556	0.2764	0.2971	0.3109	0.3247 (22b)
Effective ac	0.5621	0.5597	0.5573	0.5462	0.5441	0.5345	0.5345	0.5327	0.5382	0.5441	0.5483	0.5527 (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
DOOR			2.3500	1.0000	2.3500		(26)
G (Uw = 1.00)			29.5500	0.9615	28.4135		(27)
FR RL			1.1500	0.9615	1.1058		(27a)
GF			49.6600	0.1200	5.9592	110.0000	5462.6000 (28a)
EW	104.7000	31.9000	72.8000	0.1500	10.9200	60.0000	4368.0000 (29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361	9.0000	436.5900 (30)

Total net area of external elements Aum(A, m2)	204.0200												(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	54.0845											(33)
PW	150.4500	0.0000								45.0000	6770.2500		(32)
IW	245.5400									9.0000	2209.8600		(32c)
IF	89.8300									18.0000	1616.9400		(32d)
IF	89.8300									9.0000	808.4700		(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21672.7100											(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K													(35)
Thermal bridges (User defined value 0.030 * total exposed area)													(36)
Point Thermal bridges													(36a) =
Total fabric heat loss	(33) + (36) + (36a) =	60.2051											(37)

End of Day Calculation Summary													
ed monthly (38)m = 0.33 x (25)m x (5)													
(38)m	74.1123	73.7944	73.4829	72.0195	71.7457	70.4711	70.4711	70.2350	70.9620	71.7457	72.2995	72.8786	(38)
Heat transfer coeff	134.3174	133.9996	133.6880	132.2246	131.9508	130.6762	130.6762	130.4402	131.1671	131.9508	132.5047	133.0838	(39)
Average = Sum(39)m / 12 =												132.2233	
HLP	0.9629	0.9606	0.9584	0.9479	0.9460	0.9368	0.9368	0.9351	0.9403	0.9460	0.9499	0.9541	(40)
HLP (average)												0.9479	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333	(42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577	(42b)
Hot water usage for other uses	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939	(42c)
Average daily hot water use (litres/day)												137.1222	(43)
Daily hot water use	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848	(44)
Energy conte	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610	(45)
Energy content (annual)										Total = Sum(45)m =		2277.5713	
Distribution loss (46)m = 0.15 x (45)m	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199	(62)
WWHRS	-65.1476	-57.6171	-60.3333	-49.9584	-46.5594	-39.8412	-37.3448	-39.7124	-41.2212	-48.5953	-55.0526	-63.9412	(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	222.0627	196.2926	209.0387	185.8192	181.3138	164.7359	163.9318	169.9257	171.1414	189.1289	198.8775	219.9787	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2272.2469	(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	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	157.4062	174.2711	157.4062	162.6531	157.4062	162.6531	157.4062	157.4062	162.6531	157.4062	162.6531	157.4062	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	(71)
Water heating gains (Table 5)	122.7061	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356	(72)
Total internal gains	658.6853	676.0306	645.8422	622.3955	588.4015	562.8877	539.4917	540.0239	557.7276	580.8439	618.8183	643.5884	(73)

[illegible]

(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	(231)
Lighting	35.8880	28.7907	25.9228	18.9922	14.6701	11.9856	13.3826	17.3952	22.5946	29.6453	33.4843	36.8854	(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 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												4071.9568	(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												2669.2830	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												289.6368	(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												7071.8766	(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	4071.9568	0.2100	855.1109	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2669.2830	0.2100	560.5494	(264)
Space and water heating			1415.6604	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	289.6368	0.1443	41.8035	(268)
Total CO2, kg/year			1463.1511	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.4900	(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	4071.9568	1.1300	4601.3112	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2669.2830	1.1300	3016.2898	(278)
Space and water heating			7617.6010	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	289.6368	1.5338	444.2546	(282)
Total Primary energy kWh/year			8123.8803	(286)
Dwelling Primary energy Rate (DPER)			58.2400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.6600	(1b)	x	2.7000	(2b)	= 134.0820 (1b) -
First floor	49.6600	(1c)	x	3.0000	(2c)	= 148.9800 (1c) -

Second floor 40.1700 (1d) x 2.9000 (2d) = 116.4930 (1d) -
 Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 139.4900 (4)
 Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 399.5550 (5)

2. Ventilation rate

m3 per hour

Number of open chimneys 0 * 80 = 0.0000 (6a)
 Number of flues attached to solid fuel boiler 0 * 20 = 0.0000 (6b)
 Number of flues attached to other heater 0 * 10 = 0.0000 (6c)
 Number of blocked chimneys 0 * 20 = 0.0000 (6d)
 Number of intermittent extract fans 0 * 35 = 0.0000 (6e)
 Number of passive vents 0 * 20 = 0.0000 (6f)
 Number of flueless gas fires 4 * 10 = 40.0000 (7a)
 0 * 10 = 0.0000 (7b)
 0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.1001 (8)
 Pressure test Yes
 Pressure Test Method Blower Door
 Measured/design AP50 5.0000 (17)
 Infiltration rate 0.3501 (18)
 Number of sides sheltered 2 (19)
 Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2976 (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	0.3794	0.3720	0.3646	0.3274	0.3199	0.2827	0.2827	0.2753	0.2976	0.3199	0.3348	0.3497 (22b)
Effective ac	0.5720	0.5692	0.5664	0.5536	0.5512	0.5400	0.5400	0.5379	0.5443	0.5512	0.5560	0.5611 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.3500	1.0000	2.3500		(26)
TER Opening Type (Uw = 1.20)			29.5500	1.1450	33.8359		(27)
FR RL			1.1500	2.0221	2.3254		(27a)
GF			49.6600	0.1300	6.4558		(28a)
EW	104.7000	31.9000	72.8000	0.1800	13.1040		(29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361		(30)
Total net area of external elements Aum(A, m2)			204.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.4071		(33)
PW			150.4500	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 155.3711 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4312 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 72.8383 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
 (38)m Jan 75.4180 Feb 75.0494 Mar 74.6882 Apr 72.9913 May 72.6738 Jun 71.1959 Jul 71.1959 Aug 70.9223 Sep 71.7652 Oct 72.6738 Nov 73.3161 Dec 73.9875 (38)
 Heat transfer coeff 148.2563 147.8878 147.5265 145.8297 145.5122 144.0343 144.0343 143.7606 144.6035 145.5122 146.1544 146.8259 (39)
 Average = Sum(39)m / 12 = 145.8281

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0628	1.0602	1.0576	1.0454	1.0432	1.0326	1.0326	1.0306	1.0367	1.0432	1.0478	1.0526 (40)
HLP (average)												1.0454
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333 (42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577 (42b)

Hot water usage for other uses												
	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939 (42c)
Average daily hot water use (litres/day)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)
Energy conte	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)
Energy content (annual)										Total = Sum(45)m =		2277.5713
Distribution loss (46)m = 0.15 x (45)m												
	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)
Water storage loss:												
Total storage loss												
Ув. Служба	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199 (62)
WWHRS	-33.4244	-29.5608	-30.9544	-25.6314	-23.8876	-20.4408	-19.1600	-20.3747	-21.1488	-24.9321	-28.2451	-32.8054 (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												
	253.7859	224.3489	238.4176	210.1461	203.9856	184.1363	182.1166	189.2634	191.2138	212.7921	225.6850	251.1145 (64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2567.0059 (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												
	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993 (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	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)
Lighting gains	(calculated in Appendix L, equation L9 or L9a), also see Table 5											
	155.7883	172.4799	155.7883	160.9812	155.7883	160.9812	155.7883	155.7883	160.9812	155.7883	160.9812	155.7883 (67)
Appliances gains	(calculated in Appendix L, equation L13 or L13a), also see Table 5											
	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)
Cooking gains	(calculated in Appendix L, equation L15 or L15a), also see Table 5											
	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (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)											
	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)
Water heating gains	(Table 5)											
	122.7061	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356 (72)
Total internal gains	657.0674	674.2394	644.2243	620.7236	586.7836	561.2159	537.8739	538.4060	556.0558	579.2260	617.1465	641.9705 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	15.2500	10.6334	0.6300	0.7000	0.7700	49.5580 (74)
East	0.9500	19.6403	0.6300	0.7000	0.7700	5.7022 (76)
South	13.3500	46.7521	0.6300	0.7000	0.7700	190.7453 (78)
North	1.1500	26.0000	0.6300	0.7000	1.0000	11.8673 (82)

Solar gains	257.8728	442.9017	621.0513	803.5038	937.3563	948.7063	906.9851	803.2339	683.0340	493.0417	309.4067	220.4098 (83)
Total gains	914.9402	1117.1411	1265.2756	1424.2275	1524.1399	1509.9222	1444.8590	1341.6399	1239.0898	1072.2677	926.5532	862.3803 (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, n _{l,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	40.6067	40.7079	40.8076	41.2824	41.3725	41.7970	41.7970	41.8765	41.6324	41.3725	41.1907	41.0023
alpha	3.7071	3.7139	3.7205	3.7522	3.7582	3.7865	3.7865	3.7918	3.7755	3.7582	3.7460	3.7335
util living area	0.9841	0.9671	0.9368	0.8649	0.7405	0.5700	0.4275	0.4752	0.6978	0.9009	0.9706	0.9871 (86)
MIT	19.2322	19.5397	19.9283	20.3994	20.7467	20.9308	20.9819	20.9731	20.8496	20.3827	19.7244	19.1824 (87)
Th 2	20.0313	20.0335	20.0356	20.0456	20.0475	20.0563	20.0563	20.0579	20.0529	20.0475	20.0437	20.0397 (88)
util rest of house	0.9808	0.9606	0.9241	0.8383	0.6925	0.4985	0.3405	0.3850	0.6297	0.8753	0.9636	0.9844 (89)
MIT 2	17.9654	18.3550	18.8423	19.4216	19.8171	20.0080	20.0478	20.0444	19.9361	19.4162	18.5996	17.9076 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.2694 (91)
MIT	18.3067	18.6741	19.1349	19.6850	20.0676	20.2566	20.2995	20.2946	20.1822	19.6766	18.9026	18.2511 (92)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9726	0.9485	0.9095	0.8268	0.6936	0.5142	0.3634	0.4083	0.6397	0.8634	0.9524	0.9772 (94)
Useful gains	889.8898	1059.5558	1150.7271	1177.6145	1057.1685	776.4703	525.0883	547.8416	792.6345	925.7449	882.4419	842.7299 (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)

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Space heating	kWh	882.8956	656.8603	530.6610	284.5161	119.3489	0.0000	0.0000	0.0000	0.0000	293.8851	606.6460	907.9252	(98a)
Space heating requirement - total per year	(kWh/year)												4282.7382	
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	882.8956	656.8603	530.6610	284.5161	119.3489	0.0000	0.0000	0.0000	0.0000	293.8851	606.6460	907.9252	(98c)
Space heating requirement after solar contribution - total per year	(kWh/year)												4282.7382	
Space heating per m2											(98c) / (4) =		30.7028	(99)

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 %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

[illegible]

Water heating													
Water heating requirement	253.7859	224.3489	238.4176	210.1461	203.9856	184.1363	182.1166	189.2634	191.2138	212.7921	225.6850	251.1145	(64)
Efficiency of water heater (217) _m	86.8239	86.5404	86.0433	85.0312	83.2735	80.3000	80.3000	80.3000	80.3000	85.0735	86.3912	80.3000	(216)
Fuel for water heating, kWh/month	292.2996	259.2419	277.0903	247.1400	244.9586	229.3105	226.7953	235.6954	238.1243	250.1273	261.2360	289.0228	(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	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	7.3041	(231)
Lighting	32.3697	25.9682	23.3815	17.1303	13.2319	10.8106	12.0706	15.6898	20.3795	26.7390	30.2017	33.2694	33.2694	(232)

Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-47.3417	-67.2065	-97.2438	-110.0411	-119.1809	-111.3365	-109.8626	-103.4023	-92.1772	-77.0630	-52.1723	-40.8674	(233a)

[illegible][illegible][illegible]

Electricity generated by PVs (Appendix M) (negative quantity)	(233b)M	-25.3703	-53.5192	-106.6796	-160.7067	-213.0120	-214.3006	-211.8790	-179.2515	-131.1232	-76.8173	-33.9558	-20.0594	(233b)
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[illegible][illegible][illegible][illegible]

Space heating fuel - main system 1	4634.9981	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)

Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	3051.0430	(210)

Water heating fuel used	3051.0420 (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)	261.2423 (232)

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

PV generation	-2454.5699 (233)
Wind generation	0.0000 (234)

Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)

Electricity generated - Micro CH (Appendix N)	0.0000 (255)
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Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	5578.7124 (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	4634.9981	0.2100	973.3496 (261)
Επιπλέον Κατανάλωση Ενέργειας Community systems			0.0000 (373)
Space and water heating	3051.0420	0.2100	640.7188 (264)
Pumps, fans and electric keep-hot	86.0000	0.1387	1614.0684 (265)
Energy for lighting	261.2423	0.1443	11.9293 (267)
			37.7053 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	0.1345	-138.2176
PV Unit electricity exported	-1426.6745	0.1258	-179.4705
Total			-317.6881 (269)
Total CO2, kg/year			1346.0149 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.6500 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4634.9981	1.1300	5237.5478 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)			
Space and water heating	3051.0420	1.1300	3447.6775 (278)
Pumps, fans and electric keep-hot	86.0000	1.5128	8685.2253 (279)
Energy for lighting	261.2423	1.5338	130.1008 (281)
			400.7021 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	1.4970	-1538.7175
PV Unit electricity exported	-1426.6745	0.4618	-658.7722
Total			-2197.4897 (283)
Total Primary energy kWh/year			7018.5385 (286)
Target Primary Energy Rate (TPER)			50.3200 (287)

Property Reference	Unit 7		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	85 B	DER	16.05	TER	15.28
Environmental	89 B	% DER < TER			-5.04
CO ₂ Emissions (t/year)	0.71	DFEE	35.84	TFEE	41.35
Compliance Check	See BREL	% DFEE < TFEE			13.33
% DPER < TPER	-10.47	DPER	88.86	TPER	80.44
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

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)
Ground floor	49.3200 (1b)	x 2.8000 (2b)	= 138.0960 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.3200		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 138.0960 (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) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1448 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	4.0000 (17)
Number of sides sheltered	0.3448 (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) = 0.3190 (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	0.4067	0.3987	0.3907	0.3509	0.3429	0.3030	0.3030	0.2950	0.3190	0.3429	0.3588	0.3748 (22b)
Effective ac	0.5827	0.5795	0.5763	0.5616	0.5588	0.5459	0.5459	0.5435	0.5509	0.5588	0.5644	0.5702 (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
G (Uw = 1.00)			12.8900	0.9615	12.3942		(27)
EF			5.3300	0.1200	0.6396	110.0000	586.3000 (28b)
EW	57.9300	12.8900	45.0400	0.1500	6.7560	60.0000	2702.4000 (29a)
SW	18.5900		18.5900	0.1500	2.7885	60.0000	1115.4000 (29a)
FR	11.3900		11.3900	0.1100	1.2529	9.0000	102.5100 (30)
Total net area of external elements Aum(A, m ²)			93.2400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.8312		(33)
PW			14.2500	0.0000	0.0000	45.0000	641.2500 (32)

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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	41.5562	41.6599	41.7621	42.2487	42.3411	42.7762	42.7762	42.8577	42.6075	42.3411	42.1547	41.9617
alpha	3.7704	3.7773	3.7841	3.8166	3.8227	3.8517	3.8517	3.8572	3.8405	3.8227	3.8103	3.7974
util living area	0.9665	0.9382	0.8908	0.7954	0.6590	0.4939	0.3628	0.3978	0.6015	0.8357	0.9416	0.9716 (86)
MIT	19.8183	20.0446	20.3152	20.6101	20.7994	20.8899	20.9127	20.9098	20.8557	20.5978	20.1618	19.7800 (87)
Th 2	19.9266	19.9290	19.9313	19.9423	19.9443	19.9539	19.9539	19.9557	19.9502	19.9443	19.9402	19.9358 (88)
util rest of house	0.9592	0.9256	0.8692	0.7579	0.6026	0.4203	0.2788	0.3108	0.5257	0.7960	0.9274	0.9654 (89)
MIT 2	18.5701	18.8525	19.1838	19.5366	19.7405	19.8326	19.8484	19.8488	19.8032	19.5350	19.0118	18.5293 (90)
Living area fraction									fLA = Living area / (4) =			0.5146 (91)
MIT	19.2124	19.4660	19.7660	20.0890	20.2854	20.3767	20.3961	20.3948	20.3448	20.0819	19.6036	19.1729 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.0624	19.3160	19.6160	19.9390	20.1354	20.2267	20.2461	20.2448	20.1948	19.9319	19.4536	19.0229 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9519	0.9170	0.8619	0.7578	0.6134	0.4400	0.3026	0.3353	0.5442	0.7954	0.9196	0.9587 (94)
Useful gains	447.8523	513.8544	541.3462	526.0929	446.1498	312.8520	206.7014	216.8837	330.2983	425.1959	433.7271	428.1259 (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												
Space heating	867.6931	845.2197	767.1218	638.2068	486.6190	321.2896	208.1951	219.1224	349.3959	538.3345	715.7988	862.8305 (97)
Space heating requirement - total per year (kWh/year)	312.3616	222.6774	167.9770	80.7220	30.1091	0.0000	0.0000	0.0000	0.0000	84.1752	203.0916	323.4202 (98a)
Solar heating contribution - total per year (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 (98b)
Space heating requirement after solar contribution - total per year (kWh/year)	312.3616	222.6774	167.9770	80.7220	30.1091	0.0000	0.0000	0.0000	0.0000	84.1752	203.0916	323.4202 (98c)
Space heating per m2												1424.5342
											(98c) / (4) =	28.8835 (99)

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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)													
	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												1543.3740	(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												2115.0973	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												121.7076	(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												3821.1789	(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	1543.3740	0.2100	324.1085	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2115.0973	0.2100	444.1704	(264)
Space and water heating			768.2790	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	121.7076	0.1443	17.5662	(268)
Total CO2, kg/year			791.5323	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.0500	(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	1543.3740	1.1300	1744.0126	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2115.0973	1.1300	2390.0600	(278)
Space and water heating			4134.0725	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	121.7076	1.5338	186.6792	(282)
Total Primary energy kWh/year			4382.7765	(286)
Dwelling Primary energy Rate (DPER)			88.8600	(287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	49.3200 (1b)	x 2.8000 (2b)	= 138.0960 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.3200		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	138.0960 (5)	

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
	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) =	0.1448 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3948	(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) =		0.3652 (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													
Effective ac	0.4656	0.4565	0.4474	0.4017	0.3926	0.3470	0.3470	0.3378	0.3652	0.3926	0.4109	0.4291	(22b)
	0.6084	0.6042	0.6001	0.5807	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5844	0.5921	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			12.3300	1.1450	14.1183			(27)
EF			5.3300	0.1300	0.6929			(28b)
EW	57.9300	12.3300	45.6000	0.1800	8.2080			(29a)
SW	18.5900		18.5900	0.1800	3.3462			(29a)
FR	11.3900		11.3900	0.1100	1.2529			(30)
Total net area of external elements Aum(A, m2)			93.2400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.6183			(33)
PW			14.2500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 185.9753 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525	
E3 Sill	9.0500	0.0500	0.4525	
E4 Jamb	19.0600	0.0500	0.9530	
E5 Ground floor (normal)	27.8800	0.1600	4.4608	
E14 Flat roof	27.8800	0.0800	2.2304	
E16 Corner (normal)	9.8000	0.0900	0.8820	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4312 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 37.0495 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	27.7265	27.5346	27.3466	26.4633	26.2980	25.5287	25.5287	25.3863	25.8251	26.2980	26.6323	26.9819	(38)
Heat transfer coeff	64.7760	64.5841	64.3961	63.5128	63.3476	62.5783	62.5783	62.4358	62.8746	63.3476	63.6819	64.0314	(39)
Average = Sum(39)m / 12 =												63.5120	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3134	1.3095	1.3057	1.2878	1.2844	1.2688	1.2688	1.2659	1.2748	1.2844	1.2912	1.2983	(40)
HLP (average)												1.2878	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.6701 (42)
Hot water usage for mixer showers													
	52.2216	51.4368	50.2932	48.1051	46.4904	44.6897	43.6661	44.8011	46.0452	47.9786	50.2136	52.0215	(42a)
Hot water usage for baths													
	22.5802	22.2449	21.7726	20.9019	20.2499	19.5270	19.1364	19.6054	20.1160	20.8896	21.7782	22.5039	(42b)
Hot water usage for other uses													
	31.7335	30.5795	29.4256	28.2716	27.1177	25.9638	25.9638	27.1177	28.2716	29.4256	30.5795	31.7335	(42c)
Average daily hot water use (litres/day)													97.9306 (43)
Daily hot water use													
	106.5352	104.2612	101.4914	97.2787	93.8580	90.1804	88.7663	91.5241	94.4328	98.2937	102.5714	106.2588	(44)
Energy conte	168.7258	148.4665	155.9885	133.1696	126.3509	110.8873	107.3552	113.3260	116.4451	133.3837	146.1318	166.3756	(45)

Energy content (annual)												Total = Sum(45)m =	1626.6059
Distribution loss (46)m = 0.15 x (45)m	25.3089	22.2700	23.3983	19.9754	18.9526	16.6331	16.1033	16.9989	17.4668	20.0076	21.9198	24.9563	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	47.9730	47.8290	44.4725	45.2343	46.6397	46.5696	50.0894	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	219.6847	194.4939	206.9474	181.1427	174.1799	155.3598	152.5895	159.9657	163.0146	183.4731	195.4468	217.3345	(62)
WWHRS	-23.8735	-21.1139	-22.1093	-18.3074	-17.0618	-14.5999	-13.6851	-14.5527	-15.1056	-17.8079	-20.1742	-23.4314	(63a)
Energy saving calculation function	0.0000	0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
	195.8112	173.3800	184.8381	162.8353	157.1181	140.7599	138.9044	145.4130	147.9090	165.6652	175.2727	193.9031	(64)
	Total per year (kWh/year) = Sum(64)m =											1981.8100	(64)
12Total per year (kWh/year)												1982	(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	68.8410	60.8720	64.6059	56.2722	53.9689	47.9881	47.0042	49.3408	50.3604	56.8724	60.9176	68.0596	(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	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	73.3719	81.2331	73.3719	75.8176	73.3719	75.8176	73.3719	73.3719	75.8176	73.3719	75.8176	73.3719	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.4679	146.9774	143.1735	135.0755	124.8532	115.2456	108.8272	107.3177	111.1216	119.2196	129.4419	139.0495	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	(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)	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	(71)
Water heating gains (Table 5)	92.5283	90.5833	86.8359	78.1558	72.5389	66.6502	63.1777	66.3183	69.9450	76.4414	84.6077	91.4780	(72)
Total internal gains	362.4196	369.8453	354.4328	340.1003	321.8154	305.7649	293.4282	295.0593	304.9356	320.0844	340.9188	354.9508	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
East				7.4700	19.6403	0.6300		0.7000		0.7700		44.8373 (76)	
South				4.8600	46.7521	0.6300		0.7000		0.7700		69.4399 (78)	
Solar gains	114.2772	201.4359	289.3130	374.3978	428.7983	428.4902	412.0483	371.9359	319.3277	226.7395	138.2168	96.8745 (83)	
Total gains	476.6968	571.2813	643.7458	714.4981	750.6136	734.2551	705.4765	666.9952	624.2633	546.8239	479.1356	451.8253 (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	39.3334	39.4503	39.5655	40.1157	40.2204	40.7148	40.7148	40.8077	40.5229	40.2204	40.0092	39.7908	
alpha	3.6222	3.6300	3.6377	3.6744	3.6814	3.7143	3.7143	3.7205	3.7015	3.6814	3.6673	3.6527	
util living area	0.9706	0.9453	0.9023	0.8137	0.6828	0.5178	0.3830	0.4197	0.6277	0.8529	0.9488	0.9752	(86)
MIT	19.3735	19.6859	20.0713	20.5057	20.7975	20.9461	20.9863	20.9808	20.8887	20.4912	19.8632	19.3258	(87)
Th 2	19.8304	19.8334	19.8364	19.8504	19.8531	19.8653	19.8653	19.8676	19.8606	19.8531	19.8477	19.8422	(88)
util rest of house	0.9637	0.9332	0.8810	0.7753	0.6225	0.4358	0.2876	0.3212	0.5450	0.8128	0.9352	0.9693	(89)
MIT 2	17.9876	18.3780	18.8514	19.3707	19.6860	19.8331	19.8604	19.8600	19.7859	19.3723	18.6156	17.9357	(90)
Living area fraction	18.7008	19.0510	19.4792	19.9547	20.2580	20.4058	20.4398	20.4367	20.3534	19.9481	19.2576	18.6510	(91)
MIT	18.7008	19.0510	19.4792	19.9547	20.2580	20.4058	20.4398	20.4367	20.3534	19.9481	19.2576	18.6510	(92)
Temperature adjustment	18.7008	19.0510	19.4792	19.9547	20.2580	20.4058	20.4398	20.4367	20.3534	19.9481	19.2576	18.6510	(93)
adjusted MIT	18.7008	19.0510	19.4792	19.9547	20.2580	20.4058	20.4398	20.4367	20.3534	19.9481	19.2576	18.6510	(93)

8. Space heating requirement

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

Utilisation	0.9550	0.9232	0.8734	0.7791	0.6448	0.4758	0.3365	0.3715	0.5823	0.8165	0.9266	0.9613 (94)
Useful gains	455.2484	527.3902	562.2401	556.6977	484.0069	349.3595	237.3678	247.7981	363.5137	446.5060	443.9667	434.3442 (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	932.8267	913.9329	835.8067	702.1177	542.1262	363.3179	240.2866	252.0370	393.1805	592.1786	774.2193	925.3203 (97)
Space heating kWh	355.3182	259.7567	203.5335	104.7024	43.2407	0.0000	0.0000	0.0000	0.0000	108.3804	237.7819	365.2862 (98a)
Space heating requirement - total per year (kWh/year)												1678.0002
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	355.3182	259.7567	203.5335	104.7024	43.2407	0.0000	0.0000	0.0000	0.0000	108.3804	237.7819	365.2862 (98c)
Space heating contribution - total per year (kWh/year)												1678.0002
Energy saving calculation Summary												(98c) / (4) = 34.0227 (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 %)												92.4000 (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	355.3182	259.7567	203.5335	104.7024	43.2407	0.0000	0.0000	0.0000	0.0000	108.3804	237.7819	365.2862 (98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000 (210)
Space heating fuel (main heating system)	384.5436	281.1220	220.2744	113.3143	46.7973	0.0000	0.0000	0.0000	0.0000	117.2948	257.3397	395.3314 (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	195.8112	173.3800	184.8381	162.8353	157.1181	140.7599	138.9044	145.4130	147.9090	165.6652	175.2727	193.9031 (64)
Efficiency of water heater	85.6413	85.2455	84.5884	83.4597	82.0122	80.3000	80.3000	80.3000	80.3000	83.4943	85.0355	85.7167 (216)
Fuel for water heating, kWh/month	228.6412	203.3890	218.5147	195.1065	191.5789	175.2925	172.9819	181.0872	184.1955	198.4149	206.1170	226.2139 (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	15.2452	12.2303	11.0120	8.0679	6.2319	5.0915	5.6849	7.3895	9.5982	12.5933	14.2241	15.6689 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-23.5221	-33.3990	-48.3728	-54.8549	-59.6001	-55.8510	-55.2119	-51.9250	-46.1567	-38.4490	-25.9630	-20.3127 (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)	-12.5850	-26.5506	-52.8908	-79.5922	-105.3591	-105.8528	-104.5574	-88.4343	-64.7290	-37.9643	-16.8063	-9.9422 (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)
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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1816.0175 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.3000
Water heating fuel used												2381.5331 (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)												123.0377 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1218.8823 (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												3187.7060 (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	1816.0175	0.2100	381.3637 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2381.5331	0.2100	500.1220 (264)
Space and water heating			881.4856 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	123.0377	0.1443	17.7581 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-513.6182	0.1344	-69.0283
PV Unit electricity exported	-705.2640	0.1259	-88.7583
Total			-157.7866 (269)
ENVI 2A6 Calculation Summary			753.3865 (272)
Energy Emission Rate (TER)			15.2800 (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	1816.0175	1.1300	2052.0998 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2381.5331	1.1300	2691.1324 (278)
Space and water heating			4743.2322 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	123.0377	1.5338	188.7193 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-513.6182	1.4967	-768.7293
PV Unit electricity exported	-705.2640	0.4620	-325.8034
Total			-1094.5327 (283)
Total Primary energy kWh/year			3967.5195 (286)
Target Primary Energy Rate (TPER)			80.4400 (287)

Property Reference	Unit 8		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	85 B	DER	14.58	TER	13.40
Environmental	88 B	% DER < TER			-8.81
CO ₂ Emissions (t/year)	1	DFEE	38.31	TFEE	43.59
Compliance Check	See BREL	% DFEE < TFEE			12.11
% DPER < TPER	-15.13	DPER	80.85	TPER	70.22
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

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)
Ground floor	76.9200 (1b)	x 2.8000 (2b)	= 215.3760 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.9200		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3760 (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) =	Air changes per hour
Pressure test	30.0000 / (5) = 0.1393 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	4.0000 (17)
Number of sides sheltered	0.3393 (18)
	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3393 (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	0.4326	0.4241	0.4156	0.3732	0.3647	0.3223	0.3223	0.3138	0.3393	0.3647	0.3817	0.3987 (22b)
Effective ac	0.5936	0.5899	0.5864	0.5696	0.5665	0.5519	0.5519	0.5492	0.5576	0.5665	0.5728	0.5795 (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
G (Uw = 1.00)			20.9900	0.9615	20.1827		(27)
EF			3.1900	0.1200	0.3828	110.0000	350.9000 (28b)
EW	86.9300	20.9900	65.9400	0.1500	9.8910	60.0000	3956.4000 (29a)
SW	22.4000		22.4000	0.1500	3.3600	60.0000	1344.0000 (29a)
FR	76.9200		76.9200	0.1100	8.4612	9.0000	692.2800 (30)
Total net area of external elements Aum(A, m ²)			189.4400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.2777		(33)
PF			73.7300			40.0000	2949.2000 (32d)

(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)

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

Space heating fuel - main system 1	2726.2849	(211)
Space heating fuel - secondary	0.0000	(213)
Efficiency of water heater	0.0000	(215)
Water heating fuel used	79.8000	
Space cooling fuel	2452.2490	(219)
	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
Total electricity for the above, kWh/year	41.0000	(231)
Electricity for lighting (calculated in Appendix L)	198.8336	(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	5418.3676	(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	2726.2849	0.2100	572.5198	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2452.2490	0.2100	514.9723	(264)
Space and water heating			1087.4921	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	198.8336	0.1443	28.6978	(268)
Total CO2, kg/year			1121.8772	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.5800	(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	2726.2849	1.1300	3080.7019	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2452.2490	1.1300	2771.0414	(278)
Space and water heating			5851.7433	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	198.8336	1.5338	304.9777	(282)
Total Primary energy kWh/year			6218.7458	(286)
Dwelling Primary energy Rate (DPER)			80.8500	(287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	76.9200	(1b)	x	2.8000 (2b) = 215.3760 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.9200			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3760 (5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys		0 * 80 =	0.0000 (6a)
Number of open flues		0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000 (6d)
Number of flues attached to other heater		0 * 35 =	0.0000 (6e)
Number of blocked chimneys		0 * 20 =	0.0000 (6f)
Number of intermittent extract fans		3 * 10 =	30.0000 (7a)
Number of passive vents		0 * 10 =	0.0000 (7b)
Number of flueless gas fires		0 * 40 =	0.0000 (7c)
Air changes per hour			
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1393 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3893 (18)
Number of sides sheltered			0 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3893 (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	0.4963	0.4866	0.4769	0.4282	0.4185	0.3698	0.3698	0.3601	0.3893	0.4185	0.4380	0.4574 (22b)
Effective ac	0.6232	0.6184	0.6137	0.5917	0.5876	0.5684	0.5684	0.5648	0.5758	0.5876	0.5959	0.6046 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			19.2300	1.1450	22.0191		(27)
EF			3.1900	0.1300	0.4147		(28b)
EW	86.9300	19.2300	67.7000	0.1800	12.1860		(29a)
SW	22.4000		22.4000	0.1800	4.0320		(29a)
FR	76.9200		76.9200	0.1100	8.4612		(30)
Total net area of external elements Aum(A, m2)			189.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.1130		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							137.6959 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				9.0500	0.0500	0.4525	
E3 Sill				9.0500	0.0500	0.4525	
E4 Jamb				19.0600	0.0500	0.9530	
E5 Ground floor (normal)				27.8800	0.1600	4.4608	
E14 Flat roof				27.8800	0.0800	2.2304	
E16 Corner (normal)				9.8000	0.0900	0.8820	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4312 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	56.5442 (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	44.2919	43.9520	43.6187	42.0536	41.7607	40.3975	40.3975	40.1451	40.9226	41.7607	42.3531	42.9725 (38)
Heat transfer coeff	100.8361	100.4962	100.1629	98.5977	98.3049	96.9417	96.9417	96.6892	97.4668	98.3049	98.8973	99.5167 (39)
Average = Sum(39)m / 12 =												98.5963
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3109	1.3065	1.3022	1.2818	1.2780	1.2603	1.2603	1.2570	1.2671	1.2780	1.2857	1.2938 (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	2.4018 (42)											
Hot water usage for mixer showers	64.4904	63.5212	62.1089	59.4068	57.4127	55.1889	53.9249	55.3265	56.8629	59.2506	62.0107	64.2433 (42a)
Hot water usage for baths	27.8562	27.4425	26.8599	25.7857	24.9814	24.0895	23.6078	24.1863	24.8162	25.7705	26.8668	27.7620 (42b)
Hot water usage for other uses	39.2271	37.8006	36.3742	34.9478	33.5213	32.0949	32.0949	33.5213	34.9478	36.3742	37.8006	39.2271 (42c)
Average daily hot water use (litres/day)												120.9460 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	131.5736	128.7643	125.3430	120.1403	115.9155	111.3734	109.6276	113.0341	116.6268	121.3953	126.6782	131.2324 (44)
Energy content (annual)	208.3805	183.3587	192.6476	164.4661	156.0445	136.9465	132.5851	139.9599	143.8126	164.7323	180.4763	205.4782 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		2008.8881

	31.2571	27.5038	28.8971	24.6699	23.4067	20.5420	19.8878	20.9940	21.5719	24.7098	27.0714	30.8217 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	259.3394	229.3861	243.6065	213.7812	207.0034	186.2616	183.5440	190.9188	193.1276	215.6912	229.7914	256.4371 (62)
WWHRS	-29.4823	-26.0744	-27.3036	-22.6085	-21.0703	-18.0300	-16.9002	-17.9717	-18.6545	-21.9916	-24.9138	-28.9363 (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)
Energy gain calculation function	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)
	229.8571	203.3117	216.3029	191.1727	185.9331	168.2316	166.6438	172.9471	174.4731	193.6996	204.8775	227.5007 (64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				2334.9508 (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	82.0262	72.4736	76.7950	67.0137	64.6245	57.8635	56.8243	59.2764	60.1464	67.5132	72.3371	81.0612 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.3751	118.8796	107.3751	110.9543	107.3751	110.9543	107.3751	107.3751	110.9543	107.3751	110.9543	107.3751 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	212.8832	215.0923	209.5255	197.6745	182.7148	168.6548	159.2618	157.0527	162.6195	174.4705	189.4302	203.4902 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091 (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)	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729 (71)
Water heating gains (Table 5)	110.2503	107.8476	103.2192	93.0746	86.8609	80.3660	76.3767	79.6726	83.5367	90.7436	100.4682	108.9533 (72)
Total internal gains	492.5360	503.8469	482.1471	463.7308	438.9782	419.0024	402.0410	403.1278	416.1379	434.6165	462.8801	481.8460 (73)

6. Solar gains												

[Jan]				Area	Solar flux							
				m2	Table 6a		g	FF		Access		Gains
					W/m2		Specific data	Specific data		factor		W
							or Table 6b	or Table 6c		Table 6d		
North				5.9600	10.6334		0.6300	0.7000		0.7700		19.3682 (74)
South				8.0100	46.7521		0.6300	0.7000		0.7700		114.4472 (78)
West				5.2600	19.6403		0.6300	0.7000		0.7700		31.5722 (80)

Solar gains	165.3876	286.2106	403.3673	519.2179	599.0903	602.4102	577.6073	516.8858	443.3290	319.5119	198.9190	141.0027 (83)
Total gains	657.9236	790.0575	885.5145	982.9487	1038.0685	1021.4125	979.6483	920.0136	859.4668	754.1284	661.7991	622.8486 (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, n11,m (see Table 9a)												
Jan	29.1771	29.2758	29.3732	29.8395	29.9283	30.3492	30.3492	30.4284	30.1857	29.9283	29.7491	29.5639
alpha	2.9451	2.9517	2.9582	2.9893	2.9952	3.0233	3.0233	3.0286	3.0124	2.9952	2.9833	2.9709
util living area	0.9608	0.9345	0.8949	0.8166	0.7003	0.5464	0.4148	0.4542	0.6527	0.8501	0.9381	0.9659 (86)
MIT	18.8257	19.1794	19.6326	20.1868	20.6094	20.8693	20.9576	20.9437	20.7666	20.2048	19.4310	18.7774 (87)
Th 2	19.8323	19.8357	19.8391	19.8551	19.8581	19.8721	19.8721	19.8747	19.8667	19.8581	19.8520	19.8457 (88)
util rest of house	0.9534	0.9226	0.8757	0.7835	0.6465	0.4675	0.3165	0.3540	0.5770	0.8152	0.9248	0.9595 (89)
MIT 2	17.3417	17.7854	18.3486	19.0262	19.5078	19.7819	19.8528	19.8470	19.6891	19.0677	18.1185	17.2891 (90)
Living area fraction									fLA = Living area / (4) =			0.4875 (91)
MIT	18.0652	18.4650	18.9746	19.5920	20.0448	20.3120	20.3914	20.3817	20.2144	19.6220	18.7584	18.0147 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0652	18.4650	18.9746	19.5920	20.0448	20.3120	20.3914	20.3817	20.2144	19.6220	18.7584	18.0147 (93)

8. Space heating requirement												

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9384	0.9050	0.8586	0.7749	0.6559	0.4995	0.3628	0.4005	0.6018	0.8069	0.9087	0.9456 (94)

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Fraction of space heat from secondary/supplementary system (Table 11)

Fraction of space heat from secondary/supplementary system (Table 11)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	67	67	67	67	67	67	67	67	67	67	67	67
1981	67	67	67	67	67	67	67	67	67	67	67	67
1982	67	67	67	67	67	67	67	67	67	67	67	67
1983	67	67	67	67	67	67	67	67	67	67	67	67
1984	67	67	67	67	67	67	67	67	67	67	67	67
1985	67	67	67	67	67	67	67	67	67	67	67	67
1986	67	67	67	67	67	67	67	67	67	67	67	67
1987	67	67	67	67	67	67	67	67	67	67	67	67
1988	67	67	67	67	67	67	67	67	67	67	67	67
1989	67	67	67	67	67	67	67	67	67	67	67	67
1990	67	67	67	67	67	67	67	67	67	67	67	67
1991	67	67	67	67	67	67	67	67	67	67	67	67
1992	67	67	67	67	67	67	67	67	67	67	67	67
1993	67	67	67	67	67	67	67	67	67	67	67	67
1994	67	67	67	67	67	67	67	67	67	67	67	67
1995	67	67	67	67	67	67	67	67	67	67	67	67
1996	67	67	67	67	67	67	67	67	67	67	67	67
1997	67	67	67	67	67	67	67	67	67	67	67	67
1998	67	67	67	67	67	67	67	67	67	67	67	67
1999	67	67	67	67	67	67	67	67	67	67	67	67
2000	67	67	67	67	67	67	67	67	67	67	67	67
2001	67	67	67	67	67	67	67	67	67	67	67	67
2002	67	67	67	67	67	67	67	67	67	67	67	67
2003	67	67	67	67	67	67	67	67	67	67	67	67
2004	67	67	67	67	67	67	67	67	67	67	67	67
2005	67	67	67	67	67	67	67	67	67	67	67	67
2006	67	67	67	67	67	67	67	67	67	67	67	67
2007	67	67	67	67	67	67	67	67	67	67	67	67
2008	67	67	67	67	67	67	67	67	67	67	67	67
2009	67	67	67	67	67	67	67	67	67	67	67	67
2010	67	67	67	67	67	67	67	67	67	67	67	67
2011	67	67	67	67	67	67	67	67	67	67	67	67
2012	67	67	67	67	67	67	67	67	67	67	67	67
2013	67	67	67	67	67	67	67	67	67	67	67	67
2014	67	67	67	67	67	67	67	67	67	67	67	67
2015	67	67	67	67	67	67	67	67	67	67	67	67
2016	67	67	67	67	67	67	67	67	67	67	67	67
2017	67	67	67	67	67	67	67	67	67	67	67	67
2018	67	67	67	67	67	67	67	67	67	67	67	67
2019	67	67	67	67	67	67	67	67	67	67	67	67
2020	67	67	67	67	67	67	67	67	67	67	67	67

Water heating

Total electricity for the above, kwh/year

Total electricity for the above, kWh/year	86.0000 (231)
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PV generation

PV generation	-1900.9819 (233)
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Hydro-electric generation (Appendix N)

Hydro-electric generation (Appendix N)	0.0000 (235a)
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Electricity generated - Micro CHP (Appendix N)

Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
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Appendix Q - special features

Electricity generated - micro em (Appendix N) 0.0000 (255)

Appendix O - special features

Energy saved or generated

Appendix Q – Special Features	
Energy saved or generated	-0.0000 (236)

Energy saved
Energy used

Energy saved or generated	0.0000 (236)
Energy used	0.0000 (237)

Total delivered energy for all uses

Energy used	0.0000 (237)
Total delivered energy for all uses	4264.7102 (238)

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

Energy	Emission factor	Emissions
--------	-----------------	-----------

	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	3112.8265	0.2100	653.6936 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2786.8076	0.2100	585.2296 (264)
Space and water heating			1238.9232 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	180.0580	0.1443	25.9879 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-766.0894	0.1346	-103.1121
PV Unit electricity exported	-1134.8924	0.1259	-142.8877
Total			-245.9998 (269)
Total CO2, kg/year			1030.8406 (272)
Energy saving/generation technologies			13.4000 (273)

Energy 101

Energy 101

Energy 101

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	3112.8265	1.1300	3517.4940 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2786.8076	1.1300	3149.0926 (278)
Space and water heating			6666.5866 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	180.0580	1.5338	276.1789 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-766.0894	1.4974	-1147.1745
PV Unit electricity exported	-1134.8924	0.4622	-524.4967
Total			-1671.6712 (283)
Total Primary energy kWh/year			5401.1951 (286)
Target Primary Energy Rate (TPER)			70.2200 (287)

Property Reference	Unit 2			Issued on Date	27/09/2023
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	88 B	DER	10.80	TER	9.95
Environmental	89 B	% DER < TER			-8.54
CO ₂ Emissions (t/year)	1.31	DFEE	32.10	TFEE	36.78
Compliance Check	See BREL	% DFEE < TFEE			12.73
% DPER < TPER	-15.40	DPER	59.90	TPER	51.91
Assessor Details	Mr. George Farr			Assessor ID	T355-0001
Energy Saving Calculation Function					

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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 399.5550 (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	5 * 10 = 50.0000 (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) =	50.0000 / (5) =	0.1251 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3251	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2764	(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	0.3524	0.3455	0.3386	0.3040	0.2971	0.2625	0.2625	0.2556	0.2764	0.2971	0.3109	0.3247 (22b)
Effective ac	0.5621	0.5597	0.5573	0.5462	0.5441	0.5345	0.5345	0.5327	0.5382	0.5441	0.5483	0.5527 (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
DOOR			2.3500	1.0000	2.3500		(26)
G (Uw = 1.00)			29.5500	0.9615	28.4135		(27)
FR RL			1.1500	0.9615	1.1058		(27a)
GF			49.6600	0.1200	5.9592	110.0000	5462.6000 (28a)
EW	125.1800	31.9000	93.2800	0.1500	13.9920	60.0000	5596.8000 (29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361	9.0000	436.5900 (30)

Heat capacity $C_m = \text{Sum}(A \times k)$	(28)...(30) + (32) + (32a)...(32e) =	21979.9100	(34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m ² K		157.5734	(35)
Thermal bridges (User defined value 0.030 * total exposed area)		6.7350	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	63.8915	(37)

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333 (42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577 (42b)
Hot water usage for other uses	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939 (42c)
Average daily hot water use (litres/day)												137.1222 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)
Energy content (annual)	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)
Distribution loss	Total = Sum(45)m =											2277.5713
Water storage loss:	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199 (62)
WWHRS	-65.1476	-57.6171	-60.3333	-49.9584	-46.5594	-39.8412	-37.3448	-39.7124	-41.2212	-48.5953	-55.0526	-63.9412 (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	222.0627	196.2926	209.0387	185.8192	181.3138	164.7359	163.9318	169.9257	171.1414	189.1289	198.8775	219.9787 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2272.2469 (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	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)
Lighting gains	(calculated in Appendix L, equation L9 or L9a), also see Table 5											
	157.4062	174.2711	157.4062	162.6531	157.4062	162.6531	157.4062	157.4062	162.6531	157.4062	162.6531	157.4062 (67)
Appliances gains	(calculated in Appendix L, equation L13 or L13a), also see Table 5											
	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)
Cooking gains	(calculated in Appendix L, equation L15 or L15a), also see Table 5											
	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (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)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)
Water heating gains (Table 5)	122.7961	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356 (72)
Total internal gains	658.6853	676.0306	645.8422	622.3955	588.4015	562.8877	539.4917	540.0239	557.7276	580.8439	618.8183	643.5884 (73)

[illegible]

(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	(231)
Lighting	35.8880	28.7907	25.9228	18.9922	14.6701	11.9856	13.3826	17.3952	22.5946	29.6453	33.4843	36.8854	(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 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												4280.8124	(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												2665.9476	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												289.6368	(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												7277.3967	(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	4280.8124	0.2100	898.9706	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2665.9476	0.2100	559.8490	(264)
Space and water heating			1458.8196	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	289.6368	0.1443	41.8035	(268)
Total CO2, kg/year			1506.3103	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.8000	(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	4280.8124	1.1300	4837.3180	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2665.9476	1.1300	3012.5208	(278)
Space and water heating			7849.8387	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	289.6368	1.5338	444.2546	(282)
Total Primary energy kWh/year			8356.1181	(286)
Dwelling Primary energy Rate (DPER)			59.9000	(287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b)	-
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c)	-

Second floor
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 139.4900
Dwelling volume 40.1700 (1d) x 2.9000 (2d) = 116.4930 (1d) - (4)
(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 399.5550 (5)

2. Ventilation rate

Number of open chimneys 0 * 80 = 0.0000 (6a)
Number of flues attached to solid fuel boiler 0 * 20 = 0.0000 (6b)
Number of flues attached to other heater 0 * 10 = 0.0000 (6c)
Number of blocked chimneys 0 * 20 = 0.0000 (6d)
Number of intermittent extract fans 0 * 35 = 0.0000 (6e)
Number of passive vents 0 * 20 = 0.0000 (6f)
Number of flueless gas fires 4 * 10 = 40.0000 (7a)
0 * 10 = 0.0000 (7b)
0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.1001 (8)
Pressure test Yes
Pressure Test Method Blower Door
Measured/design AP50 5.0000 (17)
Infiltration rate 0.3501 (18)
Number of sides sheltered 2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2976 (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	0.3794	0.3720	0.3646	0.3274	0.3199	0.2827	0.2827	0.2753	0.2976	0.3199	0.3348	0.3497 (22b)
Effective ac	0.5720	0.5692	0.5664	0.5536	0.5512	0.5400	0.5400	0.5379	0.5443	0.5512	0.5560	0.5611 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.3500	1.0000	2.3500		(26)
TER Opening Type (Uw = 1.20)			29.5500	1.1450	33.8359		(27)
FR RL			1.1500	2.0221	2.3254		(27a)
GF			49.6600	0.1300	6.4558		(28a)
EW	125.1800	31.9000	93.2800	0.1800	16.7904		(29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361		(30)
Total net area of external elements Aum(A, m2)			224.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0935		(33)
PW			129.9700	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 157.5734 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element	9.0500	0.0500	0.4525
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	19.0600	0.0500	0.9530
E4 Jamb	27.8800	0.1600	4.4608
E5 Ground floor (normal)	27.8800	0.0800	2.2304
E14 Flat roof	9.8000	0.0900	0.8820
E16 Corner (normal)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.4312 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 76.5247 (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	75.4180	75.0494	74.6882	72.9913	72.6738	71.1959	71.1959	70.9223	71.7652	72.6738	73.3161	73.9875 (38)
Heat transfer coeff	151.9427	151.5742	151.2129	149.5161	149.1986	147.7207	147.7207	147.4470	148.2899	149.1986	149.8408	150.5123 (39)
Average = Sum(39)m / 12 =												149.5145
HLP	1.0893	1.0866	1.0840	1.0719	1.0696	1.0590	1.0590	1.0570	1.0631	1.0696	1.0742	1.0790 (40)
HLP (average)												1.0719
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333 (42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577 (42b)

Hot water usage for other uses												
Average daily hot water use (litres/day)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)
Energy conte	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)
Energy content (annual)	Total = Sum(45)m = 2277.5713											
Distribution loss (46)m = 0.15 x (45)m	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (59)
Total heat required for water heating calculated for each month	287.2103	253.9097	269.3720	235.7776	227.8732	204.5771	201.2766	209.6381	212.3626	237.7242	253.9301	283.9199 (62)
WWHRS	-33.4244	-29.5608	-30.9544	-25.6314	-23.8876	-20.4408	-19.1600	-20.3747	-21.1488	-24.9321	-28.2451	-32.8054 (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	253.7859	224.3489	238.4176	210.1461	203.9856	184.1363	182.1166	189.2634	191.2138	212.7921	225.6850	251.1145 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m = 2567 (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)
Heat gains from water heating, kWh/month	91.2933	80.6277	85.3621	74.3275	71.5637	63.9534	62.7204	65.5006	66.5421	74.8392	80.3633	90.1993 (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	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	155.7883	172.4799	155.7883	160.9812	155.7883	160.9812	155.7883	155.7883	160.9812	155.7883	160.9812	155.7883 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (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)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)
Water heating gains (Table 5)	122.7061	119.9817	114.7340	103.2327	96.1878	88.8241	84.3016	88.0384	92.4195	100.5903	111.6156	121.2356 (72)
Total internal gains	657.0674	674.2394	644.2243	620.7236	586.7836	561.2159	537.8739	538.4060	556.0558	579.2260	617.1465	641.9705 (73)
6. Solar gains												
[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
North	15.2500	10.6334	0.6300	0.7000	0.7700	49.5580 (74)						
East	0.9500	19.6403	0.6300	0.7000	0.7700	5.7022 (75)						
South	13.3500	46.7521	0.6300	0.7000	0.7700	190.7453 (76)						
North	1.1500	26.0000	0.6300	0.7000	1.0000	11.8673 (82)						
Solar gains	257.8728	442.9017	621.0513	803.5038	937.3563	948.7063	906.9851	803.2339	683.0340	493.0417	309.4067	220.4098 (83)
Total gains	914.9402	1117.1411	1265.2756	1424.2275	1524.1399	1509.9222	1444.8590	1341.6399	1239.0898	1072.2677	926.5532	862.3803 (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	40.1831	40.2808	40.3770	40.8353	40.9222	41.3316	41.3316	41.4083	41.1729	40.9222	40.7468	40.5650
alpha	3.6789	3.6854	3.6918	3.7224	3.7281	3.7554	3.7554	3.7606	3.7449	3.7281	3.7165	3.7043
util living area	0.9849	0.9687	0.9399	0.8710	0.7500	0.5809	0.4372	0.4855	0.7081	0.9057	0.9720	0.9877 (86)
MIT	19.1950	19.5008	19.8917	20.3698	20.7290	20.9241	20.9798	20.9701	20.8380	20.3563	19.6908	19.1453 (87)
Th 2	20.0096	20.0118	20.0139	20.0239	20.0257	20.0345	20.0345	20.0361	20.0311	20.0257	20.0220	20.0180 (88)
util rest of house	0.9817	0.9624	0.9275	0.8447	0.7016	0.5072	0.3466	0.3919	0.6388	0.8804	0.9652	0.9851 (89)
MIT 2	17.9023	18.2901	18.7808	19.3695	19.7797	19.9818	20.0252	20.0213	19.9056	19.3680	18.5413	17.8446 (90)
Living area fraction	fLA = Living area / (4) = 0.2694 (91)											
MIT	18.2505	18.6163	19.0801	19.6390	20.0354	20.2357	20.2823	20.2769	20.1568	19.6343	18.8510	18.1951 (92)

Temperature adjustment												0.0000
adjusted MIT	18.2505	18.6163	19.0801	19.6390	20.0354	20.2357	20.2823	20.2769	20.1568	19.6343	18.8510	18.1951 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9736	0.9504	0.9128	0.8327	0.7021	0.5233	0.3704	0.4160	0.6485	0.8681	0.9542	0.9781 (94)
Useful gains	890.8255	1061.7365	1154.9576	1186.0074	1070.0617	790.0791	535.2216	558.1445	803.5547	930.8879	884.1186	843.4644 (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)
AP Contribution Budget		3386	1902.2670	1605.6546	1243.6369	832.5054	543.9578	571.6400	898.1676	1347.8981	1760.7825	2106.4273 (97)
Space heating kWh	914.2701	683.6270	555.9981	302.1460	129.1400	0.0000	0.0000	0.0000	0.0000	310.2556	631.1980	939.6443 (98a)
Space heating requirement - total per year (kWh/year)												4466.2791
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	914.2701	683.6270	555.9981	302.1460	129.1400	0.0000	0.0000	0.0000	0.0000	310.2556	631.1980	939.6443 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4466.2791
Space heating per m ²										(98c) / (4) =		32.0186 (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 %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

[illegible]

Water heating													
Water heating requirement	253.7859	224.3489	238.4176	210.1461	203.9856	184.1363	182.1166	189.2634	191.2138	212.7921	225.6850	251.1145 (64)	
Efficiency of water heater (217)m	86.8784	86.6081	86.1316	85.1588	83.4287	80.3000	80.3000	80.3000	80.3000	85.1883	86.4612	80.3000 (216)	
Fuel for water heating, kWh/month	292.1163	259.0391	276.8063	246.7698	244.5029	229.3105	226.7953	235.6954	238.1243	249.7904	261.0247	86.9365 (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	7.3041	7.0685	7.3041	7.0685	7.3041 (231)	
Lighting	32.3697	25.9682	23.3815	17.1303	13.2319	10.8106	12.0706	15.6898	20.3795	26.7390	30.2017	33.2694 (232)	

[illegible][illegible]

Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	261.2423 (232)

Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2454.5699 (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	5775.1310 (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	4833.6354	0.2100	1015.0634 (261)
Επιπλέον Κατανάλωση Ενέργειας ΕΠΙΠΛΕΟΝ ΚΑΤΑΝΑΛΩΣΗ ΕΝΕΡΓΕΙΑΣ Community systems			0.0000 (373)
Space and water heating	3048.8232	0.2100	640.2529 (264)
Pumps, fans and electric keep-hot	86.0000	0.1387	1655.3163 (265)
Energy for lighting	261.2423	0.1443	11.9293 (267)
			37.7053 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	0.1345	-138.2176
PV Unit electricity exported	-1426.6745	0.1258	-179.4705
Total			-317.6881 (269)
Total CO2, kg/year			1387.2628 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.9500 (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	4833.6354	1.1300	5462.0080 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)			
Space and water heating	3048.8232	1.1300	3445.1703 (278)
Pumps, fans and electric keep-hot	86.0000	1.5128	8907.1783 (279)
Energy for lighting	261.2423	1.5338	130.1008 (281)
			400.7021 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	1.4970	-1538.7175
PV Unit electricity exported	-1426.6745	0.4618	-658.7722
Total			-2197.4897 (283)
Total Primary energy kWh/year			7240.4915 (286)
Target Primary Energy Rate (TPER)			51.9100 (287)

Project name

Fortis Green Tennis Club

As designed

Date: Fri Sep 22 15:21:58 2023

Administrative information**Building Details**Address: Fortis Green Tennis Club, 31 Southern Road,
London, N2 9LH**Certifier details**

Name: Neil Ingham

Telephone number:

Address: Holborn Tower, 137-144 High Holborn London,
WC1V 6PL**Certification tool**

Calculation engine: SBEM

Calculation engine version: v6.1.e.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.2.0

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 87.2**The CO₂ emission and primary energy rates of the building must not exceed the targets**

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	17.31
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	13.68
Target primary energy rate (TPER), kWh _{PE} /m ² annum	187.13
Building primary energy rate (BPER), kWh _{PE} /m ² annum	148.41
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.18	0.25	Block 1 - WC-Showers_P_8
Floors	0.18	0.11	0.12	Block 1 - WC-Showers_S_3
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	-	-	No heat loss flat roofs
Windows** and roof windows	1.6	1.3	1.3	Block 1 - Bar area_G_7
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	1	1	Block 1 - Bar area_D_6
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]
U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]
U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	4

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Notional ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.81	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- via ASHP

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.002
Standard value	N/A	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
Block 1 - WC-Showers	0.2	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
Block 1 - Plant		130	-	-
Block 1 - Store		130	-	-
Block 1 - Stores		130	-	-
Block 1 - WC-Showers		130	-	-
Block 1 - Bar area		130	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block 1 - Bar area	YES (+24.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	130.6	130.6
External area [m ²]	346.5	346.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	4	3
Average conductance [W/K]	97.73	113.55
Average U-value [W/m ² K]	0.28	0.33
Alpha value* [%]	25.04	19.31

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area Building Type

Retail/Financial and Professional Services
 Restaurants and Cafes/Drinking Establishments/Takeaways
 Offices and Workshop Businesses
 General Industrial and Special Industrial Groups
 Storage or Distribution
 Hotels
 Residential Institutions: Hospitals and Care Homes
 Residential Institutions: Residential Schools
 Residential Institutions: Universities and Colleges
 Secure Residential Institutions
 Residential Spaces
 Non-residential Institutions: Community/Day Centre
 Non-residential Institutions: Libraries, Museums, and Galleries
 Non-residential Institutions: Education
 Non-residential Institutions: Primary Health Care Building
 Non-residential Institutions: Crown and County Courts
100 General Assembly and Leisure, Night Clubs, and Theatres
 Others: Passenger Terminals
 Others: Emergency Services
 Others: Miscellaneous 24hr Activities
 Others: Car Parks 24 hrs
 Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	6.94	7.68
Cooling	0	0
Auxiliary	1.62	9.08
Lighting	4.46	3.99
Hot water	84.8	118.87
Equipment*	54.56	54.56
TOTAL**	97.83	139.62

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	13.05
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>13.05</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	358.61	313.56
Primary energy [kWh _{PE} /m ²]	148.41	187.13
Total emissions [kg/m ²]	13.68	17.31

HVAC Systems Performance									
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling									
	Actual	280.4	211.8	0	0	0	0	0	0
	Notional	284.9	229.7	0	0	0	0	----	----
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas									
	Actual	98.8	193.3	10.4	0	2.4	2.64	0	2.81
	Notional	109.3	104.1	11.5	0	3.3	2.64	0	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Appendix C

Generating energy on-site:-

SAP & SBEM Outputs & Dwelling/Building Emission Rates

Property Reference	Unit 2		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green		Prop Type Ref	Fortis Green	
Property					
SAP Rating	89 B	DER	1.74	TER	9.70
Environmental	98 A	% DER < TER	82.06		
CO ₂ Emissions (t/year)	0.18	DFEE	32.10	TFEE	36.78
Compliance Check	See BREL	% DFEE < TFEE	12.73		
% DPER < TPER	52.04	DPER	24.26	TPER	50.59
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 399.5550 (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	5 * 10 = 50.0000 (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) =	50.0000 / (5) =	0.1251 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	4.0000 (17)	
Infiltration rate	0.3251 (18)	
Number of sides sheltered	2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2764 (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	0.3524	0.3455	0.3386	0.3040	0.2971	0.2625	0.2625	0.2556	0.2764	0.2971	0.3109	0.3247 (22b)
Effective ac	0.5621	0.5597	0.5573	0.5462	0.5441	0.5345	0.5345	0.5327	0.5382	0.5441	0.5483	0.5527 (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
DOOR			2.3500	1.0000	2.3500		(26)
G (Uw = 1.00)			29.5500	0.9615	28.4135		(27)
FR RL			1.1500	0.9615	1.1058		(27a)
GF			49.6600	0.1200	5.9592	110.0000	5462.6000 (28a)
EW	125.1800	31.9000	93.2800	0.1500	13.9920	60.0000	5596.8000 (29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361	9.0000	436.5900 (30)

Heat capacity $C_m = \text{Sum}(A \times k)$	(28)...(30) + (32) + (32a)...(32e) =	21979.9100	(34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m ² K		157.5734	(35)
Thermal bridges (User defined value 0.030 * total exposed area)		6.7350	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	63.8915	(37)

4. Water heating energy requirements (kwh/year)													
Assumed occupancy												2.9161 (42)	
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333 (42a)	
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577 (42b)	
Hot water usage for other uses	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939 (42c)	
Average daily hot water use (litres/day)												137.1222 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)	
Energy content	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)	
Energy content (annual)											Total = Sum(45)m =	2277.5713	
Distribution loss (46)m = 0.15 x (45)m	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)	
Water storage loss:													
Store volume													145.0000 (47)
a) If manufacturer declared loss factor is known (kwh/day):													1.1800 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.6372 (55)
Total storage loss	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532 (56)	
If cylinder contains dedicated solar storage	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532 (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	279.2670	246.7351	261.4287	228.0905	219.9299	196.8900	193.3333	201.6948	204.6755	229.7809	246.2430	275.9766 (62)	
WWHRS	-65.1476	-57.6171	-60.3333	-49.9584	-46.5594	-39.8412	-37.3448	-39.7124	-41.2212	-48.5953	-55.0526	-63.9412 (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	214.1194	189.1180	201.0954	178.1321	173.3705	157.0488	155.9885	161.9824	163.4543	181.1856	191.1904	212.0354 (64)	
Total per year (kWh/year)									Total per year (kWh/year) = Sum(64)m =				2178.7209 (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													
	112.9661	100.2031	107.0348	95.3012	93.2365	84.9270	84.3931	87.1733	87.5157	96.5119	101.3369	111.8720 (65)	

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)
Lighting gains	(calculated in Appendix L, equation L9 or L9a), also see Table 5											
	157.4062	174.2711	157.4062	162.6531	157.4062	162.6531	157.4062	157.4062	162.6531	157.4062	162.6531	157.4062 (67)
Appliances gains	(calculated in Appendix L, equation L13 or L13a), also see Table 5											
	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)
Cooking gains	(calculated in Appendix L, equation L15 or L15a), also see Table 5											
	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation	(negative values) (Table 5)											
	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)
Water heating gains	(Table 5)											
	151.8361	149.1118	143.8640	132.3628	125.3179	117.9542	113.4316	117.1684	121.5496	129.7204	140.7457	150.3656 (72)
Total internal gains												
	684.8154	702.1607	671.9722	648.5255	614.5315	592.0177	568.6218	569.1539	586.8577	606.9739	644.9483	669.7184 (73)

Solar gains	233.3135	400.7206	561.9036	726.9797	848.0843	858.3533	820.6056	726.7354	617.9831	446.0854	279.9394	199.4184 (83)
Total gains	918.1288	1102.8813	1233.8758	1375.5052	1462.6158	1450.3711	1389.2274	1295.8893	1204.8408	1053.0593	924.8877	869.1368 (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, $u_{l,m}$ (see Table 9a)

21.0000 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	44.2417	44.3439	44.4445	44.9230	45.0137	45.4407	45.4407	45.5207	45.2753	45.0137	44.8306	44.6408
alpha	3.9494	3.9563	3.9630	3.9949	4.0009	4.0294	4.0294	4.0347	4.0184	4.0009	3.9887	3.9761
util living area	0.9840	0.9672	0.9371	0.8642	0.7369	0.5612	0.4176	0.4633	0.6866	0.8976	0.9698	0.9869 (86)
Living	19.7315	19.9444	20.2114	20.5340	20.7662	20.8841	20.9139	20.9093	20.8349	20.5256	20.0734	19.6961
Non living	18.5977	18.8679	19.2029	19.6009	19.8647	19.9882	20.0113	20.0101	19.9440	19.6009	19.0406	18.5585
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.0922	20.0941	20.0960	20.1048	20.1064	20.1141	20.1141	20.1155	20.1111	20.1064	20.1031	20.0996 (88)
util rest of house	0.9807	0.9608	0.9247	0.8383	0.6905	0.4936	0.3370	0.3795	0.6209	0.8720	0.9627	0.9842 (89)
MIT 2	20.0922	20.0941	20.0960	20.1048	20.1064	20.1141	20.1141	20.1155	20.1111	20.1064	20.1031	20.0996 (90)
Living area fraction									fLA = Living area / (4) =			0.2694 (91)
MIT	20.3368	20.3382	20.3395	20.3460	20.3472	20.3528	20.3528	20.3538	20.3506	20.3472	20.3447	20.3422 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3368	20.3382	20.3395	20.3460	20.3472	20.3528	20.3528	20.3538	20.3506	20.3472	20.3447	20.3422 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9816	0.9627	0.9283	0.8458	0.7037	0.5124	0.3590	0.4026	0.6396	0.8795	0.9648	0.9850 (94)
Useful gains	901.2758	1061.7109	1145.4565	1163.3540	1029.1790	743.1061	498.7854	521.6949	770.6149	926.1448	892.3411	856.0676 (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	2213.1380	2125.6204	1901.1986	1555.6308	1172.8758	772.9549	504.2298	530.3085	842.9150	1322.0767	1803.8134	2207.7694 (97)
Space heating kwh	976.0255	714.9472	562.2722	282.4393	106.9104	0.0000	0.0000	0.0000	0.0000	294.5733	656.2601	1005.6661 (98a)
Space heating requirement - total per year (kwh/year)												4599.0940
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	976.0255	714.9472	562.2722	282.4393	106.9104	0.0000	0.0000	0.0000	0.0000	294.5733	656.2601	1005.6661 (98c)
Space heating requirement after solar contribution - total per year (kwh/year)												4599.0940
Space heating per m2												32.9708 (99)
										(98c) / (4) =		

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)

1.00000 (202)

Efficiency of main space heating system 1 (in %)

322.0895 (206)

Efficiency of main space heating system 2 (in %)

0.00000 (207)

Efficiency of secondary/supplementary heating system, %

0.0000 (208)

[illegible]

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	1427.8930	1.5772	2252.1173 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1936.6408	1.5203	2944.3610 (278)
Space and water heating			5196.4783 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	289.6368	1.5338	444.2546 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1172.0978	1.4959	-1753.3719
PV Unit electricity exported	-1107.8582	0.4539	-502.9058
Total			-2256.2777 (283)
Total Primary energy kwh/year			3384.4551 (286)
Dwelling Primary energy Rate (DPER)			24.2600 (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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	399.5550 (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	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 40.0000 / (5) = 0.1001 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3501 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2976 (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	0.3794	0.3720	0.3646	0.3274	0.3199	0.2827	0.2827	0.2753	0.2976	0.3199	0.3348	0.3497 (22b)
Effective ac	0.5720	0.5692	0.5664	0.5536	0.5512	0.5400	0.5400	0.5379	0.5443	0.5512	0.5560	0.5611 (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
TER Opaque door			2.3500	1.0000	2.3500		(26)
TER Opening Type (Uw = 1.20)			29.5500	1.1450	33.8359		(27)
FR RL			1.1500	2.0221	2.3254		(27a)
GF			49.6600	0.1300	6.4558		(28a)
EW	125.1800	31.9000	93.2800	0.1800	16.7904		(29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361		(30)
Total net area of external elements Aum(A, m ²)			224.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0935		(33)
PW			129.9700	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 157.5734 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.4312 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	76.5247 (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	75.4180	75.0494	74.6882	72.9913	72.6738	71.1959	71.1959	70.9223	71.7652	72.6738	73.3161	73.9875 (38)
Heat transfer coeff	151.9427	151.5742	151.2129	149.5161	149.1986	147.7207	147.7207	147.4470	148.2899	149.1986	149.8408	150.5123 (39)

Average = Sum(39)m / 12 =													149.5145
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0893	1.0866	1.0840	1.0719	1.0696	1.0590	1.0590	1.0570	1.0631	1.0696	1.0742	1.0790	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Energy Calculation Summary													2.9161 (42)
Hot water usage for baths	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333	(42a)
Hot water usage for other uses	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577	(42b)
Average daily hot water use (litres/day)	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939	(42c)
												137.1222	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848	(44)
Energy content (annual)	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610	(45)
Distribution loss (46)m = 0.15 x (45)m	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442	(46)
Water storage loss:													
Store volume													145.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.3665 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.7379 (55)
Total storage loss	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(56)
If cylinder contains dedicated solar storage	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	282.3885	249.5545	264.5502	231.1113	223.0514	199.9108	196.4548	204.8163	207.6963	232.9024	249.2638	279.0981	(62)
WWHRS	-33.4244	-29.5608	-30.9544	-25.6314	-23.8876	-20.4408	-19.1600	-20.3747	-21.1488	-24.9321	-28.2451	-32.8054	(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	248.9641	219.9937	233.5958	205.4798	199.1638	179.4700	177.2948	184.4416	186.5475	207.9703	221.0187	246.2927	(64)
12Total per year (kWh/year)													2510.2327 (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	115.4632	102.4586	109.5320	97.7178	95.7337	87.3436	86.8903	89.6705	89.9323	99.0091	103.7535	114.3692	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.7883	172.4799	155.7883	160.9812	155.7883	160.9812	155.7883	155.7883	160.9812	155.7883	160.9812	155.7883	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050	(68)
Pumps, fans	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	(69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	(71)
Total internal gains	155.1925	152.4682	147.2204	135.7192	128.6743	121.3106	116.7880	120.5249	124.9060	133.0768	144.1021	153.7220	(72)
	689.5539	706.7259	676.7108	653.2101	619.2701	593.7023	570.3603	570.8925	588.5423	611.7124	649.6329	674.4569	(73)

6. Solar gains

[Jan]		Area	Solar flux		g	FF	Access	Gains					
		m2	Table 6a		Specific data	Specific data	factor	W					
			W/m2		or Table 6b	or Table 6c	Table 6d						
North		15.2500	10.6334		0.6300	0.7000	0.7700	49.5580	(74)				
East		0.9500	19.6403		0.6300	0.7000	0.7700	5.7022	(76)				
South		13.3500	46.7521		0.6300	0.7000	0.7700	190.7453	(78)				
North		1.1500	26.0000		0.6300	0.7000	1.0000	11.8673	(82)				
Solar gains	257.8728	442.9017	621.0513	803.5038	937.3563	948.7063	906.9851	803.2339	683.0340	493.0417	309.4067	220.4098	(83)

Total gains 947.4267 1149.6276 1297.7621 1456.7140 1556.6264 1542.4086 1477.3454 1374.1263 1271.5763 1104.7542 959.0396 894.8668 (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	40.1831	40.2808	40.3770	40.8353	40.9222	41.3316	41.3316	41.4083	41.1729	40.9222	40.7468	40.5650
alpha	3.6789	3.6854	3.6918	3.7224	3.7281	3.7554	3.7554	3.7606	3.7449	3.7281	3.7165	3.7043

util living area	9660	0.9356	0.8642	0.7410	0.5711	0.4284	0.4754	0.6964	0.8985	0.9690	0.9861	(86)
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MIT	19.2284	19.5321	19.9193	20.3903	20.7404	20.9283	20.9811	20.9722	20.8471	20.3801	19.7226	19.1793	(87)
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Th 2	20.0096	20.0118	20.0139	20.0239	20.0257	20.0345	20.0345	20.0361	20.0311	20.0257	20.0220	20.0180	(88)
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util rest of house

	0.9796	0.9591	0.9225	0.8371	0.6920	0.4980	0.3393	0.3832	0.6268	0.8719	0.9615	0.9832	(89)
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MIT 2	17.9446	18.3291	18.8144	19.3928	19.7911	19.9850	20.0258	20.0224	19.9134	19.3953	18.5809	17.8877	(90)
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Living area fraction									fLA = Living area / (4) =				0.2694	(91)
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MIT	18.2905	18.6532	19.1121	19.6616	20.0468	20.2391	20.2832	20.2783	20.1650	19.6606	18.8884	18.2357	(92)
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Temperature adjustment												0.0000	
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adjusted MIT	18.2905	18.6532	19.1121	19.6616	20.0468	20.2391	20.2832	20.2783	20.1650	19.6606	18.8884	18.2357	(93)
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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation	0.9710	0.9467	0.9077	0.8256	0.6932	0.5141	0.3628	0.4070	0.6371	0.8599	0.9500	0.9756	(94)
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Useful gains	919.9383	1088.3443	1177.9679	1202.5992	1079.0261	792.9773	535.9379	559.2919	810.1556	950.0299	911.0556	873.0746	(95)
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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)
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Heat loss rate W

	2125.7527	2084.6329	1907.1056	1609.0250	1245.3353	833.0103	544.0808	571.8368	899.3761	1351.8283	1766.3900	2112.5393	(97)
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Space heating kWh

	897.1259	669.5059	542.4784	292.6266	123.7341	0.0000	0.0000	0.0000	0.0000	298.9380	615.8408	922.1617	(98a)
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Space heating requirement - total per year (kWh/year)

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)
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Solar heating contribution - total per year (kWh/year)

Space heating kWh

	897.1259	669.5059	542.4784	292.6266	123.7341	0.0000	0.0000	0.0000	0.0000	298.9380	615.8408	922.1617	(98c)
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Space heating requirement after solar contribution - total per year (kWh/year)

Space heating per m2

										(98c) / (4) =		31.2740	(99)
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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
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Space heating requirement

	897.1259	669.5059	542.4784	292.6266	123.7341	0.0000	0.0000	0.0000	0.0000	298.9380	615.8408	922.1617	(98)
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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)
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Space heating fuel (main heating system)

	971.9674	725.3585	587.7339	317.0386	134.0564	0.0000	0.0000	0.0000	0.0000	323.8765	667.2164	999.0917	(211)
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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)
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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	0.0000	(213)
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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)
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Water heating

Water heating requirement

	248.9641	219.9937	233.5958	205.4798	199.1638	179.4700	177.2948	184.4416	186.5475	207.9703	221.0187	246.2927	(64)
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Efficiency of water heater

(217)m	86.6765	86.3903	85.8845	84.8522	83.0245	79.8000	79.8000	79.8000	79.8000	84.8728	86.2315	86.7380	(216)
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Fuel for water heating, kWh/month

	287.2337	254.6510	271.9884	242.1619	239.8857	224.8998	222.1739	231.1298	233.7688	245.0375	256.3086	283.9501	(219)
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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)
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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)
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Lighting

	32.3697	25.9682	23.3815	17.1303	13.2319	10.8106	12.0706	15.6898	20.3795	26.7390	30.2017	33.2694	(232)
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Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m	-47.3417	-67.2065	-97.2438	-110.0411	-119.1809	-111.3365	-109.8626	-103.4023	-92.1772	-77.0630	-52.1723	-40.8674	(233a)
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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)
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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)
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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)
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Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m	-25.3703	-53.5192	-106.6796	-160.7067	-213.0120	-214.3006	-211.8790	-179.2515	-131.1232	-76.8173	-33.9558	-20.0594	(233b)
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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												4726.3395	(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												2993.1892	(219)
Space cooling fuel												0.0000	(221)

Electricity for lighting (calculated in Appendix L) kWh/year													
Electricity for lighting (calculated in Appendix L)												86.0000	(231)
												261.2423	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2454.5699	(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												5612.2011	(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	4726.3395	0.2100	992.5313 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2993.1892	0.2100	628.5697 (264)
Space and water heating			1621.1010 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	261.2423	0.1443	37.7053 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	0.1345	-138.2176
PV Unit electricity exported	-1426.6745	0.1258	-179.4705
Total			-317.6881 (269)
Total CO2, kg/year			1353.0475 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7000 (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	4726.3395	1.1300	5340.7636 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2993.1892	1.1300	3382.3038 (278)
Space and water heating			8723.0675 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	261.2423	1.5338	400.7021 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	1.4970	-1538.7175
PV Unit electricity exported	-1426.6745	0.4618	-658.7722
Total			-2197.4897 (283)
Total Primary energy kWh/year			7056.3807 (286)
Target Primary Energy Rate (TPER)			50.5900 (287)

Property Reference	Unit 3		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green		Prop Type Ref	Fortis Green	
Property					
SAP Rating	90 B	DER	1.66	TER	9.41
Environmental	98 A	% DER < TER	82.36		
CO ₂ Emissions (t/year)	0.17	DFEE	30.75	TFEE	35.45
Compliance Check	See BREL	% DFEE < TFEE	13.25		
% DPER < TPER	52.11	DPER	23.47	TPER	49.01
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 399.5550 (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	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.1251 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3251 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2764 (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	0.3524	0.3455	0.3386	0.3040	0.2971	0.2625	0.2625	0.2556	0.2764	0.2971	0.3109	0.3247 (22b)
Effective ac	0.5621	0.5597	0.5573	0.5462	0.5441	0.5345	0.5345	0.5327	0.5382	0.5441	0.5483	0.5527 (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
DOOR			2.3500	1.0000	2.3500		(26)
G (Uw = 1.00)			29.5500	0.9615	28.4135		(27)
FR RL			1.1500	0.9615	1.1058		(27a)
GF			49.6600	0.1200	5.9592	110.0000	5462.6000 (28a)
EW	104.7000	31.9000	72.8000	0.1500	10.9200	60.0000	4368.0000 (29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361	9.0000	436.5900 (30)

Heat capacity $C_m = \text{Sum}(A \times k)$	(28)...(30) + (32) + (32a)...(32e) =	21672.7100	(34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m ² K		155.3711	(35)
Thermal bridges (User defined value 0.030 * total exposed area)		6.1206	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	60.2051	(37)

4. Water heating energy requirements (kwh/year)												
Assumed occupancy												2.9161 (42)
Hot water usage for mixer showers	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333 (42a)
Hot water usage for baths	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577 (42b)
Hot water usage for other uses	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939 (42c)
Average daily hot water use (litres/day)												137.1222 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)
Energy content	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)
Energy content (annual)											Total = Sum(45)m =	2277.5713
Distribution loss (46)m = 0.15 x (45)m	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)
Water storage loss:												
Store volume												145.0000 (47)
a) If manufacturer declared loss factor is known (kwh/day):												1.1800 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6372 (55)
Total storage loss	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532 (56)
If cylinder contains dedicated solar storage	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532 (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	279.2670	246.7351	261.4287	228.0905	219.9299	196.8900	193.3333	201.6948	204.6755	229.7809	246.2430	275.9766 (62)
WWHRS	-65.1476	-57.6171	-60.3333	-49.9584	-46.5594	-39.8412	-37.3448	-39.7124	-41.2212	-48.5953	-55.0526	-63.9412 (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	214.1194	189.1180	201.0954	178.1321	173.3705	157.0488	155.9885	161.9824	163.4543	181.1856	191.1904	212.0354 (64)
Total per year (kwh/year) = Sum(64)m =									2178.7209 (64)			
12Total per year (kWh/year)												2179 (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	112.9661	100.2031	107.0348	95.3012	93.2365	84.9270	84.3931	87.1733	87.5157	96.5119	101.3369	111.8720 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)
Lighting gains	(calculated in Appendix L, equation L9 or L9a), also see Table 5											
	157.4062	174.2711	157.4062	162.6531	157.4062	162.6531	157.4062	157.4062	162.6531	157.4062	162.6531	157.4062 (67)
Appliances gains	(calculated in Appendix L, equation L13 or L13a), also see Table 5											
	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)
Cooking gains	(calculated in Appendix L, equation L15 or L15a), also see Table 5											
	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)
Water heating gains (Table 5)												
	151.8361	149.1118	143.8640	132.3628	125.3179	117.9542	113.4316	117.1684	121.5496	129.7204	140.7457	150.3656 (72)
Total internal gains												
	684.8154	702.1607	671.9722	648.5255	614.5315	592.0177	568.6218	569.1539	586.8577	606.9739	644.9483	669.7184 (73)

Solar gains	233.3135	400.7206	561.9036	726.9797	848.0843	858.3533	820.6056	726.7354	617.9831	446.0854	279.9394	199.4184 (83)
Total gains	918.1288	1102.8813	1233.8758	1375.5052	1462.6158	1450.3711	1389.2274	1295.8893	1204.8408	1053.0593	924.8877	869.1368 (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, $u_{l,m}$ (see Table 9a)

21.0000 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	44.8207	44.9270	45.0317	45.5301	45.6246	46.0696	46.0696	46.1529	45.8971	45.6246	45.4338	45.2362
alpha	3.9880	3.9951	4.0021	4.0353	4.0416	4.0713	4.0713	4.0769	4.0598	4.0416	4.0289	4.0157
util living area	0.9830	0.9653	0.9334	0.8569	0.7259	0.5490	0.4071	0.4520	0.6747	0.8917	0.9680	0.9861 (86)
Living	19.7637	19.9774	20.2419	20.5578	20.7799	20.8892	20.9160	20.9118	20.8438	20.5473	20.1021	19.7283
Non living	18.6564	18.9274	19.2589	19.6480	19.8995	20.0144	20.0351	20.0342	19.9733	19.6453	19.0947	18.6172
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1143	20.1163	20.1181	20.1270	20.1286	20.1363	20.1363	20.1377	20.1334	20.1286	20.1253	20.1218 (88)
util rest of house	0.9797	0.9587	0.9207	0.8307	0.6800	0.4836	0.3301	0.3718	0.6104	0.8657	0.9607	0.9833 (89)
MIT 2	20.1143	20.1163	20.1181	20.1270	20.1286	20.1363	20.1363	20.1377	20.1334	20.1286	20.1253	20.1218 (90)
Living area fraction									fLA = Living area / (4)			0.2694 (91)
MIT	20.3530	20.3544	20.3557	20.3622	20.3634	20.3690	20.3690	20.3700	20.3668	20.3634	20.3609	20.3584 (92)
Temperature adjustment									0.0000			0.0000
adjusted MIT	20.3530	20.3544	20.3557	20.3622	20.3634	20.3690	20.3690	20.3700	20.3668	20.3634	20.3609	20.3584 (93)

8. Space heating requirement

[illegible]

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)

1.00000 (202)

Efficiency of main space heating system 1 (in %)

321.6823 (206)

Efficiency of main space heating system 2 (in %)

0.00000 (207)

Efficiency of secondary/supplementary heating system, %

0.0000 (208)

[illegible]

Water heating													
Water heating requirement	214.1194	189.1180	201.0954	178.1321	173.3705	157.0488	155.9885	161.9824	163.4543	181.1856	191.1904	212.0354 (64)	
Efficiency of water heater	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000 (216)	
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000 (217)	
Fuel for water heating, kWh/month	190.3283	168.1049	178.7515	158.3397	154.1071	139.5990	138.6564	143.9843	145.2927	161.0539	169.9470	188.4759 (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	35.8880	28.7907	25.9228	18.9922	14.6701	11.9856	13.3826	17.3952	22.5946	29.6453	33.4843	36.8854 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
түбәсі менен түбәсі тү													

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	1356.2453	0.1560	211.6059 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1936.6408	0.1407	272.5356 (264)
Space and water heating			484.1415 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	289.6368	0.1443	41.8035 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1170.0925	0.1342	-156.9884
PV Unit electricity exported	-1109.8635	0.1238	-137.3605
Total			-294.3490 (269)
Total CO2, kg/year			231.5961 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.6600 (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	1356.2453	1.5776	2139.6247 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1936.6408	1.5203	2944.3610 (278)
Space and water heating			5083.9857 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	289.6368	1.5338	444.2546 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1170.0925	1.4958	-1750.2797
PV Unit electricity exported	-1109.8635	0.4542	-504.0916
Total			-2254.3713 (283)
Total Primary energy kWh/year			3273.8689 (286)
Dwelling Primary energy Rate (DPER)			23.4700 (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)
Ground floor	49.6600 (1b)	x 2.7000 (2b)	= 134.0820 (1b) -
First floor	49.6600 (1c)	x 3.0000 (2c)	= 148.9800 (1c) -
Second floor	40.1700 (1d)	x 2.9000 (2d)	= 116.4930 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.4900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	399.5550 (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	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 40.0000 / (5) = 0.1001 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3501 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2976 (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	0.3794	0.3720	0.3646	0.3274	0.3199	0.2827	0.2827	0.2753	0.2976	0.3199	0.3348	0.3497 (22b)
Effective ac	0.5720	0.5692	0.5664	0.5536	0.5512	0.5400	0.5400	0.5379	0.5443	0.5512	0.5560	0.5611 (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
TER Opaque door			2.3500	1.0000	2.3500		(26)
TER Opening Type (Uw = 1.20)			29.5500	1.1450	33.8359		(27)
FR RL			1.1500	2.0221	2.3254		(27a)
GF			49.6600	0.1300	6.4558		(28a)
EW	104.7000	31.9000	72.8000	0.1800	13.1040		(29a)
FR	49.6600	1.1500	48.5100	0.1100	5.3361		(30)
Total net area of external elements Aum(A, m ²)			204.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.4071		(33)
PW			150.4500	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 155.3711 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820

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

Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	72.8383 (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	75.4180	75.0494	74.6882	72.9913	72.6738	71.1959	71.1959	70.9223	71.7652	72.6738	73.3161	73.9875 (38)
Heat transfer coeff	148.2563	147.8878	147.5265	145.8297	145.5122	144.0343	144.0343	143.7606	144.6035	145.5122	146.1544	146.8259 (39)

Average = Sum(39)m / 12 =													145.8281
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0628	1.0602	1.0576	1.0454	1.0432	1.0326	1.0326	1.0306	1.0367	1.0432	1.0478	1.0526 (40)	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.0454	31

4. Water heating energy requirements (kWh/year)

Energy calculation Example													2.9161 (42)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for baths	73.1134	72.0146	70.4135	67.3501	65.0894	62.5683	61.1353	62.7242	64.4661	67.1730	70.3022	72.8333 (42a)	
Hot water usage for other uses	31.5644	31.0956	30.4355	29.2183	28.3069	27.2963	26.7504	27.4059	28.1197	29.2010	30.4433	31.4577 (42b)	
Average daily hot water use (litres/day)	44.4939	42.8759	41.2579	39.6400	38.0220	36.4041	36.4041	38.0220	39.6400	41.2579	42.8759	44.4939 (42c)	137.1222 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)	149.1716	145.9861	142.1069	136.2084	131.4183	126.2686	124.2897	128.1522	132.2257	137.6320	143.6214	148.7848 (44)	
Distribution loss (46)m = 0.15 x (45)m	236.2514	207.8823	218.4131	186.4625	176.9143	155.2620	150.3177	158.6792	163.0475	186.7653	204.6150	232.9610 (45)	227.5713
Water storage loss:	35.4377	31.1823	32.7620	27.9694	26.5371	23.2893	22.5477	23.8019	24.4571	28.0148	30.6922	34.9442 (46)	
Store volume												145.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.3665 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												0.7379 (55)	
Total storage loss	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747 (56)	
If cylinder contains dedicated solar storage	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747 (57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month	282.3885	249.5545	264.5502	231.1113	223.0514	199.9108	196.4548	204.8163	207.6963	232.9024	249.2638	279.0981 (62)	
WWHRS	-33.4244	-29.5608	-30.9544	-25.6314	-23.8876	-20.4408	-19.1600	-20.3747	-21.1488	-24.9321	-28.2451	-32.8054 (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	248.9641	219.9937	233.5958	205.4798	199.1638	179.4700	177.2948	184.4416	186.5475	207.9703	221.0187	246.2927 (64)	
12Total per year (kWh/year)												2510.2327 (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	115.4632	102.4586	109.5320	97.7178	95.7337	87.3436	86.8903	89.6705	89.9323	99.0091	103.7535	114.3692 (65)	

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054	145.8054 (66)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.7883	172.4799	155.7883	160.9812	155.7883	160.9812	155.7883	155.7883	160.9812	155.7883	160.9812	155.7883 (67)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	308.8314	312.0361	303.9604	286.7681	265.0659	244.6688	231.0424	227.8377	235.9134	253.1057	274.8080	295.2050 (68)	
Pumps, fans	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805	37.5805 (69)	
Losses e.g. evaporation (negative values) (Table 5)	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)	
Water heating gains (Table 5)	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443	-116.6443 (71)	
Total internal gains	155.1925	152.4682	147.2204	135.7192	128.6743	121.3106	116.7880	120.5249	124.9060	133.0768	144.1021	153.7220 (72)	
	689.5539	706.7259	676.7108	653.2101	619.2701	593.7023	570.3603	570.8925	588.5423	611.7124	649.6329	674.4569 (73)	

6. Solar gains

[Jan]		Area	Solar flux		g	FF	Access	Gains				
		m2	Table 6a		Specific data	Specific data	factor	W				
			W/m2		or Table 6b	or Table 6c	Table 6d					
North		15.2500	10.6334		0.6300	0.7000	0.7700	49.5580 (74)				
East		0.9500	19.6403		0.6300	0.7000	0.7700	5.7022 (76)				
South		13.3500	46.7521		0.6300	0.7000	0.7700	190.7453 (78)				
North		1.1500	26.0000		0.6300	0.7000	1.0000	11.8673 (82)				
Solar gains	257.8728	442.9017	621.0513	803.5038	937.3563	948.7063	906.9851	803.2339	683.0340	493.0417	309.4067	220.4098 (83)

Total gains 947.4267 1149.6276 1297.7621 1456.7140 1556.6264 1542.4086 1477.3454 1374.1263 1271.5763 1104.7542 959.0396 894.8668 (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	40.6067	40.7079	40.8076	41.2824	41.3725	41.7970	41.7970	41.8765	41.6324	41.3725	41.1907	41.0023
alpha	3.7071	3.7139	3.7205	3.7522	3.7582	3.7865	3.7865	3.7918	3.7755	3.7582	3.7460	3.7335

util living area

2082.5770 2042.5321 1868.7074 1576.0125 1219.1749 815.2051 532.9621 560.0711 880.6290 1324.5537 1730.5260 2069.1040 (97)

MIT 19.2661 19.5712 19.9559 20.4196 20.7577 20.9347 20.9831 20.9750 20.8583 20.4063 19.7565 19.2168 (87)

Th 2 20.0313 20.0335 20.0356 20.0456 20.0475 20.0563 20.0563 20.0579 20.0529 20.0475 20.0437 20.0397 (88)

util rest of house

0.9786 0.9572 0.9189 0.8305 0.6829 0.4893 0.3333 0.3764 0.6176 0.8665 0.9597 0.9824 (89)

MIT 2 18.0082 18.3943 18.8760 19.4445 19.8280 20.0109 20.0484 20.0454 19.9435 19.4432 18.6395 17.9513 (90)

Living area fraction fLA = Living area / (4) = 0.2694 (91)

MIT 18.3471 18.7114 19.1669 19.7072 20.0785 20.2598 20.3002 20.2959 20.1900 19.7027 18.9404 18.2922 (92)

Temperature adjustment 0.0000

adjusted MIT 18.3471 18.7114 19.1669 19.7072 20.0785 20.2598 20.3002 20.2959 20.1900 19.7027 18.9404 18.2922 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9699	0.9446	0.9042	0.8195	0.6846	0.5051	0.3559	0.3994	0.6282	0.8549	0.9480	0.9747 (94)
Useful gains	918.8671	1085.9341	1173.3948	1193.7285	1065.6741	779.1346	525.7330	548.8811	798.8408	944.4530	909.1594	872.2230 (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 2082.5770 2042.5321 1868.7074 1576.0125 1219.1749 815.2051 532.9621 560.0711 880.6290 1324.5537 1730.5260 2069.1040 (97)

Space heating kWh 865.8001 642.8339 517.3126 275.2445 114.2046 0.0000 0.0000 0.0000 0.0000 282.7949 591.3839 890.4795 (98a)

Space heating requirement - total per year (kWh/year) 4180.0541

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 865.8001 642.8339 517.3126 275.2445 114.2046 0.0000 0.0000 0.0000 0.0000 282.7949 591.3839 890.4795 (98c)

Space heating requirement after solar contribution - total per year (kWh/year) 4180.0541

Space heating per m2 (98c) / (4) = 29.9667 (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	865.8001	642.8339	517.3126	275.2445	114.2046	0.0000	0.0000	0.0000	0.0000	282.7949	591.3839	890.4795 (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) 938.0283 696.4614 560.4687 298.2064 123.7320 0.0000 0.0000 0.0000 0.0000 306.3867 640.7193 964.7665 (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 248.9641 219.9937 233.5958 205.4798 199.1638 179.4700 177.2948 184.4416 186.5475 207.9703 221.0187 246.2927 (64)

Efficiency of water heater (217)m 86.6183 86.3179 85.7901 84.7161 82.8606 79.8000 79.8000 79.8000 79.8000 84.7495 86.1565 86.6819 (217)

Fuel for water heating, kWh/month 287.4268 254.8646 272.2876 242.5512 240.3601 224.8998 222.1739 231.1298 233.7688 245.3940 256.5318 284.1339 (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 32.3697 25.9682 23.3815 17.1303 13.2319 10.8106 12.0706 15.6898 20.3795 26.7390 30.2017 33.2694 (232)

Electricity generated by PVs (Appendix M) (negative quantity) (233a)m -47.3417 -67.2065 -97.2438 -110.0411 -119.1809 -111.3365 -109.8626 -103.4023 -92.1772 -77.0630 -52.1723 -40.8674 (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 -25.3703 -53.5192 -106.6796 -160.7067 -213.0120 -214.3006 -211.8790 -179.2515 -131.1232 -76.8173 -33.9558 -20.0594 (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												4528.7693	(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												2995.5223	(219)
Space cooling fuel												0.0000	(221)

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2454.5699	(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												5416.9639	(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	4528.7693	0.2100	951.0416 (261)
Total CO2 associated with community systems			0.0000 (273)
Water heating (other fuel)	2995.5223	0.2100	629.0597 (264)
Space and water heating			1580.1012 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	261.2423	0.1443	37.7053 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	0.1345	-138.2176
PV Unit electricity exported	-1426.6745	0.1258	-179.4705
Total			-317.6881 (269)
Total CO2, kg/year			1312.0477 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.4100 (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	4528.7693	1.1300	5117.5093 (275)
Total CO2 associated with community systems			0.0000 (273)
Water heating (other fuel)	2995.5223	1.1300	3384.9402 (278)
Space and water heating			8502.4495 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	261.2423	1.5338	400.7021 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1027.8954	1.4970	-1538.7175
PV Unit electricity exported	-1426.6745	0.4618	-658.7722
Total			-2197.4897 (283)
Total Primary energy kWh/year			6835.7627 (286)
Target Primary Energy Rate (TPER)			49.0100 (287)

Property Reference	Unit 7		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	84 B	DER	3.57	TER	14.74
Environmental	98 A	% DER < TER	75.78		
CO ₂ Emissions (t/year)	0.11	DFEE	30.19	TFEE	41.35
Compliance Check	See BREL	% DFEE < TFEE	26.99		
% DPER < TPER	29.10	DPER	55.00	TPER	77.58
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

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)
Ground floor	49.3200 (1b)	x 2.8000 (2b)	= 138.0960 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.3200		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 138.0960 (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) =	Air changes per hour
Pressure test		20.0000 / (5) = 0.1448 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		4.0000 (17)
Number of sides sheltered		0.3448 (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) =	0.3190 (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	0.4067	0.3987	0.3907	0.3509	0.3429	0.3030	0.3030	0.2950	0.3190	0.3429	0.3588	0.3748 (22b)
Effective ac	0.5827	0.5795	0.5763	0.5616	0.5588	0.5459	0.5459	0.5435	0.5509	0.5588	0.5644	0.5702 (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
G (Uw = 1.00)			12.8900	0.9615	12.3942		(27)
EF			5.3300	0.1200	0.6396	110.0000	586.3000 (28b)
EW	57.9300	12.8900	45.0400	0.1500	6.7560	60.0000	2702.4000 (29a)
SW	18.5900		18.5900	0.1500	2.7885	60.0000	1115.4000 (29a)
FR	11.3900		11.3900	0.1100	1.2529	9.0000	102.5100 (30)
Total net area of external elements Aum(A, m ²)			93.2400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.8312		(33)
PW			14.2500	0.0000	0.0000	45.0000	641.2500 (32)

PF	43.9900	40.0000	1759.6000 (32d)
PC	37.9100	30.0000	1137.3000 (32b)
IW	83.1600	9.0000	748.4400 (32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	8793.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		178.2887 (35)
Thermal bridges (User defined value 0.030 * total exposed area)		2.7972 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	26.6284 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 26.5544	Feb 26.4080	Mar 26.2646	Apr 25.5909	May 25.4648	Jun 24.8780	Jul 24.8780	Aug 24.7693	Sep 25.1040	Oct 25.4648	Nov 25.7198	Dec 25.9864	(38)

ΕΠΙΣΤΑΣΕΩΣ ΕΠΙΧΕΙΡΗΣΕΩΣ



Average = Sum(39)m / 12 =	3365	52.8930	52.2193	52.0932	51.5064	51.5064	51.3978	51.7325	52.0932	52.3482	52.6148 (39)	52.2187
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HLP	Jan 1.0783	Feb 1.0754	Mar 1.0724	Apr 1.0588	May 1.0562	Jun 1.0443	Jul 1.0443	Aug 1.0421	Sep 1.0489	Oct 1.0562	Nov 1.0614	Dec 1.0668 (40)
HLP (average)												1.0588
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6701 (42)
Hot water usage for mixer showers	52.2216	51.4368	50.2932	48.1051	46.4904	44.6897	43.6661	44.8011	46.0452	47.9786	50.2136	52.0215 (42a)
Hot water usage for baths	22.5802	22.2449	21.7726	20.9019	20.2499	19.5270	19.1364	19.6054	20.1160	20.8896	21.7782	22.5039 (42b)
Hot water usage for other uses	31.7335	30.5795	29.4256	28.2716	27.1177	25.9638	25.9638	27.1177	28.2716	29.4256	30.5795	31.7335 (42c)
Average daily hot water use (litres/day)												97.9306 (43)

Daily hot water use	Jan 106.5352	Feb 104.2612	Mar 101.4914	Apr 97.2787	May 93.8580	Jun 90.1804	Jul 88.7663	Aug 91.5241	Sep 94.4328	Oct 98.2937	Nov 102.5714	Dec 106.2588 (44)
Energy conte	168.7258	148.4665	155.9885	133.1696	126.3509	110.8873	107.3552	113.3260	116.4451	133.3837	146.1318	166.3756 (45)
Energy content (annual)										Total = Sum(45)m =		1626.6059
Distribution loss (46)m = 0.15 x (45)m	25.3089	22.2700	23.3983	19.9754	18.9526	16.6331	16.1033	16.9989	17.4668	20.0076	21.9198	24.9563 (46)
Water storage loss:												145.0000 (47)
Store volume												1.1800 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.6372 (55)
Enter (49) or (54) in (55)												
Total storage loss	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532 (56)
If cylinder contains dedicated solar storage	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532 (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	211.7414	187.3193	199.0041	174.7976	169.3665	152.5153	150.3708	156.3416	158.0731	176.3993	187.7598	209.3912 (62)
WtHRS	-46.5320	-41.1533	-43.0933	-35.6830	-33.2552	-28.4567	-26.6737	-28.3648	-29.4424	-34.7094	-39.3215	-45.6703 (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	165.2094	146.1660	155.9108	139.1147	136.1113	124.0585	123.6971	127.9768	128.6306	141.6899	148.4382	163.7210 (64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				1700.7243 (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	90.5138	80.4474	86.2786	77.5813	76.4242	70.1724	70.1081	72.0934	72.0204	78.7626	81.8912	89.7324 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan 83.5050	Feb 83.5050	Mar 83.5050	Apr 83.5050	May 83.5050	Jun 83.5050	Jul 83.5050	Aug 83.5050	Sep 83.5050	Oct 83.5050	Nov 83.5050	Dec 83.5050 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	73.3719	81.2331	73.3719	75.8176	73.3719	75.8176	73.3719	73.3719	75.8176	73.3719	75.8176	73.3719 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.4679	146.9774	143.1735	135.0755	124.8532	115.2456	108.8272	107.3177	111.1216	119.2196	129.4419	139.0495 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040 (71)
Water heating gains (Table 5)	121.6583	119.7133	115.9659	107.7518	102.7206	97.4617	94.2313	96.8997	100.0283	105.8636	113.7378	120.6080 (72)
Total internal gains	388.5496	395.9754	380.5628	366.6964	348.9971	336.5764	324.4818	325.6407	335.0190	346.5066	367.0488	381.0809 (73)

Solar gains	108.0841	190.5213	273.6410	354.1220	405.5802	405.2903	389.7380	351.7950	302.0317	214.4551	130.7267	91.6242 (83)
Ab Casajon Burrol		4967	654.2038	720.8184	754.5774	741.8666	714.2198	677.4358	637.0506	560.9617	497.7755	472.7051 (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, $ni_{1,m}$ (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	45.9276	46.0543	46.1792	46.7750	46.8881	47.4223	47.4223	47.5226	47.2151	46.8881	46.6597	46.4233
alpha	4.0618	4.0793	4.0786	4.1183	4.1259	4.1615	4.1615	4.1682	4.1477	4.1259	4.1106	4.0949
util living area												
	0.9561	0.9202	0.8613	0.7484	0.6009	0.4358	0.3155	0.3462	0.5368	0.7907	0.9225	0.9626 (86)
Living	20.0377	20.2500	20.4873	20.7259	20.8581	20.9120	20.9229	20.9217	20.8932	20.7133	20.3469	20.0023
Non living	18.9152	19.1777	19.4644	19.7461	19.8852	19.9428	19.9502	19.9515	19.9252	19.7423	19.3111	18.8789
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.0186	20.0210	20.0234	20.0346	20.0367	20.0466	20.0466	20.0484	20.0428	20.0367	20.0325	20.0200 (88)
util rest of house												
	0.9473	0.9055	0.8372	0.7101	0.5490	0.3740	0.2480	0.2759	0.4701	0.7485	0.9056	0.9549 (89)
MIT 2	20.0186	20.0210	20.0234	20.0346	20.0367	20.0466	20.0466	20.0484	20.0428	20.0367	20.0325	20.0200 (90)
Living area fraction									fLA =	Living area /	(4) =	0.5146 (91)
MIT	20.5236	20.5248	20.5260	20.5314	20.5324	20.5372	20.5372	20.5381	20.5354	20.5324	20.5304	20.5282 (92)
Temperature adjustment												0.0000
adjusted MIT	20.5236	20.5248	20.5260	20.5314	20.5324	20.5372	20.5372	20.5381	20.5354	20.5324	20.5304	20.5282 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9521	0.9134	0.8501	0.7304	0.5762	0.4061	0.2829	0.3122	0.5051	0.7711	0.9148	0.9591 (94)
Useful gains	472.8207	535.7226	556.1386	526.4874	434.7809	301.2594	202.0197	211.5184	321.7506	432.5561	455.3577	453.3702 (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												
	862.8172	828.6839	741.8752	607.3840	460.1100	305.8038	202.7910	212.6881	332.9170	517.4125	703.0560	859.1058 (97)
Space heating kWh					18.8448	0.0000	0.0000	0.0000	0.0000	63.1332	178.3428	301.8673 (98a)
Space heating requirement - total per year (kWh/year)	290.1574	196.8700	138.1880	58.2455								1245.6490
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												
	290.1574	196.8700	138.1880	58.2455	18.8448	0.0000	0.0000	0.0000	0.0000	63.1332	178.3428	301.8673 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1245.6490
Space heating per m2												
										(98c) / (4) =		25.2565 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)

Fraction of space heat from main system(s)

Efficiency of main space heating system 1 (in %)

Efficiency of main space heating system 2 (in %)

Efficiency of secondary/supplementary heating system, %

[illegible]

Water heating

Water heating requirement

[illegible]

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

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.3200 (1b)	x 2.8000 (2b)	= 138.0960 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.3200		(4)
		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 138.0960 (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) =	Air changes per hour 20.0000 / (5) = 0.1448 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3948 (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) = 0.3652 (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	0.4656	0.4565	0.4474	0.4017	0.3926	0.3470	0.3470	0.3378	0.3652	0.3926	0.4109	0.4291 (22b)
Effective ac	0.6084	0.6042	0.6001	0.5807	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5844	0.5921 (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
TER Opening Type (Uw = 1.20)			12.3300	1.1450	14.1183		(27)
EF			5.3300	0.1300	0.6929		(28b)
EW	57.9300	12.3300	45.6000	0.1800	8.2080		(29a)
SW	18.5900		18.5900	0.1800	3.3462		(29a)
FR	11.3900		11.3900	0.1100	1.2529		(30)
Total net area of external elements Aum(A, m ²)			93.2400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.6183		(33)
PW			14.2500	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							185.9753 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				9.0500	0.0500	0.4525	
E3 Sill				9.0500	0.0500	0.4525	
E4 Jamb				19.0600	0.0500	0.9530	
E5 Ground floor (normal)				27.8800	0.1600	4.4608	
E14 Flat roof				27.8800	0.0800	2.2304	
E16 Corner (normal)				9.8000	0.0900	0.8820	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4312 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	37.0495 (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	27.7265	27.5346	27.3466	26.4633	26.2980	25.5287	25.5287	25.3863	25.8251	26.2980	26.6323	26.9819 (38)
Average = Sum(39)m / 12 =	64.7760	64.5841	64.3961	63.5128	63.3476	62.5783	62.5783	62.4358	62.8746	63.3476	63.6819	64.0314 (39)
												63.5120
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3134	1.3095	1.3057	1.2878	1.2844	1.2688	1.2688	1.2659	1.2748	1.2844	1.2912	1.2983 (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												1.6701 (42)
Hot water usage	for mixer showers											
	52.2216	51.4368	50.2932	48.1051	46.4904	44.6897	43.6661	44.8011	46.0452	47.9786	50.2136	52.0215 (42a)
Hot water usage	for baths											
	22.5802	22.2449	21.7726	20.9019	20.2499	19.5270	19.1364	19.6054	20.1160	20.8896	21.7782	22.5039 (42b)
Hot water usage	for other uses											
	31.7335	30.5795	29.4256	28.2716	27.1177	25.9638	25.9638	27.1177	28.2716	29.4256	30.5795	31.7335 (42c)
Average daily hot water use (litres/day)												97.9306 (43)

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

Daily hot water use												
Energy content (annual)	106.5352	104.2612	101.4914	97.2787	93.8580	90.1804	88.7663	91.5241	94.4328	98.2937	102.5714	106.2588 (44)
Distribution loss (46)m = 0.15 x (45)m	168.7258	148.4665	155.9885	133.1696	126.3509	110.8873	107.3552	113.3260	116.4451	133.3837	146.1318	166.3756 (45)
										Total =	Sum(45)m =	1626.6059
Water storage loss:	25.3089	22.2700	23.3983	19.9754	18.9526	16.6331	16.1033	16.9989	17.4668	20.0076	21.9198	24.9563 (46)
Store volume												145.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3665 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7379 (55)
Total storage loss	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747 (56)
If cylinder contains dedicated solar storage	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747 (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	214.8629	190.1387	202.1256	177.8184	172.4880	155.5361	153.4923	159.4631	161.0938	179.5208	190.7805	212.5127 (62)
WWHRS	-23.8735	-21.1139	-22.1093	-18.3074	-17.0618	-14.5999	-13.6851	-14.5527	-15.1056	-17.8079	-20.1742	-23.4314 (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	190.9893	169.0248	180.0163	159.5110	155.4262	140.9362	139.8072	144.9104	145.9882	161.7129	170.6064	189.0813 (64)
										Total per year (kWh/year) =	Sum(64)m =	1948.0101 (64)
12Total per year (kWh/year)												1948 (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 =
Heat gains from water heating, kWh/month	93.0110	82.7029	88.7758	79.9979	78.9213	72.5890	72.6053	74.5906	74.4370	81.2597	84.3078	92.2296 (65)

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

Metabolic gains (Table 5), Watts	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050	83.5050 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	73.3719	81.2331	73.3719	75.8176	73.3719	75.8176	73.3719	73.3719	75.8176	73.3719	75.8176	73.3719 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.4679	146.9774	143.1735	135.0755	124.8532	115.2456	108.8272	107.3177	111.1216	119.2196	129.4419	139.0495 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505	31.3505 (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)	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040	-66.8040 (71)
Water heating gains (Table 5)	125.0148	123.0697	119.3223	111.1082	106.0771	100.8181	97.5877	100.2561	103.3847	109.2201	117.0942	123.9645 (72)
Total internal gains	394.9060	402.3318	386.9192	373.0528	355.3536	339.9328	327.8382	328.9972	338.3754	352.8630	373.4052	387.4373 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
East				7.4700	19.6403	0.6300	0.7000	0.7700	44.8373 (76)			
South				4.8600	46.7521	0.6300	0.7000	0.7700	69.4399 (78)			
Solar gains	114.2772	201.4359	289.3130	374.3978	428.7983	428.4902	412.0483	371.9359	319.3277	226.7395	138.2168	96.8745 (83)
Total gains	509.1832	603.7677	676.2323	747.4506	784.1518	768.4230	739.8865	700.9331	657.7030	579.6026	511.6220	484.3118 (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	39.3334	39.4503	39.5655	40.1157	40.2204	40.7148	40.7148	40.8077	40.5229	40.2204	40.0092	39.7908	
alpha	3.6222	3.6300	3.6377	3.6744	3.6814	3.7143	3.7143	3.7205	3.7015	3.6814	3.6673	3.6527	
util living area	0.9644	0.9366	0.8901	0.7968	0.6629	0.4979	0.3661	0.4009	0.6036	0.8336	0.9387	0.9695 (86)	
MIT	19.4481	19.7528	20.1268	20.5432	20.8167	20.9526	20.9882	20.9835	20.9023	20.5356	19.9310	19.4020 (87)	
Th 2	19.8304	19.8334	19.8364	19.8504	19.8531	19.8653	19.8653	19.8676	19.8606	19.8531	19.8477	19.8422 (88)	
util rest of house	0.9562	0.9229	0.8670	0.7569	0.6023	0.4180	0.2745	0.3062	0.5218	0.7908	0.9231	0.9624 (89)	
MIT 2	18.0803	18.4593	18.9161	19.4105	19.7033	19.8372	19.8611	19.8611	19.7959	19.4194	18.6975	18.0309 (90)	
Living area fraction									fLA = Living area / (4) =				0.5146 (91)
MIT	18.7842	19.1249	19.5391	19.9934	20.2763	20.4112	20.4411	20.4387	20.3653	19.9938	19.3322	18.7365 (92)	
Temperature adjustment												0.0000	
Final 20% Circulation Factor		0.1249	19.5391	19.9934	20.2763	20.4112	20.4411	20.4387	20.3653	19.9938	19.3322	18.7365 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9469	0.9128	0.8602	0.7623	0.6257	0.4573	0.3215	0.3546	0.5594	0.7966	0.9145	0.9537 (94)
Useful gains	482.1337	551.1344	581.7038	569.7537	490.6120	351.3957	237.8652	248.5317	367.8951	461.7235	467.8950	461.8733 (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												
Space heating	938.2254	918.7041	839.6666	704.5718	543.2850	363.6538	240.3702	252.1592	393.9251	595.0744	778.9721	930.7910 (97)
Space heating kWh	339.3323	247.0068	191.9243	97.0690	39.1887	0.0000	0.0000	0.0000	0.0000	99.2131	223.9755	348.8748 (98a)
Space heating requirement - total per year (kWh/year)												1586.5845
Solar heating kWh												
Solar heating contribution - total per year (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 (98b)
Space heating kWh												
Space heating requirement after solar contribution - total per year (kWh/year)	339.3323	247.0068	191.9243	97.0690	39.1887	0.0000	0.0000	0.0000	0.0000	99.2131	223.9755	348.8748 (98c)
Space heating per m2												1586.5845
										(98c) / (4) =		32.1692 (99)

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

[illegible]

Water heating fuel used	2353.7289 (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)	123.0377 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1218.8823 (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	
	-0.0000 (236)
	0.0000 (237)
Total delivered energy for all uses	3062.8274 (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	1718.9431	0.2100	360.9780 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2353.7289	0.2100	494.2831 (264)
Space and water heating			855.2611 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	123.0377	0.1443	17.7581 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-513.6182	0.1344	-69.0283
PV Unit electricity exported	-705.2640	0.1259	-88.7583
Total			-157.7866 (269)
Total CO2, kg/year			727.1620 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.7400 (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	1718.9431	1.1300	1942.4057 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2353.7289	1.1300	2659.7136 (278)
Space and water heating			4602.1193 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	123.0377	1.5338	188.7193 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-513.6182	1.4967	-768.7293
PV Unit electricity exported	-705.2640	0.4620	-325.8034
Total			-1094.5327 (283)
Total Primary energy kWh/year			3826.4067 (286)
Target Primary Energy Rate (TPER)			77.5800 (287)

Property Reference	Unit 8		Issued on Date	27/09/2023	
Assessment Reference	Fortis Green	Prop Type Ref	Fortis Green		
Property					
SAP Rating	86 B	DER	2.57	TER	13.00
Environmental	98 A	% DER < TER			80.23
CO ₂ Emissions (t/year)	0.15	DFEE	37.11	TFEE	43.59
Compliance Check	See BREL	% DFEE < TFEE			14.87
% DPER < TPER	44.94	DPER	37.47	TPER	68.06
Assessor Details	Mr. George Farr			Assessor ID	T355-0001

Energy Saving Calculation Function



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)
Ground floor	76.9200 (1b)	x 2.8000 (2b)	= 215.3760 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.9200		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3760 (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) =	Air changes per hour
Pressure test		30.0000 / (5) = 0.1393 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		4.0000 (17)
Number of sides sheltered		0.3393 (18)
		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3393 (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	0.4326	0.4241	0.4156	0.3732	0.3647	0.3223	0.3223	0.3138	0.3393	0.3647	0.3817	0.3987 (22b)
Effective ac	0.5936	0.5899	0.5864	0.5696	0.5665	0.5519	0.5519	0.5492	0.5576	0.5665	0.5728	0.5795 (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
G (Uw = 1.00)			20.9900	0.9615	20.1827		(27)
EF			3.1900	0.1200	0.3828	110.0000	350.9000 (28b)
EW	86.9300	20.9900	65.9400	0.1500	9.8910	60.0000	3956.4000 (29a)
SW	22.4000		22.4000	0.1500	3.3600	60.0000	1344.0000 (29a)
FR	76.9200		76.9200	0.1100	8.4612	9.0000	692.2800 (30)
Total net area of external elements Aum(A, m ²)			189.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.2777		(33)
PF			73.7300			40.0000	2949.2000 (32d)

6. Solar gains

Fuel for water heating, kWh/month	184.3346	162.9080	173.4167	154.0094	150.1732	136.3340	135.6004	140.6251	141.7032	156.7241	164.9562	182.5875	(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	24.6369	19.7646	17.7958	13.0380	10.0709	8.2280	9.1870	11.9417	15.5110	20.3513	22.9868	25.3216	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.9325	-64.8510	-96.6490	-110.3916	-119.4177	-109.2337	-107.9279	-100.8871	-87.6744	-73.8272	-48.9434	-37.6710	(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 wind turbines (Appendix M) (negative quantity)													
(233b)m	-14.9191	-33.3555	-70.6078	-113.7656	-157.5096	-163.0299	-160.7377	-133.8473	-96.1697	-51.7167	-20.8631	-11.5778	(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												1065.9044	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												105.2065	
Water heating fuel used												1883.3724	(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)												198.8336	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2029.5063	(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												1118.6042	(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	1065.9044	0.1558	166.0580 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1883.3724	0.1407	264.9249 (264)
Space and water heating			430.9830 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	198.8336	0.1443	28.6978 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1001.4065	0.1343	-134.5286
PV Unit electricity exported	-1028.0998	0.1239	-127.3820
Total			-261.9106 (269)
Total CO2, kg/year			197.7702 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.5700 (273)

13a. Primary energy - Individual heating systems including micro-CHP			
	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1065.9044	1.5767	1680.6611 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1883.3724	1.5201	2862.9460 (278)
Space and water heating			4543.6071 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	198.8336	1.5338	304.9777 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1001.4065	1.4965	-1498.5983
PV Unit electricity exported	-1028.0998	0.4547	-467.4774
Total			-1966.0757 (283)
Total Primary energy kWh/year			2882.5090 (286)
Dwelling Primary energy Rate (DPER)			37.4700 (287)

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	76.9200 (1b)	x 2.8000 (2b)	= 215.3760 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.9200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	215.3760 (5)

Επιμέτρηση Εμβαδών

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) =	Air changes per hour 30.0000 / (5) =	0.1393 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3893 (18)
Number of sides sheltered		0 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3893 (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												
Effective ac	0.4963	0.4866	0.4769	0.4282	0.4185	0.3698	0.3698	0.3601	0.3893	0.4185	0.4380	0.4574 (22b)
	0.6232	0.6184	0.6137	0.5917	0.5876	0.5684	0.5684	0.5648	0.5758	0.5876	0.5959	0.6046 (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
TER Opening Type (Uw = 1.20)			19.2300	1.1450	22.0191		(27)
EF			3.1900	0.1300	0.4147		(28b)
EW	86.9300	19.2300	67.7000	0.1800	12.1860		(29a)
SW	22.4000		22.4000	0.1800	4.0320		(29a)
FR	76.9200		76.9200	0.1100	8.4612		(30)
Total net area of external elements Aum(A, m ²)			189.4400				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	47.1130	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 137.6959 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4312 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 56.5442 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	44.2919	43.9520	43.6187	42.0536	41.7607	40.3975	40.3975	40.1451	40.9226	41.7607	42.3531	42.9725 (38)
Heat transfer coeff	100.8361	100.4962	100.1629	98.5977	98.3049	96.9417	96.9417	96.6892	97.4668	98.3049	98.8973	99.5167 (39)
Average = Sum(39)m / 12 =												98.5963

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3109	1.3065	1.3022	1.2818	1.2780	1.2603	1.2603	1.2570	1.2671	1.2780	1.2857	1.2938 (40)
HLP (average)												1.2818
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												2.4018 (42)
Hot water usage for mixer showers												
64.4904	63.5212	62.1089	59.4068	57.4127	55.1889	53.9249	55.3265	56.8629	59.2506	62.0107	64.2433	(42a)
Hot water usage for baths												
27.8562	27.4425	26.8599	25.7857	24.9814	24.0895	23.6078	24.1863	24.8162	25.7705	26.8668	27.7620	(42b)
Hot water usage for other uses												
39.2271	37.8006	36.3742	34.9478	33.5213	32.0949	32.0949	33.5213	34.9478	36.3742	37.8006	39.2271	(42c)
Average daily hot water use (litres/day)												120.9460 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)	208.3805	183.3587	125.3430	120.1403	115.9155	111.3734	109.6276	113.0341	116.6268	121.3953	126.6782	131.2324 (44)
Distribution loss (46)m = 0.15 x (45)m	31.2571	27.5038	28.8971	24.6699	23.4067	20.5420	19.8878	20.9940	21.5719	24.7098	27.0714	30.8217 (46)
Water storage loss:												
Store volume												145.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3665 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7379 (55)
Total storage loss	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747 (56)
If cylinder contains dedicated solar storage												
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	254.5175	225.0309	238.7847	209.1149	202.1816	181.5953	178.7222	186.0969	188.4613	210.8693	225.1251	251.6153 (62)
WWHRS	-29.4823	-26.0744	-27.3036	-22.6085	-21.0703	-18.0300	-16.9002	-17.9717	-18.6545	-21.9916	-24.9138	-28.9363 (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	225.0352	198.9565	211.4811	186.5064	181.1113	163.5653	161.8219	168.1252	169.8068	188.8777	200.2112	222.6789 (64)
12Total per year (kWh/year)												2278.1777 (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	106.1962	94.3045	100.9650	90.4040	88.7945	81.2537	80.9942	83.4463	83.5367	91.6831	95.7274	105.2312 (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	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912	120.0912 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.3751	118.8796	107.3751	110.9543	107.3751	110.9543	107.3751	107.3751	110.9543	107.3751	110.9543	107.3751 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	212.8832	215.0923	209.5255	197.6745	182.7148	168.6548	159.2618	157.0527	162.6195	174.4705	189.4302	203.4902 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091	35.0091 (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)	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729	-96.0729 (71)
Water heating gains (Table 5)	142.7368	140.3341	135.7056	125.5611	119.3474	112.8524	108.8632	112.1590	116.0232	123.2300	132.9547	141.4397 (72)
Total internal gains	525.0225	536.3333	514.6336	496.2173	471.4647	451.4888	434.5274	435.6142	448.6243	467.1030	495.3666	514.3325 (73)

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	
North	5.9600		10.6334		0.6300		0.7000		0.7700		19.3682 (74)	
South	8.0100		46.7521		0.6300		0.7000		0.7700		114.4472 (78)	
West	5.2600		19.6403		0.6300		0.7000		0.7700		31.5722 (80)	
Solar gains	165.3876	286.2106	403.3673	519.2179	599.0903	602.4102	577.6073	516.8858	443.3290	319.5119	198.9190	141.0027 (83)
Total gains	690.4101	822.5440	918.0009	1015.4352	1070.5550	1053.8990	1012.1347	952.5000	891.9533	786.6149	694.2855	655.3351 (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	29.1771	29.2758	29.3732	29.8395	29.9283	30.3492	30.3492	30.4284	30.1857	29.9283	29.7491	29.5639

alpha	2.9451	2.9517	2.9582	2.9893	2.9952	3.0233	3.0233	3.0286	3.0124	2.9952	2.9833	2.9709		
util living area	0.9560	0.9283	0.8869	0.8061	0.6878	0.5333	0.4030	0.4409	0.6371	0.8380	0.9310	0.9614	(86)	
MIT	18.8834	19.2317	19.6776	20.2198	20.6290	20.8777	20.9608	20.9480	20.7819	20.2425	19.4842	18.8364	(87)	
Th 2	19.8323	19.8357	19.8391	19.8551	19.8581	19.8721	19.8721	19.8747	19.8667	19.8581	19.8520	19.8457	(88)	
util rest of house	0.9478	0.9156	0.8667	0.7720	0.6336	0.4553	0.3069	0.3428	0.5614	0.8015	0.9165	0.9542	(89)	
MIT 2	17.4137	17.8496	18.4023	19.0631	19.5270	19.7881	19.8544	19.8494	19.7020	19.1096	18.1833	17.3630	(90)	
Living area fraction	18.1302	18.5234	19.0240	19.6270	20.0642	20.3193	20.3938	20.3850	20.2285	fLA = Living area / (4) =			0.4875	(91)
MIT	18.1302	18.5234	19.0240	19.6270	20.0642	20.3193	20.3938	20.3850	20.2285	19.6619	18.8175	18.0813	0.0000	(92)
Temperature adjustment	18.1302	18.5234	19.0240	19.6270	20.0642	20.3193	20.3938	20.3850	20.2285	19.6619	18.8175	18.0813	0.0000	(93)
adjusted MIT	18.1302	18.5234	19.0240	19.6270	20.0642	20.3193	20.3938	20.3850	20.2285	19.6619	18.8175	18.0813	0.0000	(93)

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)	180.0580 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1900.9819 (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 saving/generation technologies (Appendices M ,N and Q)	0.0000 (237)
Energy saving/generation technologies (Appendices M ,N and Q)	4117.5110 (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	3021.7260	0.2100	634.5625 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2730.7088	0.2100	573.4489 (264)
Space and water heating			1208.0113 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	180.0580	0.1443	25.9879 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-766.0894	0.1346	-103.1121
PV Unit electricity exported	-1134.8924	0.1259	-142.8877
Total			-245.9998 (269)
Total CO2, kg/year			999.9287 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.0000 (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	3021.7260	1.1300	3414.5504 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2730.7088	1.1300	3085.7010 (278)
Space and water heating			6500.2514 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	180.0580	1.5338	276.1789 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-766.0894	1.4974	-1147.1745
PV Unit electricity exported	-1134.8924	0.4622	-524.4967
Total			-1671.6712 (283)
Total Primary energy kWh/year			5234.8599 (286)
Target Primary Energy Rate (TPER)			68.0600 (287)

Project name

Fortis Green Tennis Club

As designed

Date: Fri Sep 22 15:24:21 2023

Administrative information**Building Details**Address: Fortis Green Tennis Club, 31 Southern Road,
London, N2 9LH**Certifier details**

Name: Neil Ingham

Telephone number:

Address: Holborn Tower, 137-144 High Holborn London,
WC1V 6PL**Certification tool**

Calculation engine: SBEM

Calculation engine version: v6.1.e.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.2.0

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 87.2**The CO₂ emission and primary energy rates of the building must not exceed the targets**

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	17.31
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	11.78
Target primary energy rate (TPER), kWh _{PE} /m ² annum	187.13
Building primary energy rate (BPER), kWh _{PE} /m ² annum	127.74
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.18	0.25	Block 1 - WC-Showers_P_8
Floors	0.18	0.11	0.12	Block 1 - WC-Showers_S_3
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	-	-	No heat loss flat roofs
Windows** and roof windows	1.6	1.3	1.3	Block 1 - Bar area_G_7
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	1	1	Block 1 - Bar area_D_6
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]
U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]
U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	4

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.3	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- via ASHP

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.002
Standard value	N/A	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
Block 1 - WC-Showers	0.2	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
Block 1 - Plant		130	-	-
Block 1 - Store		130	-	-
Block 1 - Stores		130	-	-
Block 1 - WC-Showers		130	-	-
Block 1 - Bar area		130	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block 1 - Bar area	YES (+24.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	130.6	130.6
External area [m ²]	346.5	346.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	4	3
Average conductance [W/K]	97.73	113.55
Average U-value [W/m ² K]	0.28	0.33
Alpha value* [%]	25.04	19.31

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area Building Type

Retail/Financial and Professional Services
 Restaurants and Cafes/Drinking Establishments/Takeaways
 Offices and Workshop Businesses
 General Industrial and Special Industrial Groups
 Storage or Distribution
 Hotels
 Residential Institutions: Hospitals and Care Homes
 Residential Institutions: Residential Schools
 Residential Institutions: Universities and Colleges
 Secure Residential Institutions
 Residential Spaces
 Non-residential Institutions: Community/Day Centre
 Non-residential Institutions: Libraries, Museums, and Galleries
 Non-residential Institutions: Education
 Non-residential Institutions: Primary Health Care Building
 Non-residential Institutions: Crown and County Courts

100 General Assembly and Leisure, Night Clubs, and Theatres

Others: Passenger Terminals
 Others: Emergency Services
 Others: Miscellaneous 24hr Activities
 Others: Car Parks 24 hrs
 Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.91	7.68
Cooling	0	0
Auxiliary	1.62	9.08
Lighting	4.46	3.99
Hot water	72.21	118.87
Equipment*	54.56	54.56
TOTAL**	84.2	139.62

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	13.05
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>13.05</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	358.61	313.56
Primary energy [kWh _{PE} /m ²]	127.74	187.13
Total emissions [kg/m ²]	11.78	17.31

HVAC Systems Performance									
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling									
	Actual	280.4	211.8	0	0	0	0	0	0
	Notional	284.9	229.7	0	0	0	0	----	----
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas									
	Actual	98.8	193.3	8.9	0	2.4	3.1	0	3.3
	Notional	109.3	104.1	11.5	0	3.3	2.64	0	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Appendix D

GLA Part L 2021 Reporting Spreadsheet

Part L 2021 Performance	
Residential	Non-residential

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

	Carbon Dioxide Emissions for residential buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	9.3	2.0
After energy demand reduction (be lean)	7.9	2.0
After heat network connection (be clean)	7.9	2.0
After renewable energy (be green)	1.7	2.0

	Regulated residential carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: savings from energy demand reduction	1.4	15%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	6.2	66%
Cumulative on site savings	7.5	81%
Annual savings from off-set payment	1.7	-
	(Tonnes CO ₂)	
Cumulative savings for off-set payment	52	-
Cash in-lieu contribution (£)	4,971	

	Regulated residential carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: savings from energy demand reduction	1.4	15%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	6.2	66%
Cumulative on site savings	7.5	81%
Annual savings from off-set payment	1.7	-
	(Tonnes CO₂)	
Cumulative savings for off-set payment	52	-
Cash in-lieu contribution (£)	4,971	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

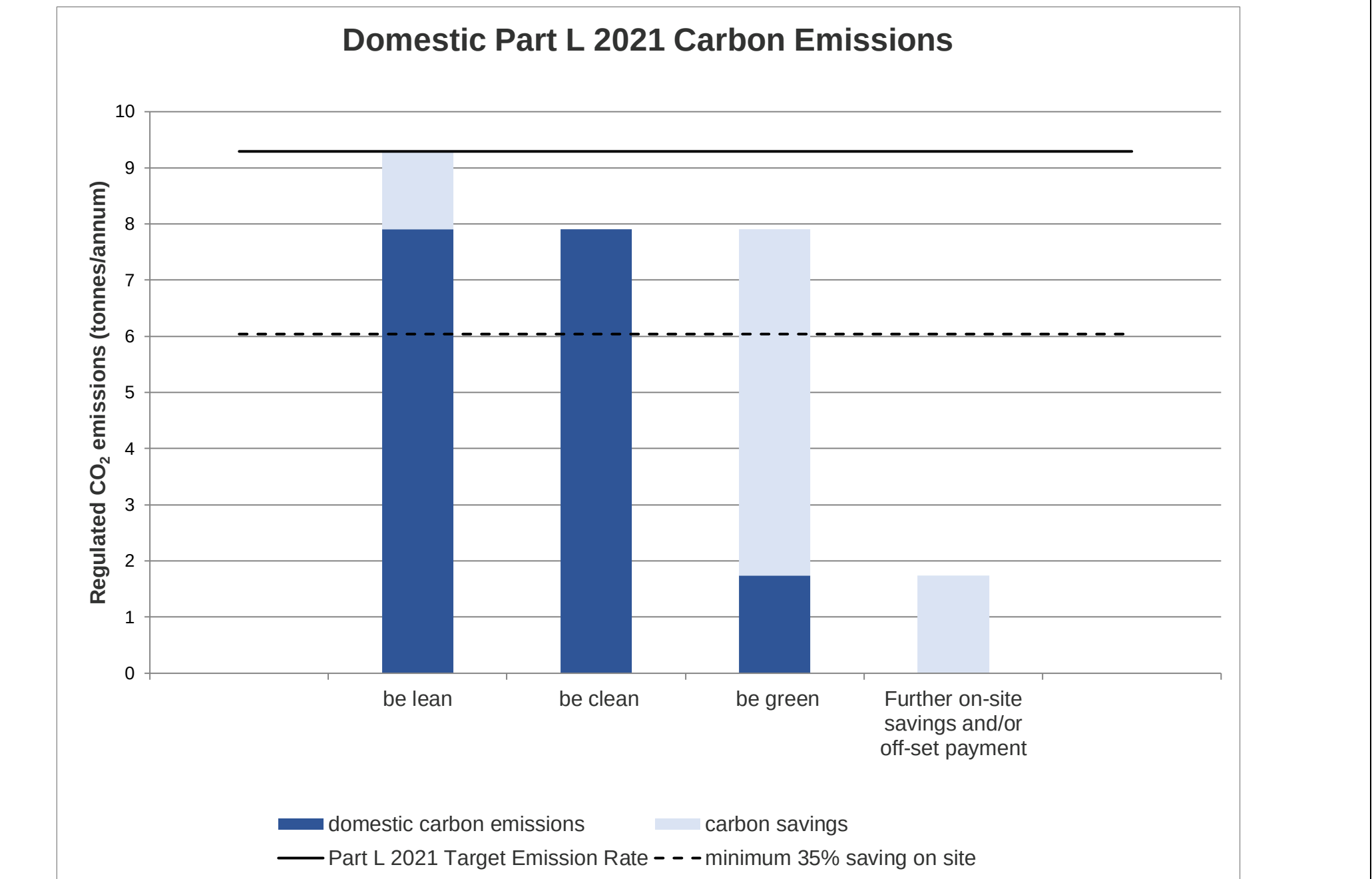


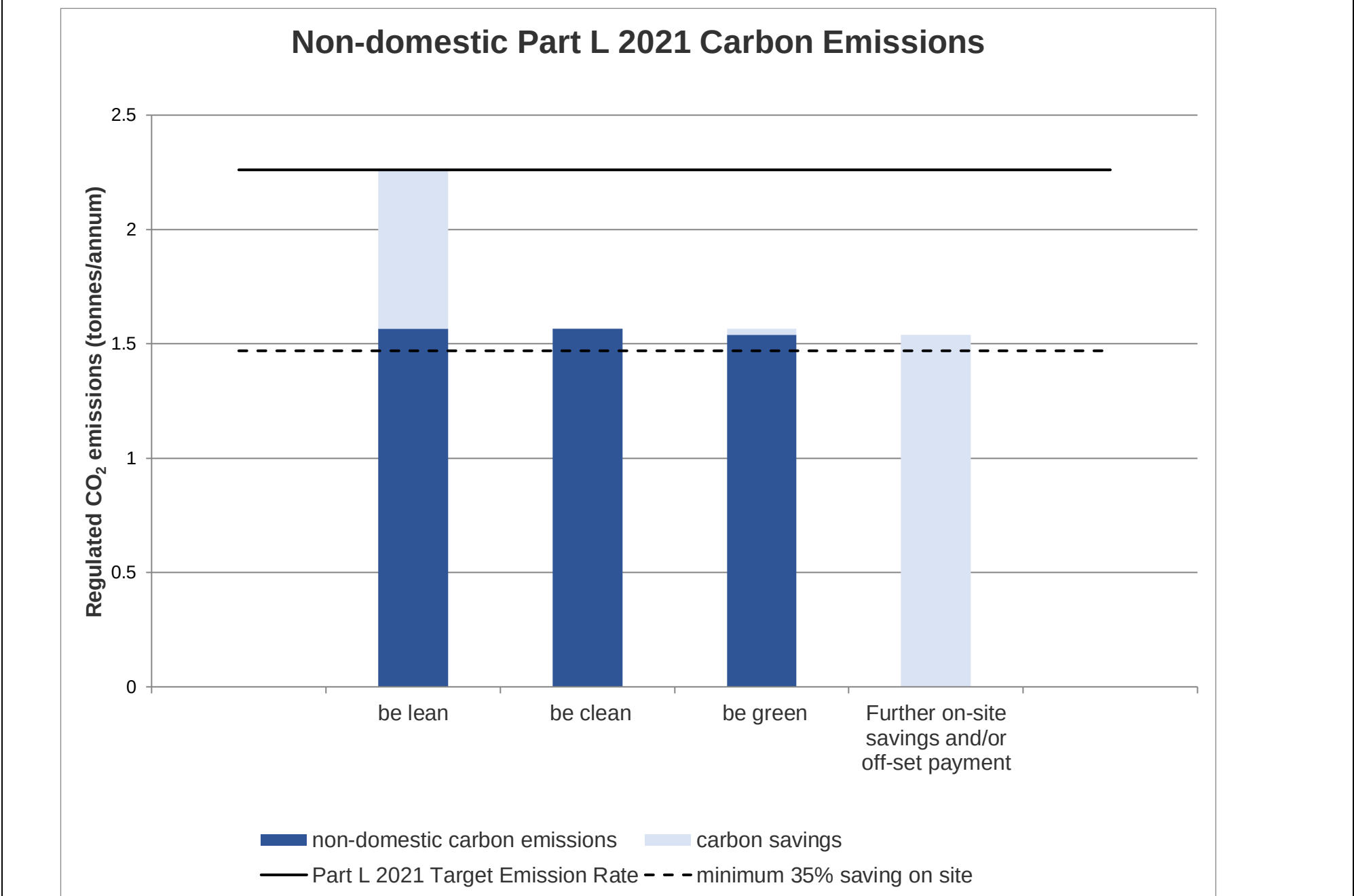
Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-residential buildings

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	2.3	1.0
After energy demand reduction (be lean)	1.6	1.0
After heat network connection (be clean)	1.6	1.0
After renewable energy (be green)	1.5	1.0

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: savings from energy demand reduction	0.7	31%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	1%
Total Cumulative Savings	0.7	32%
Annual savings from off-set payment	1.5	-
	(Tonnes CO ₂)	
Cumulative savings for off-set payment	46	-
Cash in-lieu contribution (£)	4,385	

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: savings from energy demand reduction	0.7	31%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	1%
Total Cumulative Savings	0.7	32%
Annual savings from off-set payment	1.5	-
	(Tonnes CO₂)	
Cumulative savings for off-set payment	46	-
Cash in-lieu contribution (£)	4,385	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab



	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L 2021 baseline	11.6		
Be lean	9.5	2.1	18%
Be clean	9.5	0.0	0%
Be green	3.3	6.2	54%
Total Savings	-	8.3	72%
	-	CO ₂ savings off-set (Tonnes CO ₂)	-
Off-set	-	98.5	-

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	38.17	32.35	15%

	Area weighted non-residential cooling demand (MJ/m ²)	Total non-residential cooling demand (MJ/year)
Actual	N/A	N/A
Notional	N/A	N/A

Building type	EUI (kWh/m ² /year) (excluding renewable energy)	Space heating demand (kWh/m ² /year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m ² /year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m ² /year) (excluding renewable energy)	Methodology used (e.g. 'be seen' methodology or an alternative predictive energy modelling methodology)	Explanatory notes (if expected performance differs from the Table 4 values in the guidance)
Residential	32.96158463	32.20168067	35	15	Part L1 - SAP 10.2 & none dwellings / & Landlord Circulation	

Non-residential

Building type	EUI (kWh/m ² /year) (excluding renewable energy)	Space heating demand (kWh/m ² /year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m ² /year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m ² /year) (excluding renewable energy)	Methodology used (e.g. 'be seen' methodology or an alternative predictive energy modelling methodology)	Explanatory notes (if expected performance differs from the Table 4 values in the guidance)
All other non-residential	138.7595712	19.20367534	55	15	Part L2 - SBEM &	

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