

NORTHUMBERLAND DEVELOPMENT PROJECT HOTEL

S73 APPLICATION

ENERGY STRATEGY ADDENDUM

**Northumberland Development Project Hotel
S73 Application**

Energy Strategy Addendum

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1 Executive Summary

This Energy Strategy Addendum has been prepared on behalf of Tottenham Hotspur Property Company Limited (“the Applicant”), in support of an application for minor material amendments to the London Borough of Haringey (LBH) made under Section 73 (S73) of the Town and Country Planning Act 1990 (as amended), following the grant of planning permission for the Northumberland Park Development (“the Site”) on 15 April 2016 ref HGY/2015/3000.

This report is an Addendum to the original Energy Strategy that was produced for the NDP permission in 2015. It applies to Plot 3 only (the hotel building) and addresses any updates to policy and design since the original application. This document has been prepared in alignment with GLA guidance “Greater London Authority guidance on preparing energy assessments (2022)” and other accompanying documentation from both the GLA and the London Borough of Haringey.

The carbon emissions results for each stage of the London Plan energy hierarchy have been collated in the format required for the planning submission, using the latest version of the GLA’s Carbon Emissions Reporting Spreadsheet V2.0. The following results outline the predicted carbon emissions for the site:

Table 1-1 Table showing the estimated carbon reductions at each stage of the energy hierarchy (Part L 2021) – site-wide

	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L 2021 baseline	117.5		
Be lean	98.7	18.8	16%
Be clean	56.4	42.2	36%
Be green	59.0	-2.6	-2%
Total Savings	-	58.4	50%
	-	CO ₂ savings off-set (Tonnes CO ₂)	-
Off-set	-	1,770.6	-

The façade has been informed through direction from the overheating analysis. It can be seen from the modelling that with an unconstrained façade the building complies with the CIBSE TM59 criteria throughout all sample rooms assessed. However, acoustics constraints due to event day noise break-in has resulted in mechanical cooling being required.

2 Introduction

This Energy Strategy Addendum has been prepared on behalf of Tottenham Hotspur Property Company Limited (“the Applicant”), in support of an application for minor material amendments to the London Borough of Haringey (LBH) made under Section 73 (S73) of the Town and Country Planning Act 1990 (as amended), following the grant of planning permission for the Northumberland Park Development (“the Site”) on 15 April 2016 ref HGY/2015/3000.

The NDP permission is a ‘hybrid consent’ (“the Hybrid Consent”) which comprises of: full planning permission for Plot 1 (The Stadium), Plot 2 (The Tottenham Experience) and Plot 3 (Hotel); and outline planning permission for Plot 4 (The Extreme Sports Building), Plot 5 (The Residential Buildings and Flexible B1/D1 Space) and Plot 6 (The Community Health Building). This S73 Application proposes amendments focusses on Plot 3 which has already been commenced up to ground level, including foundations and the basement car park.

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Figure 2—1 The proposed development

This S73 application seeks to enhance the deliverability of the proposals and respond to the evolving regeneration of the surrounding area.

The changes to the Plot 3 hotel building relate to:

- Changes to the building form and layout Increase to the height of the building from 23 to 29 storeys
- An increase in the site wide hotel floorspace to 16,132 m²

Figure 2—2 Typical hotel floor plan (Levels 2 to 10)

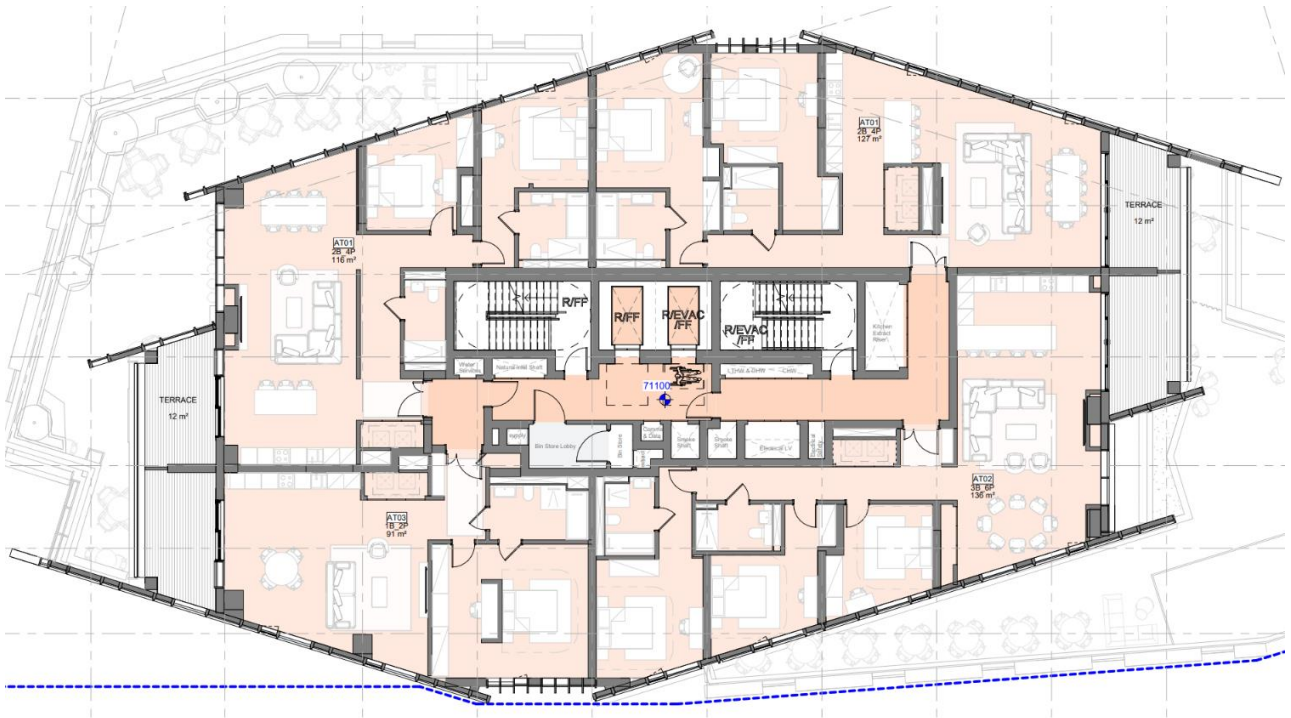


Figure 2—3 Typical residential floor plan (Levels 14 to 18)

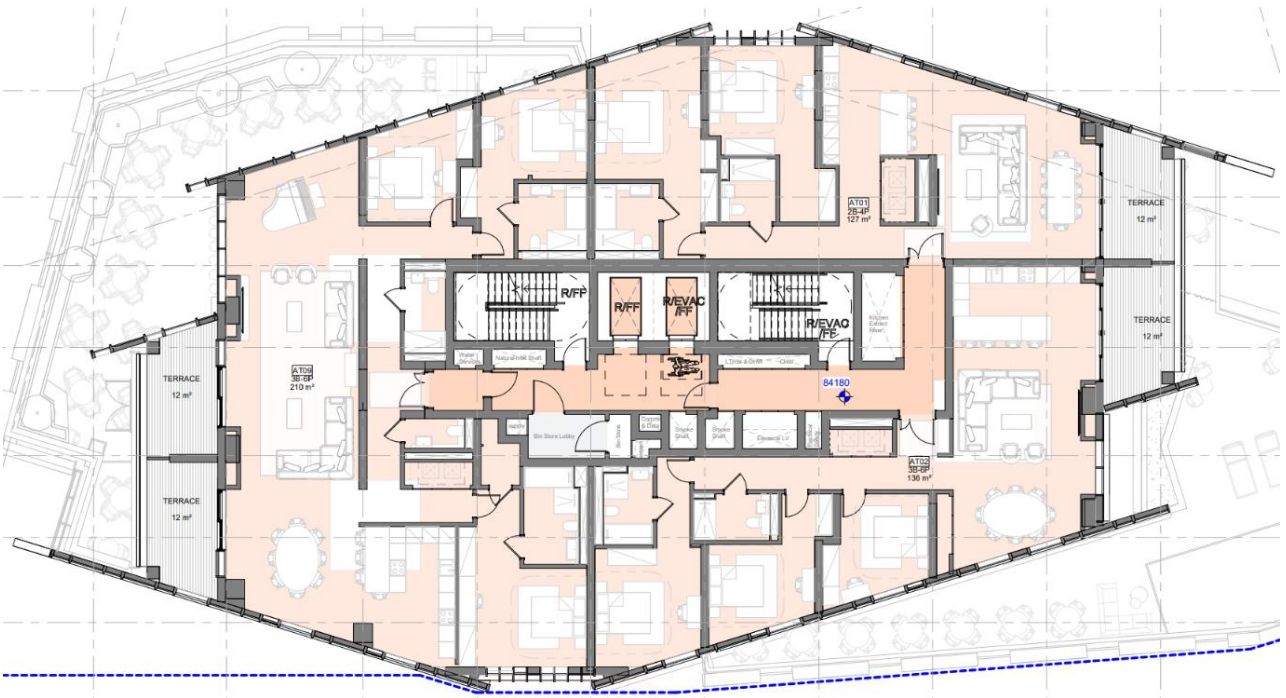


Figure 2—4 Typical residential floor plan (Levels 19 to 25)

3 Energy Policy and Drivers

This section the key national, strategic and local policy frameworks relating to energy, carbon and sustainability, as well as standards set by the Applicant. As the NDP was granted consent in 2016 and the hotel since implemented, the policies and targets have changed since then. Therefore, the most up-to-date policy and drivers are covered in this section.

The Site is located in the London Borough of Haringey (LBH) and as such any development proposal will be determined against the following documents:

- LBH Strategic Policies 2013 (with alterations adopted July 2017) ("SP")
- LBH Development Management DPD (adopted July 2017) ("DM DPD")
- Site Allocations DPD (adopted July 2017) ("SA DPD")
- Tottenham Area Action Plan (adopted July 2017) ("TAAP") -
- London Plan (March 2021) ("LP")

National Planning Policy Framework ("NPPF") (July 2021) and accompanying Planning Practice Guidance ("PPG") are the principle material considerations in this case, alongside various Supplementary Planning Guidance/Documents ("SPDs/SPGs")

3.1 National Energy Policy and Guidance

3.1.1 The United Nations Paris Climate Agreement

The Paris Agreement is a major international climate action agreement to which the UK is a signatory. The 196 countries under the agreement have committed to limiting global warming to 2°C over pre-industrial levels and aim to safely adapt to any consequences of climate change. The UK ratified this in 2016.

While countries may set their own policies and targets (NDCs), these are assessed as to their level of ambition and to their progressive approach and must be tracked and published. The UK currently falls under NDCs produced collectively with the European Union. These commit to at least a 40% domestic reduction in Greenhouse Gas (GHG) emissions by 2030 compared to 1990 Climate Analysis Indicators Tool (CAIT), including energy consumption and industrial processes. Though this calculation may change in light of Brexit, the UK will remain signatory to the Paris Agreement, with its NDC revised.

3.1.2 The National Planning Policy Framework (July 2021)

The NPPF sets out the Government's planning policies for England and how these are expected to be applied. A greater focus is now placed on the dissemination of energy policy within regional development frameworks.

Within the NPPF's planning guidance relating to energy is set out in section 14 – "meeting the challenge of climate change, flooding and coastal change".

Additionally, paragraphs 7 and 8 of the NPPF highlight that the purpose of the planning system is to contribute to the achievement of sustainable development, which has the following three overarching objectives:

- *"an economic role – to help build a strong, responsive and competitive economy..."*
- *a social role – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations..."*
- *an environmental role to contribute to protecting and enhancing our natural, built and historic environment..."*

The NPPF is underpinned by a presumption in favour of sustainable development. Paragraph 11 of the NPPF states that decisions should apply a presumption in favour of sustainable development and approve development proposals that accord with an up-to-date development plan without delay.

Paragraphs 81 and 83 of the NPPF are also relevant. These require policies and decisions to create the conditions for businesses to invest and expand, support economic growth and allow areas to build on their strengths.

3.1.3 Climate Change Act

The Climate Change Act 2008 established a legally binding target to reduce the UK's greenhouse gas emissions by at least 80% below 1990 levels by 2050. To drive progress and set the UK on a pathway towards this target, the Act introduced a system of carbon budgets which provide legally binding limits on the amount of emissions that may be produced in successive five-year periods, beginning in 2008.

The first three carbon budgets were set in law in May 2009 and require emissions to be reduced by at least 34% below base year levels in 2020. The fourth carbon budget, covering the period 2023–27, was set in law in June 2011 and requires emissions to be reduced by 50% below 1990 levels. The fifth carbon came into force in July 2016, limiting the budget for 2028–2032 of is 1,725 mega tonnes of carbon dioxide equivalent. This correlates to the reduction of 57% in greenhouse gas emissions compared to 1990 levels.

3.2 UK decarbonisation context

The UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050. The target will require the UK to bring all greenhouse gas emissions to net zero by 2050, compared with the previous target of at least 80% reduction from 1990 levels.

Electricity grid decarbonisation

The carbon intensity of electricity in the UK has been reducing from 0.519 kg CO₂/ kWh to 0.233 kg CO₂/ kWh as per SAP methodologies 2012 and SAP 10. This is due to the closure of coal fired power stations and the increase in renewable energy. As a result, electricity is becoming a more feasible lower carbon fuel source compared to traditional gas combustion. This is also resulting in gas fired combined heat and power (CHP) engines not providing the long-term carbon savings shown previously and going forward CHP will be a high carbon technology based on Part L. These changes result in a difference in Part L carbon reductions shown by recent developments and for new ones coming forward now.

London Plan Policy is looking to push towards the future of low carbon heating, with the application of heat pumps, and therefore the GLA ask for the SAP 10 carbon factors to be used as these provide the most accurate representation of the latest carbon intensity of the grid.

3.3 Policy and Regulation Changes

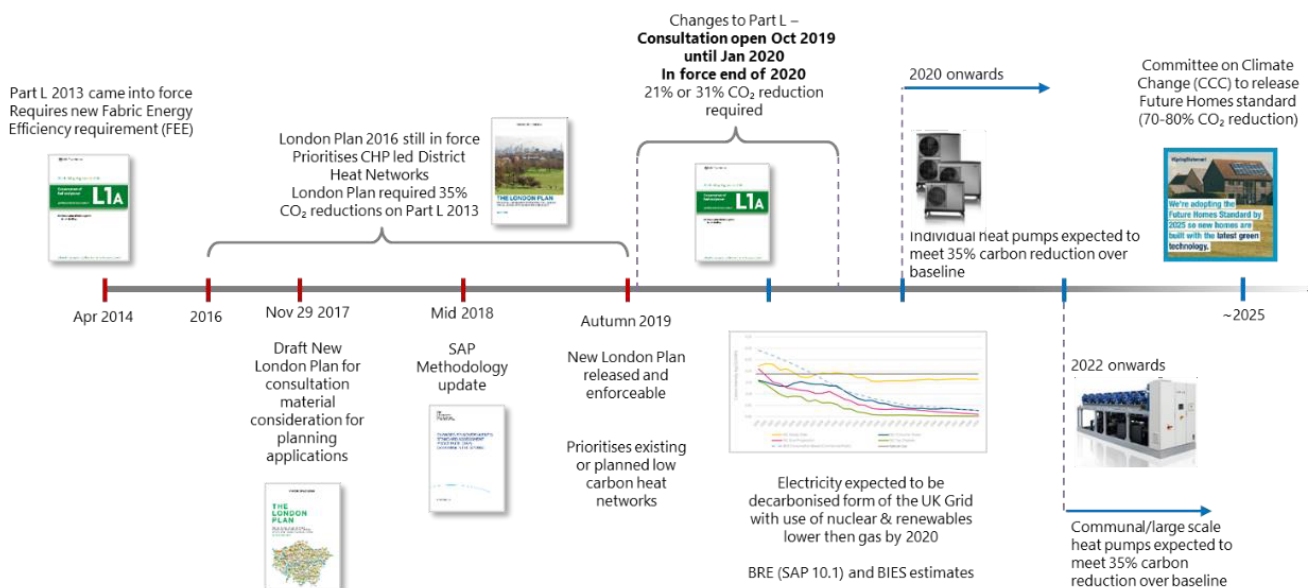


Figure 3—2 UK past and future energy and carbon regulations

Figure 2-2 shows the changing policy and regulatory landscape since 2014. The Future Homes Standard was consulted upon in 2020. No further updates on the process have been provided to date. It was outlined by BEIS that district heat networks (DHN), heat pumps and electric heating, along with improved fabric will meet these future emissions reductions targets. The consultation report stated:

"2.9 The CCC stated in its report Net Zero: The UK's contribution to stopping global warming that achieving the net zero target will require the full decarbonisation of buildings by 2050. There are a number of existing low carbon heating technologies with the potential to support the scale of change needed. We anticipate that low carbon heating may be delivered through heat pumps, heat networks and in some circumstance's direct electric heating."

3.3.1 Building Regulations Part L 2021

Part L of the 2021 Building Regulations relates to the Conservation of Fuel and Power in both new construction dwellings (Part L1) and non-domestic buildings (Part L2). These documents stipulate a minimum level of efficiency that buildings must be constructed to. The guide to the regulations (Approved Documents) must be read in conjunction with other supporting documents, such as the National Calculation Methodology (NCM) Modelling Guide 2021.

Compliance with these regulations is demonstrated through thermal modelling analysis. For domestic buildings this is demonstrated through SAP (Standard Assessment Procedure calculations) and for non-domestic buildings dynamic simulation energy modelling or SBEM (Simplified Building Energy Model) is required.

The proposed hotel building comprises self-contained domestic dwellings therefore Part L 1 applies here. For everything else, Part L 2 applies. Therefore, two separate energy models have had to be created and analysed.

3.4 Regional Planning Policy

3.4.1 The London Plan (2021)

The London Plan (2021) is the spatial development strategy for London, produced by the Greater London Authority on behalf of the Mayor of London. Every London Borough Local Plan must be in general conformity with the London Plan.

Policies surrounding sustainability are summarised below.

Policy SI2 Minimising greenhouse gas emissions

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

1. be lean: use less energy and manage demand during construction and 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.

A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major developments. Residential development should achieve **10 per cent**, and non-residential development should achieve **15 per cent** through energy efficiency ("Lean") measures.

The GLA requires the zero-carbon target to be achieved with a minimum 35% savings on-site, beyond the notional Part L 2013 baseline. The remaining carbon emissions (typically 65%) are offset through a cash in lieu payment to Haringey or offset through off-site measures, where possible. The money is used to fund carbon reduction projects in the Haringey boundary. This payment has to account for 30 years of carbon emissions at a fixed rate of cost and carbon intensity.

Policy SI3 Energy infrastructure

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 available 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)
 - 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 of policy SI1 (A)
3. where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

Policy SI4 Managing heat risk

Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the cooling hierarchy.

3.4.2 Resulting Energy and Carbon Approach

The London Plan zero carbon buildings requirement means developments must reduce regulated carbon dioxide emissions down to net zero over the year. This requires at least 35% reduction in regulated carbon dioxide emissions (using SAP 10) to be achieved on-site; the remaining regulated carbon dioxide emissions – to 100% reduction– are to be offset off-site, see Figure 3—3.

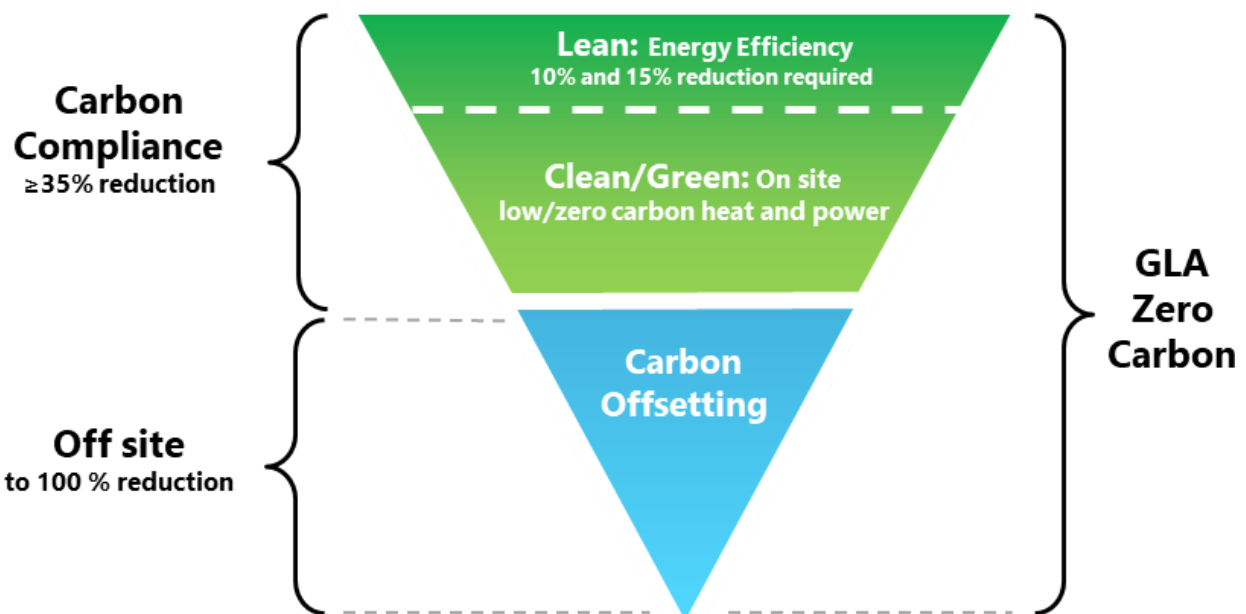


Figure 3—3 Zero carbon requirements

The New London Plan (2021) **Policy S12** shows that the GLA are concentrating on a truly fabric first approach, meaning they will expect to see how the fabric specification has been pushed as much as possible before accepting.

On-site regulated carbon dioxide emissions are to be reduced by means of a combination of measures, following the structure outlined in the GLA Energy Hierarchy:

1. Be Lean: reduce energy demand by improving the building's fabric efficiency and ventilation system, and reducing lighting consumption to meet the 10% reduction for residential and 15% reduction for non-residential uses;
2. Be Clean: exploit local energy resources where feasible and supply energy efficiently; and
3. Be Green: install and use power generated by renewable energy sources on-site.

In line with the GLA Guidance (Policy S13, 9.3.8), renewable energy sources are to be installed regardless of whether the on-site 35% reduction target has been already achieved with the previous steps of the Energy Hierarchy. An exception can be made in cases where it can be demonstrated that renewable technologies are not technically feasible or economically viable for the considered development.

Off-site carbon offsetting can be achieved through two main strategies:

1. Investing in existing local properties in the area, improving energy efficiency or installing renewable energy in order to generate an equivalent carbon reduction;
2. Carbon offset payments secured through a S106 agreement (as per footnote 155 of the London Plan)

3.5 Local Planning Policy

The LBH Local Plan comprises four main documents as outlined above which set out a number of policies applicable to developments in the Haringey area. The LBH Local Plan sets out goals across all elements of the sustainability and energy spectrum. These policies are typically in alignment with the London Plan (2021).

3.5.1 Strategic Policies 2013, with alterations adopted July 2017 ("SP")

Policy SP4 Working towards a Low Carbon Haringey

Over the lifetime 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.

Haringey have inferred their interpretation of "Zero Carbon" within their document "Local Plan: Strategic Policies 2013 (with alterations 2017)". On page 75 it confirms the following:

"In December 2008, the Government published Definition of Zero Carbon Homes and Non-Domestic Buildings: Consultation document, consulting on the definition of zero carbon homes and in particular an approach based on:

- a. *High levels of energy efficiency in the fabric of the home;*

- b. *A minimum level of carbon reduction to be achieved on-site or through directly connected heat; and*
- c. *A list of (mainly offsite) allowable solutions for dealing with the remaining emissions (including from appliances)."*

This definition of zero carbon is as per the GLA requirements, but the latter provide individual targets for "Lean" and "Green".

3.5.2 LBH Development Management DPD (adopted July 2017) ("DM DPD")

Policy DM22 Decentralised Energy

1. Subject to other policy requirements, proposals that contribute to the provision and use of Decentralised Energy network infrastructure will be supported.

Communal energy systems

2. All development that incorporates site-wide communal energy systems should examine opportunities for extending such systems, irrespective of whether it is connected to a DE network.
3. All development that incorporates site-wide communal energy systems should optimise opportunities for extending such systems beyond the site boundary to supply energy to neighbouring existing and planned future developments.

Existing and planned future DE networks

4. All development proposals should prioritise connection to existing or planned future DE networks.
5. All major development located within 500 metres of an existing DE Network, and minor new-build development located within 25 metres, will be expected to secure connection to that network subject to demonstration of technical feasibility and financial viability.
6. All major development located within 500 metres of a planned future DE Network, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be expected to secure connection to that network subject to demonstration of technical feasibility and financial viability.

DE network 'connection zones'

7. All major development located within 500 metres of a DE network 'connection zone' should be designed for connection to a DE network.
8. All minor new-build development located within 25 metres of a DE network 'connection zone' should be designed for connection to a DE network.

Customer charters

9. Where site-wide communal and district heating systems are operational, the Council will strongly encourage heat and energy service providers to enter into customer charters with domestic and micro-business customers.

3.5.3 Tottenham Area Action Plan (adopted July 2017) (“TAAP”)

Site Allocation NT7: Tottenham Hotspur Stadium

The TAAP is the key statutory planning document for delivering the regeneration strategy for Tottenham. It establishes the local spatial planning framework for the area, giving detailed expression to the overall growth objectives for Tottenham as contained in the SP DPD.

The Site lies within the Tottenham Hotspur Stadium site allocation (NT7) for which the TAAP provides the following indicative development capacity:

285 net new homes

122,045 m² of leisure floorspace

6,000 m² of community floorspace

4,000 m² of commercial floorspace

18,830 m² of hotel floorspace

The TAAP allocates the Tottenham Hotspur Stadium site for comprehensive stadium-led development will be required across the site (Site Allocation NT7). As part of the development guidelines, the site allocation identifies the as being in an area with potential for being part of a Decentralised Energy (DE) network. Development proposals should be designed for connection to a DE network, and seek to prioritise/secure connection to existing or planned future DE networks, in line with Policy DM22.

4 Energy Assessment

4.1 Introduction

In accordance with planning policy, the energy strategy for the development has been developed in alignment with the London Plan energy hierarchy; Be Lean, Be Clean, Be Green, and Be Seen.

This approach aims to minimise energy consumption from the outset through the use of efficient massing, passive measures and efficient systems before the deployment of low- and zero-carbon technologies.

- Lean: Maximise energy efficiency
- Clean: Supply energy efficiently using low carbon heating and cooling systems
- Green: Incorporate renewable energy
- Seen: Share metered operational energy data



Figure 4—1 Energy Hierarchy

Predicted carbon emissions have been taken from computer modelling software (SBEM and SAP methodology), in line with guidance outlined in the document entitled *GLA Energy Assessment Guidance (June 2022)*. The Table 4—1 below summarises the utilised methodologies and software.

Table 4—1 Modelling methodologies

Typology	Methodology (software)	Required for
New build – Residential	SAP 10.2 (Elmhurst)	Building regulations / Planning Policy
New build – Non-domestic	Dynamic simulation model (IES)	Building regulations / BREEAM / Planning Policy

The GLA energy hierarchy has been adhered to, and each stage 'Be Lean', 'Be Clean' and 'Be Green' has been explored. The following sections explain the GLA energy hierarchy inputs outlined for the Site.

Table 4-2 Summary of modelling assumptions through the energy hierarchy

	Model assumptions and inclusions
Baseline – Building Regulations Notional Development (as generated by Part L software)	Baseline Target / Building Emission Rate (TER / BER) is modelled as a reference 'compliant' building, with the following features: Residential areas: - Notional fabric and glazing areas - Heat generation via individual gas boilers Non-Domestic areas: - Notional fabric and glazing areas - Heat generation via Energetik DEN as per actual building
Lean - Energy efficiency measures applied	Improved energy efficient model, with the following features: - Improved building fabric including triple glazing and enhanced air tightness - Energy efficiency measures as required to achieve 10% reduction for residential areas, on Part L 2021 (NCM and SAP) compliance - Highly energy efficient lighting fittings and controls
Clean - Connecting to District energy network (DHN)	- Connection to the existing Energetik heat from waste District Energy Network with heat carbon intensity of 0.015 kgCO ₂ /kWh
Green - Renewable Energy Technology	- Provision of roof mounted solar photovoltaic array, allocated entirely to the non-domestic building areas

The following sections set out the carbon dioxide emissions reductions achieved for each building typology at each stage of the energy hierarchy.

4.2 Unregulated emissions

Non-domestic unregulated emissions and energy consumption have been estimated using the assumptions for equipment use provided in the NCM activity templates. These demands are assumed to be provided by grid electricity in all instances, with the relevant carbon factor applied to calculate associated carbon emissions.

Domestic unregulated emissions from energy consumption such as electrical appliance usage and cooking have been estimated using the SAP methodology as outlined in Appendix L of The Government's Standard Assessment Procedure for Energy Rating of Dwellings, SAP 10.2.

For both domestic and non-domestic buildings, the estimates are based on floor area and are therefore assumed not to change between each stage of the energy hierarchy.

Table 4-3 Estimated site-wide unregulated energy consumption and carbon emissions

Typology	Unregulated Energy Consumption		Unregulated Carbon Emissions	
	MWh/year	kWh/m ² /year	Tonnes CO ₂ /year	kg CO ₂ /m ² /year
Domestic	230.9	34.6	31.4	4.7
Non-Domestic	79.4	10.1	10.8	1.4
Total	310.3	21.3	42.2	2.9

5 Baseline

Baseline energy demands and associated carbon dioxide emissions have been estimated in line with the methodology set out in the previous section, following the GLA's "Guidance for Preparing Energy Statements" (June 2022). Part L compliance modelling has been carried out to assess the proposed development geometry using Notional Building fabric and building services specification as stipulated in the relevant guidance documents for each area of the following entities:

Residential

- SAP version 10.2
- Approved Document Part L1 2021

Non-domestic

- National Calculation Methodology modelling guide (for buildings other than dwellings) 2021 Edition (September 2022)
- Approved Document Part L2 2021

Although both are based on the Building Regulations Part L 2021 Notional Building, the Baseline for residential areas is required to be an individual gas boiler system whereas the non-domestic areas use the values from the Actual proposed existing heat network connection. The difference between the two methodologies is stipulated in Section 9.19 of the GLA's "Energy Assessment Guidance" (June 2022). Following this guidance allows for the carbon emissions savings from the heat network to be demonstrated at the Clean stage for the residential areas but this is not possible for the non-domestic. Alternative Baseline emission scenarios could be provided to show this benefit, if required by LBH.

The following diagram shows the methodology approach for each of the Part L entities (domestic and non-domestic).

GLA Energy Assessment Guidance (June 2022)

- 6.8. To determine the CO₂ emissions baseline, applicants should use the Target Emission Rate (TER) from the final proposed building specification, i.e. the rate from the modelling results of the 'be green' stage of the energy hierarchy. In some cases the TER may include low carbon or renewable energy generation. The carbon emissions reporting spreadsheet enables the CO₂ emission savings over the baseline to be accounted for at each stage of the energy hierarchy.

Heating and hot water assumptions

- 7.9. It is expected that, through following the heat hierarchy, the final proposed heating strategy will include low carbon and/or renewable technologies. The CO₂ emission improvements from these technologies are to be accounted for in the 'be clean' and 'be green' stages of the energy hierarchy. For the purposes of demonstrating CO₂ emission improvements in the 'be clean' stage of the energy hierarchy, applicants should use the notional building system type and performance values specified in the Part L 2021 baseline as determined by the final proposed building specifications. In this way CO₂ emission improvements from the proposed space heating and hot water demand reduction measures can be compared against the

Residential

GLA Energy Assessment Guidance (June 2022)

- 9.19. The baseline assumptions for existing heat network connections should align with the Part L 2021 methodology, which will ordinarily use the same CO₂ emission factor of heat delivered in both the TER and the actual building/ dwelling CO₂ emission rate. Under the Part L 2021 methodology for residential development the TER can alternatively use the main notional building assumptions as outlined in Table 1.1 of the Approved Document L1. Applicants may choose to use this approach for the baseline in order to allow for CO₂ emission improvements to be reported under the 'be clean' element of the energy hierarchy.

Approved Document Part L1 2021: Table 1.1

Main heating fuel (space and water)	Main gas
Heating system	Boiler and radiators Central heating pump 2003 or later, in heated space Design flow temperature = 55 °C
Boiler	Efficiency = SEDBUK 2009 = 89.5%
Heating system controls	Boiler interlock, EFP 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 50% recovery efficiency utilisation of 0.98
Hot water cylinder	If cylinder, declared loss factor = 0.85 + (0.2 × 0.05 V ^{0.5}) kWh/day where V is the volume of the cylinder in litres

GLA Baseline heating system

Individual gas boiler system as per Part L1 2021 Notional building

Non-Domestic

NCM Modelling Guide 2021: Section 61

6.1. Where a district heating system is used for space and/or water heating in the Actual building (see paragraph 208 and Table 32), district heating will be used for space and/or water heating in the Notional building with the following provisions:

- If the Actual building is connected to an existing⁴ district heating network, the Notional building will use the same emission and primary energy factors of heat delivered as defined by the user for the Actual building.

Energetik DEN: Existing district heat network with heat carbon intensity of 0.015kgCO₂/kWh

Figure 5—1 Flow chart showing the guidance followed in defining Baseline carbon emissions

5.1 Baseline carbon emissions

The following table sets out the predicted carbon dioxide emissions for the baseline building for each typology.

Table 5-1 Baseline predicted carbon emissions

Typology	Baseline Regulated Carbon Emissions	
	kg CO ₂ /year	Tonnes CO ₂ /year
Domestic	70964.0	71.0
Non-Domestic	46497.0	46.5
Sitewide	117461.0	117.5

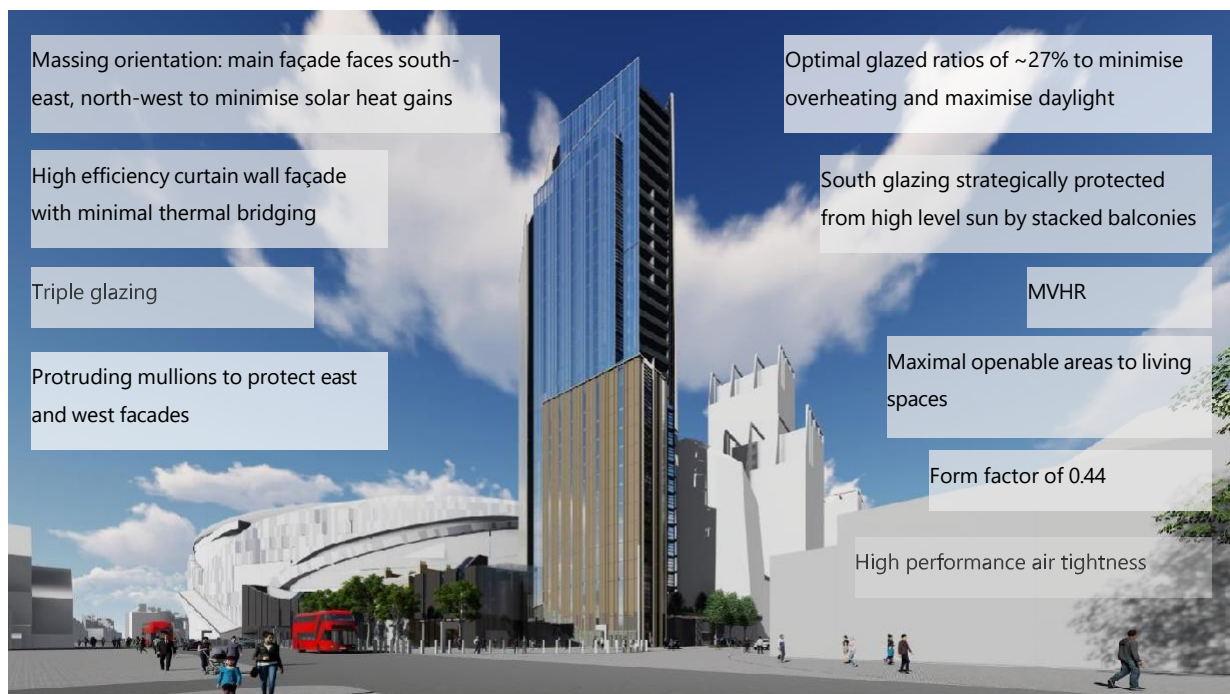
6 Be Lean

This section outlines the strategic demand reduction and energy efficiency measures integrated in the proposed development and their impacts on energy demand and carbon reductions. The values provided are indicative fabric and services specifications which will be reviewed throughout the design process to ensure compliance with Part L and planning policy.

6.1 Passive design strategy

The diagram below shows the key passive design measures that are being employed in the scheme.

Figure 6—1 Summary of passive design measures



The following passive design approaches have been considered and incorporated to minimise the energy consumption of the proposed development:

- Optimised window-to-wall ratio of 27% to limit unwanted solar gains but maintain good levels of daylight
- High levels of airtightness and optimum U-values to minimise heat losses from the thermal envelope;
- Glazing with optimum g-value and U-value to reduce heat gains and losses;
- High performance unitised curtain wall system including triple glazing, additional backing insulation and bespoke, thermally-broken framing system;
- External shading fins or “projected mullions” providing enhanced solar gain mitigation;
- The balconies on the south are strategically positioned to shade the glazing from the high-angle southerly sun to minimise overheating risk.

6.2 Building fabric

The building fabric specification, as set out in the table below, is consistent across all building areas and typologies.

Table 6—1 Fabric specification

Fabric element	Unit	Proposed design	Notional building Part L2 2021
Curtain walling	W/m ² .K	0.64	Walls: 0.18 Windows: 1.4
Glazing g-value*	-	0.4-0.5	0.29
Roof	W/m ² .K	0.13	0.15
Floor	W/m ² .K	0.13	0.15
Airtightness	m ³ /m ² @50Pa	3	3

* Effective g-value created by the external shading structure has been accounted for as an effective g-value.

6.3 Domestic building services

The energy performance values for the proposed building services used in the SAP modelling (10.2) and following Part L1 compliance are set out in the table below.

At the Lean stage of the energy hierarchy, the heating system for residential areas for space heating and domestic hot water is modelled as an individual gas boiler with performance aligned to the Notional building values from Table 1.1 of Part L1 2021, as stipulated by the GLA Energy Assessment Guidance (2022).

Table 6-2 Domestic building services specifications

Element	Value	Notes
Ventilation Specific Fan Power (SFP)	0.58 W/L/s 0.55 W/L/s 0.63 W/L/s	Values provide are from SAP Product Characteristics Database (PCDB) for Kitchen +1 wet rooms, Kitchen +2 wet rooms, Kitchen +3 wet rooms
Ventilation heat recovery efficiency	91 %	Value from PCDB
Lighting	100 %	Energy efficient lighting to be specified
Cooling SEER	4.6	From central air-cooled chiller system

6.4 Non-domestic building services

The energy performance values for the proposed building services for the non-domestic areas following Part L2 compliance are set out in the following tables.

6.4.1 Central heating plant

At all stages of the energy hierarchy the non-domestic heating system for space heating and domestic hot water is modelled as connection to the existing heat network, using the performance values set out in the Be Clean section of this report.

6.4.2 Domestic hot water systems

Table 6—3 Domestic hot water performance assumptions

Item	Units	Value
Cylinder volume	Litres	7200
Cylinder Loss	kWh/l/day	0.0026
Secondary Circulation Pipe Length (total flow & return)	m	2100
Secondary Circulation Pipe Loss	W/m	5.0
Secondary Circulation Pump Power	kW	2.0
Timeswitch		No

6.4.3 Central cooling plant

Table 6—4 Cooling plant performance

Heat source	Fuel	SEER (Seasonal Energy Efficiency Ratio)
Air source heat pumps	Electricity	4.8

6.4.4 Pumping

Variable speed pumping with multiple differential pressure sensors in the field is required for all LTHW and CHW circuit distribution.

6.4.5 Ventilation systems

All main AHUs should be selected to meet the leakage class defined in the below table. Requirements for ductwork pressure testing are also provided.

Table 6—5 Ventilation leakage performance

Parameter	Value
Ductwork Pressure Testing	CEN Class B
AHU Leakage Class	CEN Leakage Class L2

6.4.6 Space conditioning systems

Table 6—6 HVAC system parameters

NCM System	Heat Recovery Type	Heat Recovery Efficiency	Ventilation SFP (W/l/s)	Terminal unit SFP (W/l/s)	Demand controlled ventilation
Fan coil units	Thermal wheel	80%	1.6	0.15	CO ₂ sensors, fan speed controlled

6.4.7 Lighting systems

The following lighting systems have been specified:

- Average luminaire efficacy of 110 Lm/W has been assumed for all spaces
- Daylight linking for all perimeter zones
- Presence detection for all public circulation
- Absence detection for all bedroom and bathrooms

6.4.8 Power factor correction

Power factor correction to greater than 0.95 will be included.

6.4.9 Metering and monitoring

Automatic metering and monitoring with out-of-range alarms is proposed for all mechanical and electrical services. A suitable BeMS system would typically be installed to satisfy this requirement.

6.5 Lean carbon emissions

The following table sets out the predicted carbon dioxide emissions for the Lean building case for each typology in comparison to the relevant Baseline.

Table 6-7 Lean predicted carbon emissions

Typology	Baseline Regulated Carbon Emissions		Lean Regulated Carbon Emissions		
	kg CO ₂ /year	Tonnes CO ₂ /year	kg CO ₂ /year	Tonnes CO ₂ /year	% Improvement over Baseline
Domestic	70964.0	71.0	54913.0	54.9	22.6%
Non-Domestic	46497.0	46.5	43750.0	43.8	5.9%
Sitewide	117461.0	117.5	98663.0	98.7	16.0%

6.6 Residential fabric energy efficiency

Table 6-8 Residential fabric energy efficiency figures – excerpt from GLA spreadsheet

	Target Fabric Energy Efficiency (kWh/m ²)	Dwelling Fabric Energy Efficiency (kWh/m ²)	Improvement (%)
Development total	31.56	27.86	12%

7 Be Clean

In order to deliver the greatest savings in carbon dioxide emissions possible, the feasibility of decentralised systems suitable for the development have been explored below.

London Borough of Haringey and the Greater London Authority strongly promote the implementation of decentralised energy networks (DENs) across London. In alignment with planning policy, the feasibility of a DEN within the context of the development has been assessed through the following hierarchy:

1. Connection to existing/proposed networks
2. Development of a new DEN
3. Site-wide network with provision for future DEN connection

7.1 Energy Networks

With any new development, the potential to connect into an existing or proposed DEN can provide significant benefits for the reduction of carbon dioxide emissions for the development itself and the wider network. This is typically achieved by sharing waste heat and delivering the heat with greater efficiencies that are achievable at a bigger scale. Exploring connection into a planned network can increase the viability of the network itself by creating additional demand and future revenues.

There are proposed district energy networks that will be located in the vicinity of the Proposed Development as the area has been identified as a key development area within the Haringey Sustainable Design and Construction SPG¹. The identified area can be seen as Zone 1 in Figure 7—1 largely driven by the proposals for the regeneration of the North Tottenham, White Hart Lane and Northumberland Park area.

¹ <http://www.haringey.gov.uk/housing-and-planning/planning/planning-policy/local-development-framework-ldf/supplementary-planning-guidance-documents/sustainable-design-and-construction-spd>

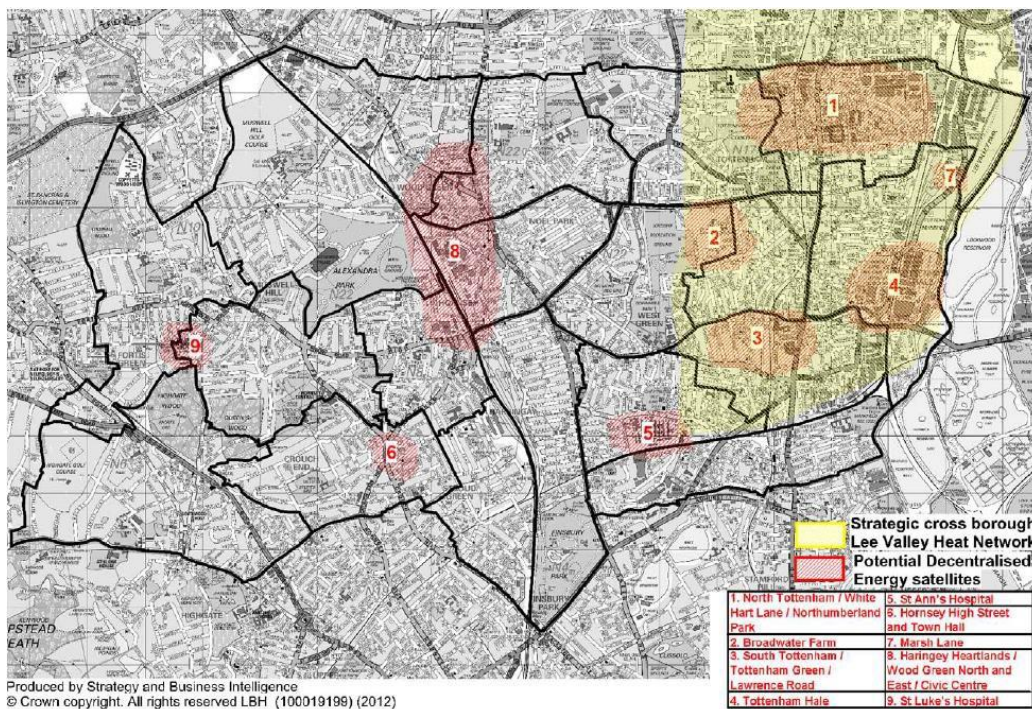


Figure 7—1 Potential for decentralised energy in Haringey (Local Plan: Sustainable Design and Construction SPG Appendices Pg 8)

The London Heat Map below also shows there are proposed district energy networks in the near vicinity of the site: It shows a potential district energy network proposed for Park Lane, to the south of the Application Site. This network is called the “Upper Lee Valley 1 (Haringey and Waltham Forest only)”.

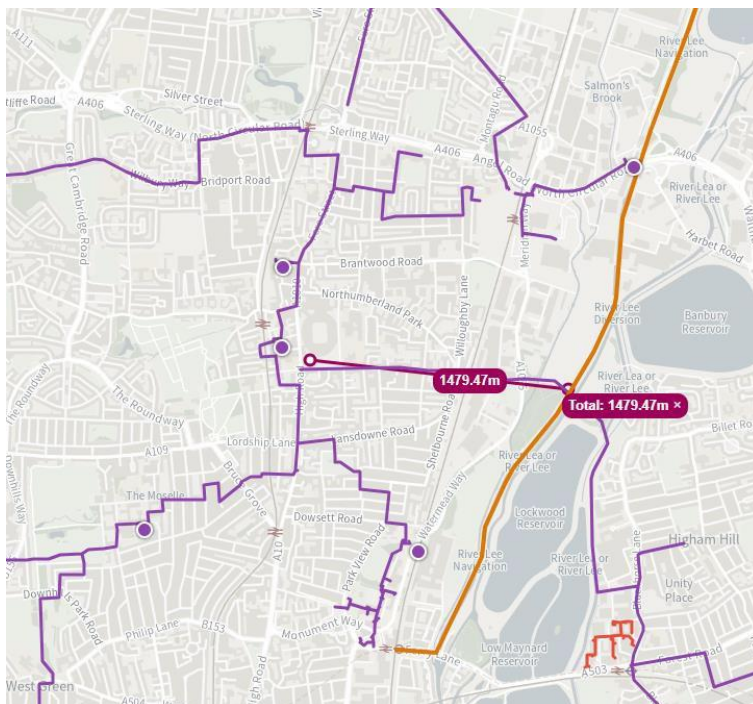


Figure 7—2 Proposed district energy networks running close to the Application Site.

The London Borough of Haringey have previously provided the following heat network map to Buro Happold.

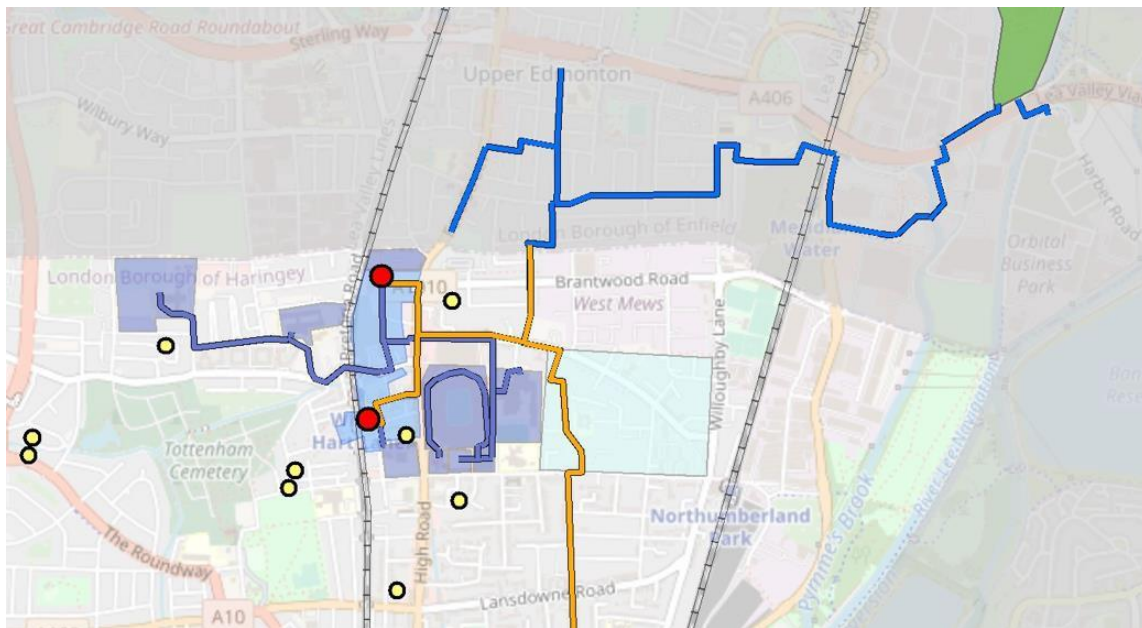


Figure 7—3 Meridian Water Heat Network Proposed Network Routes, Energetik/Meridian Water Network (Blue, Orange, Purple), Energy Centre Locations (Red Dots), Existing HRA sites (Yellow Dots). Provided by LBH

Energetik are one of the operators of a potential DEN. Our latest discussion with Energetik (telephone conversation 12th May 2023), confirmed that their current estimate is that the DEN pipework will be available in the Hotel location towards late 2025.

The Applicant and Buro Happold have been in technical and commercial discussions with Energetik since late 2019 to establish the feasibility of connecting several of the Applicant's developments, including the hotel. Those discussions have culminated in Energetik putting forward Commercial and Residential Development Connection and Supply Agreements, which the Applicant is currently considering in the context of several schemes. As at 12th May 2023, Energetik have advised that the hotel could connect into their DEN from late 2025 onwards, which should fit with the hotel construction programme.

An overview summary of engagement with the DEN Operator is demonstrated below:

Date	Details
12 May 2023	Our latest discussion with Energetik (telephone conversation 12th May 2023), confirmed that their current estimate is that the DEN will be available in the Hotel location towards late 2025.
21 October 2022	Energetik DEN - Residential Development Connection Agreement and Framework Supply Agreement with Subsidiary (Customer) Supply Agreements
21 October 2022	Energetik DEN - Commercial Development Connection & Supply Agreement.
26 April 2021	Design Note on DEN connections for the Proposed High Road West scheme. Including carbon intensity at connection. Standing charges and available capacities.
13 April 2021	Information provided by Energetik on tariffs.
5 November 2019	Design Note on carbon factor appraisal

The energy strategy will seek to connect to the DEN from the first occupation of the hotel building. This strategy assumes that the Energetik DEN is available by 2025 and a connection is technically deliverable and financially viable to allow provision for connection into a district energy network. Taking this into account, the scheme has been designed to include plate heat exchanges and suitable pipework connections.

The proposed basement energy centre has been sized and placed along the Park Lane façade of the Hotel building to ensure ease of later connection in to the proposed route. A diagram illustrating the likely future connection into a DEN can be seen in the following figure.

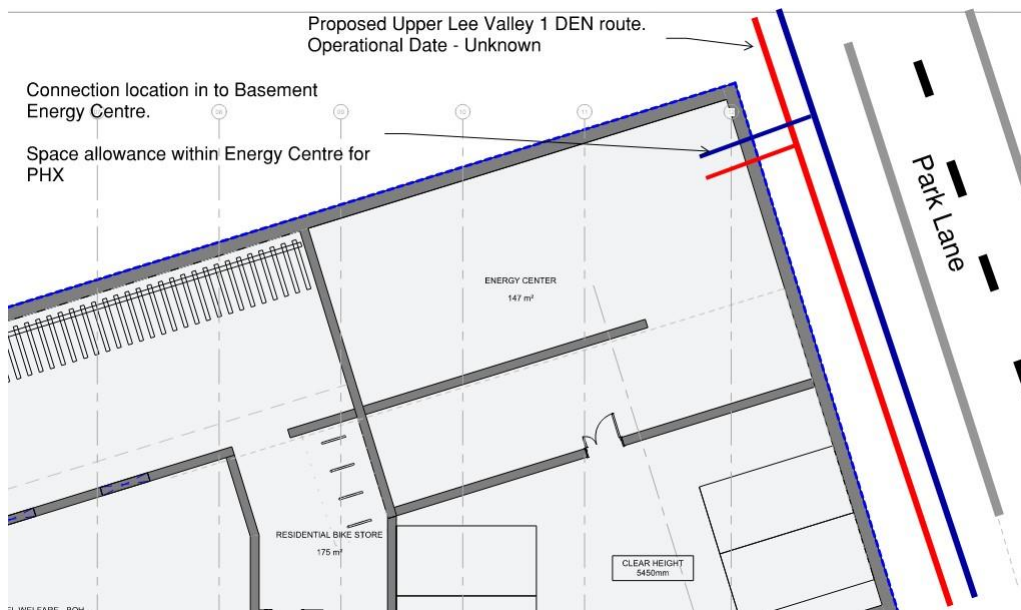


Figure 7—4 Proposed location for future DEN connection into the Application Site

If the DEN connection is unavailable or is otherwise not technically deliverable or financially viable, the proposed fallback solution for heat delivery is as follows:

- Roof-mounted Air-source heat-pumps (ASHP) serving hotel rooms and amenity spaces with low temperature hot water (LTHW) for space heating supplied via underfloor heating or connection in to 4-pipe FCUs for amenity spaces
- Basement located Water-Source heat pumps that raise the hot water temperature supplied by the ASHP to supply domestic hot water for hotel rooms and amenity spaces
- DHW thermal stores
- Provision and a strategy for future connection to a district energy network when it becomes available, and
- Mid-level plant room ASHP serving residential apartments with LTHW for space heating and DHW via apartment Heat Interface Units

There are design provisions in place in terms of space allowance in order to accommodate the above, should this fallback be required.

7.2 Clean carbon emissions

The following table sets out the predicted carbon dioxide emissions for the Clean building case for each typology in comparison to the relevant Baseline.

Table 7-1 Clean predicted carbon emissions

Typology	Baseline Regulated Carbon Emissions		Clean Regulated Carbon Emissions		
	kg CO ₂ /year	Tonnes CO ₂ /year	kg CO ₂ /year	Tonnes CO ₂ /year	% Improvement over Baseline
Domestic	70964.0	71.0	12697.0	12.697	82.1%
Non-Domestic	46497.0	46.5	43750.0	43.75	5.9%
Sitewide	117461.0	117.5	56447.0	56.4	51.9%

8 Be Green

Low and Zero Carbon (LZC) technology can help to deliver significant Carbon Dioxide emissions reductions arising from developments. The table below summarises the potential of various LZC technologies considering the context of the proposed development.

Technology	Comments	Viability
Wind turbine	- Generates electricity - Development is located in a high density urban environment. Wind flows in such locations are often turbulent which significantly reduce the available energy output - No land area for installation of a turbine. Roof mounted vertical axis systems do not offer an efficient method of generation.	 LOW
Biomass	- Generates heat/hot water - Development's location in central London creates difficulties for frequent fuel deliveries and air quality - Poor compatibility with proposed District Heating connection from wider network	 LOW
Air source heat pump	- Generates heat/hot water (pre-heat) - Would only be used as an alternative to the DEN in order to meet space heating requirements. - Potential noise issues and visual impact - Poor compatibility with proposed District Heating connection from wider network.	 MEDIUM
Ground source heat pump	- Generates heat/hot water (pre-heat) - Requires close coupling to building piles which have already been built. - Not enough ground availability for a large shallow area in which a 'slinky' can be laid - Poor compatibility with proposed District Heating connection from wider network	 LOW
Solar thermal	- Generates heat/hot water - Low maintenance, efficient technology - Moderate Carbon Dioxide emissions savings due to displacement of natural gas instead of Carbon Dioxide emissions intensive grid electricity - Most suitable for hotel and residential application, however there is limited ratio of available roof area to NIA. - Poor compatibility with proposed District Heating connection from wider network	 MEDIUM

Solar Photovoltaics (PV)	• Generates electricity • Roof areas are available as identified • Simple installation, low maintenance • Good delivered Carbon Dioxide emissions savings for the development compared to Carbon Dioxide emissions intensive national grid supply	HIGH
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As demonstrated above, LZC options for the development are limited to solar technologies. It is considered that the limited roof area available would be more beneficial for solar photovoltaics from a Carbon Dioxide emissions reduction perspective as heat-based savings will be delivered from the DEN connection. If the DEN becomes unviable then this LZC strategy will be reappraised

8.1.1 Proposed solution

The image below shows the roof plan with the required plant room space located to the north. The remaining space to the south is dedicated to photovoltaics which will be dedicated to the non-domestic usage.

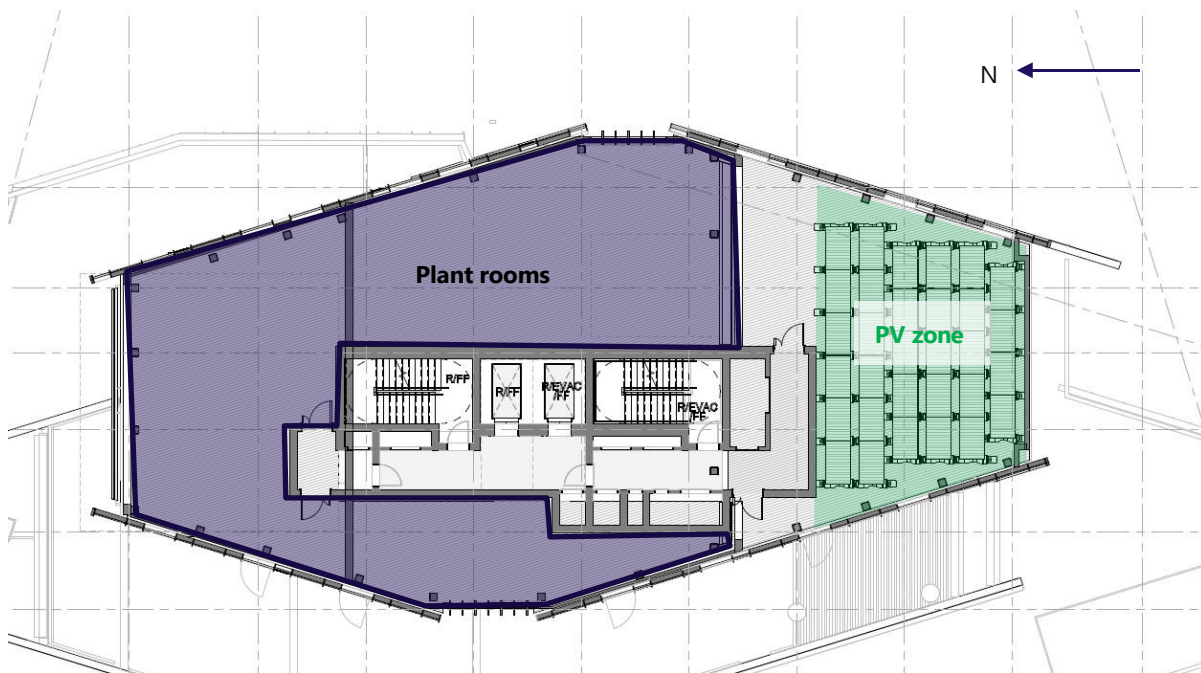


Figure 8—1 Photovoltaics located on the roof

8.2 Green carbon emissions

The following table sets out the predicted carbon dioxide emissions for the Green building case for each typology in comparison to the relevant Baseline.

Table 8-1 Green predicted carbon emissions

Typology	Baseline Regulated Carbon Emissions		Green Regulated Carbon Emissions		
	kg CO ₂ /year	Tonnes CO ₂ /year	kg CO ₂ /year	Tonnes CO ₂ /year	% Improvement over Baseline
Domestic	70964.0	71.0	14182.0	14.182	80.0%
Non-Domestic	46497.0	46.5	44839.0	44.839	3.6%
Sitewide	117461.0	117.5	59021.0	59.0	49.8%

9 Energy hierarchy summary

The carbon emissions results for each stage of the London Plan energy hierarchy have been collated in the format required for the planning submission, using the latest version of the GLA's Carbon Emissions Reporting Spreadsheet V2.0. The following figures and tables outline the carbon emissions of each typology and the site overall.

9.1 Residential carbon emissions

Table 9-1 Table showing the estimated annual carbon emissions at each stage of the energy hierarchy (Part L 2021) – Residential

	Carbon Dioxide Emissions for residential buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	71.0	31.4
After energy demand reduction (be lean)	54.9	31.4
After heat network connection (be clean)	12.7	31.4
After renewable energy (be green)	14.2	31.4

Table 9-2 Table showing the estimated carbon savings at each stage of the energy hierarchy (Part L 2021) – Residential

	Regulated residential carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: savings from energy demand reduction	16.1	23%
Be clean: savings from heat network	42.2	59%
Be green: savings from renewable energy	-1.5	-2%
Cumulative on site savings	56.8	80%
Annual savings from off-set payment	14.2	-
	(Tonnes CO ₂)	
Cumulative savings for off-set payment	425	-
Cash in-lieu contribution (£)	40,420	

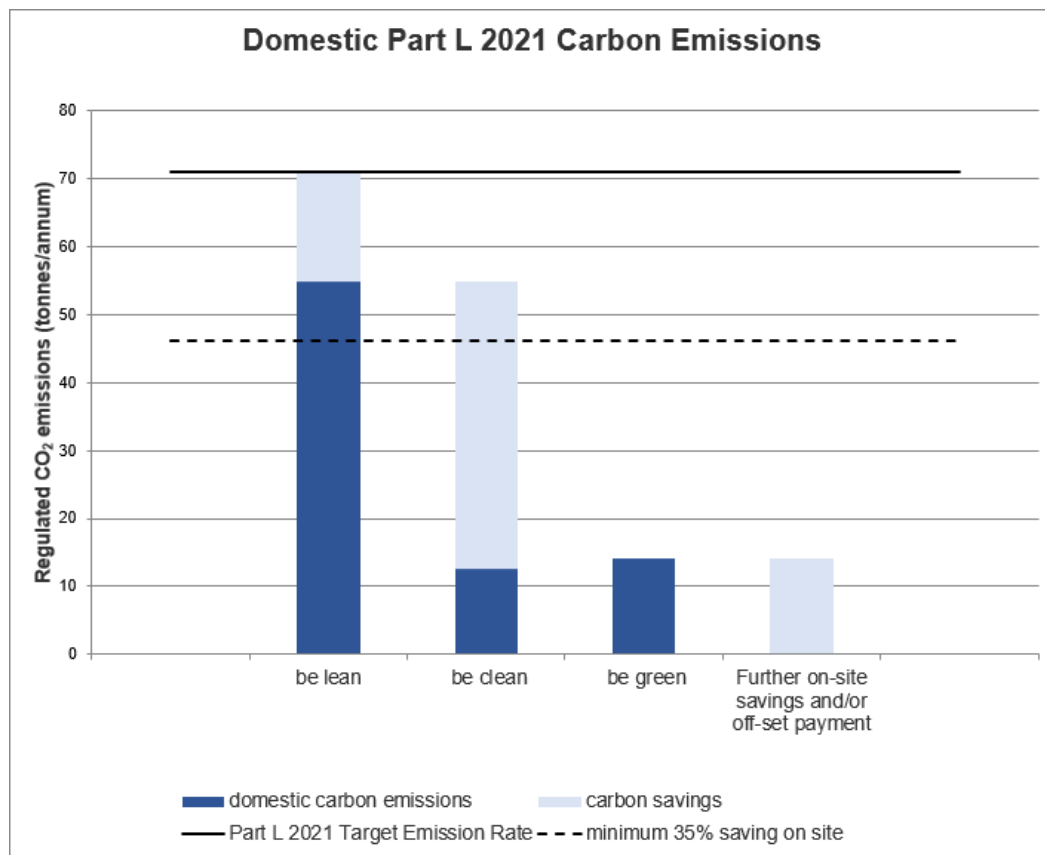


Figure 9—1 Graph showing carbon savings at each stage of the energy hierarchy (Part L 2021) – Residential

The residential carbon emissions results demonstrate compliance with the 10% reduction target through energy efficiency measures alone. The results also demonstrate compliance with the 35% reduction target through on-site measures.

9.2 Non-domestic carbon emissions

Table 9-3 Table showing the estimated annual carbon emissions at each stage of the energy hierarchy (Part L 2021)– Non-domestic

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	46.5	10.8
After energy demand reduction (be lean)	43.7	10.8
After heat network connection (be clean)	43.7	10.8
After renewable energy (be green)	44.8	10.8

Table 9-4 Table showing the estimated carbon reductions at each stage of the energy hierarchy (Part L 2021)– Non-domestic

Regulated non-residential carbon dioxide savings		
	(Tonnes CO ₂ per annum)	(%)
Be lean: savings from energy demand reduction	2.7	6%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	-1.1	-2%
Cumulative Savings	1.7	4%
Annual savings from off-set payment	44.8	-
(Tonnes CO ₂)		
Cumulative savings for off-set payment	1,345	-
contribution (£)	127,791	

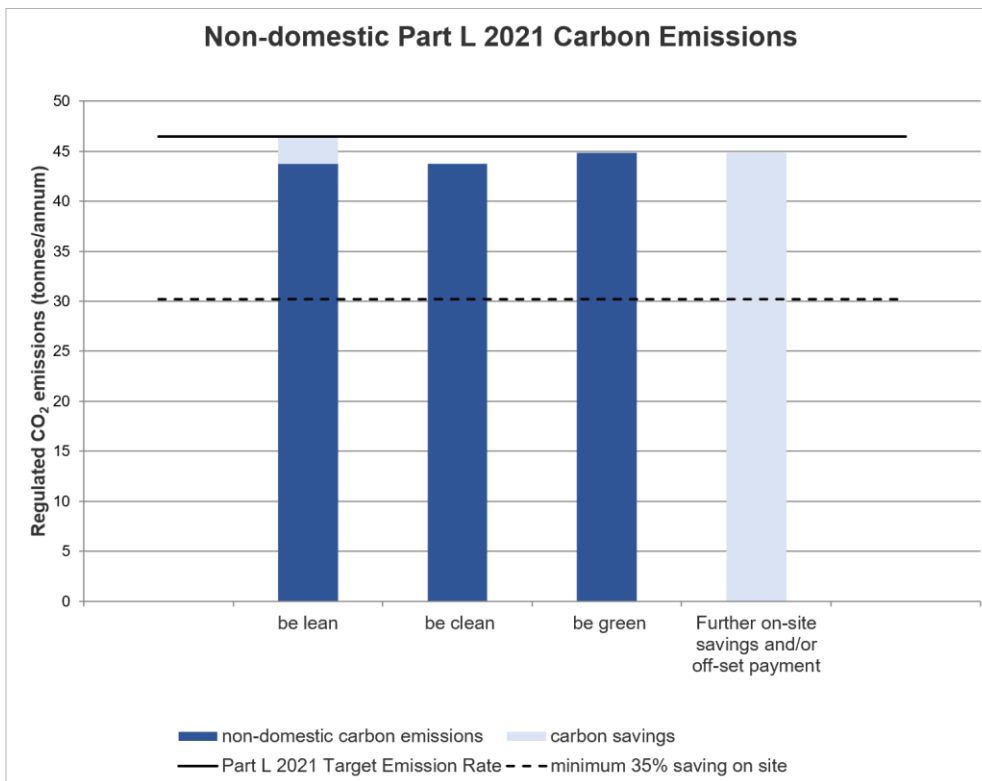


Figure 9—2 Graph showing carbon savings at each stage of the energy hierarchy (Part L 2021) – Non-domestic

The non-domestic carbon emissions results show compliance with the 15% reduction target through energy efficiency measures alone has not been achieved. The results also show compliance with the 35% reduction target through on-site measures has not been achieved.

Although the building design includes high performance façade and building services, the building does not achieve the targets because the Baseline building has an unrealistically low domestic hot water demand, as stipulated by the building typology.

That the building does not strictly comply with policy carbon emissions reduction targets is not uncommon and is addressed explicitly within the GLA's cover note entitled "Energy Assessment Guidance updates - Part L 2021 of building regulations", as shown below.

- Initially, non-residential developments may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35 per cent improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments. However, planning applicants will still be expected to follow the energy hierarchy to maximise carbon savings before offsetting is considered.

Figure 9—3 Extract from "Energy Assessment Guidance updates - Part L 2021 of building regulations"

The development still follows the energy hierarchy, as described in the previous sections, by first reducing energy demand, reducing energy intensity of system, then supplying energy via low carbon sources in order to maximise carbon savings.

9.3 Site wide carbon emissions

Table 9-5 Table showing the estimated carbon reductions at each stage of the energy hierarchy (Part L 2021) – site-wide

	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L 2021 baseline	117.5		
Be lean	98.7	18.8	16%
Be clean	56.4	42.2	36%
Be green	59.0	-2.6	-2%
Total Savings	-	58.4	50%
	-	CO ₂ savings off-set (Tonnes CO ₂)	-
Off-set	-	1,770.6	-

For both residential and non-domestic areas, at the Lean and Clean stages the presented carbon emissions include savings from the PV generation of the Notional Building as stipulated in section 7.7 of the GLA's Energy Assessment Guidance (June 2022), shown below. This results in an apparent increase in carbon emissions between the Clean, and

Green stages. This is an outcome of the calculation methodology and does not represent actual increase in emissions.

- 7.7. The applicant must clearly identify the extent to which Part L 2021 of the Building Regulations is exceeded through the use of these demand reduction measures alone, i.e. the percentage improvement of the BER/DER over the Target CO₂ Emissions Rate (TER)¹⁹ before the inclusion of a heat network connection and use of on-site renewables. Where the TER includes on-site renewable generation from PV, the carbon emissions reporting spreadsheet will automatically enable savings from 'be lean' measures only to be reported.

Figure 9—4 Extract from “GLA Energy Assessment Guidance (June 2022)”

10 Be Seen

The New London Plan Policy SI 2 stipulates that all major development proposals must be designed to be capable of monitoring and reporting on their actual operational energy performance. This data driven approach to building performance aims to bridge the 'performance gap' through understanding discrepancies between design theory and in-use operation.

'Be Seen' has been added to the GLA energy hierarchy to further outline the critical impact that post occupancy monitoring and comparative assessment has on the energy use of a building and its value to the industry as a means of rationalising design. The figure below outlines the reporting required at each stage of development and the associated parties responsible for collating this information:

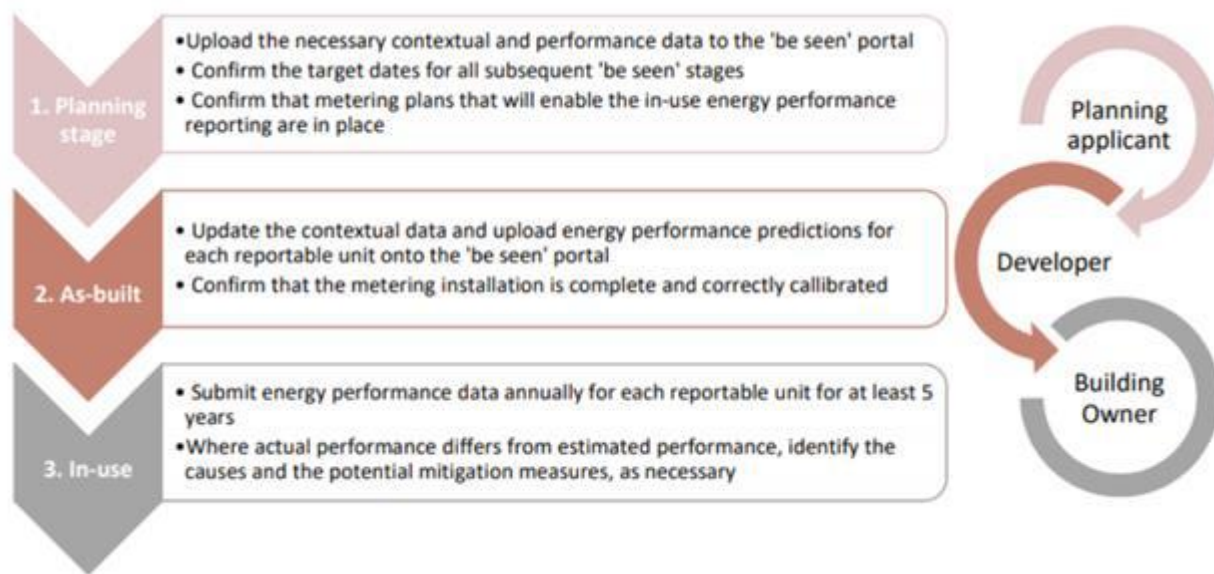


Figure 10—1 'Be Seen' processes and responsibilities

10.1 Metering Guidance & Legislation

Effective energy metering in line with the Be Seen requirements will be enabled by the provision of suitable infrastructure within the buildings services systems. The methodology used broadly follows the recommendations set out, for non-domestic buildings, in CIBSE TM39: 2009 Building Energy Metering, BREEAM 2018 NC, as well as the principles set out in NABERS-UK Rules for Metering and Consumptions (May 2022).

The Metering and monitoring of residential areas will consider the same concepts as well as the Heat Network Metering and Billing Regulations (2014) to allow for accurate billing of the apartments connected to the communal ambient loop system.

10.1.1 Domestic Legislation and Guidance

- Water – approved meters for the monitoring and billing of the water consumed are required to meet standards set out by OFWAT

- Heat Networks – regulations developed by the Department for Business, Energy & Industrial Strategy apply (Heat Network (Metering and Billing) Regulations 2014)
- Part L1A -2021– Building Regulations specific to domestic buildings.
- CIBSE TM 39 :2009 Building Energy Metering – although written for non-domestic buildings, the principles of metering strategies can be adapted for residential buildings
- BRE Home Quality Mark for Energy and Water
- LETI Climate Emergency Design Guide (pages 98-107)

10.1.2 Non-Domestic Legislation and Guidance

- Electricity - approved tariff-based meters, meeting standards set out by the Office of Gas and Electricity Markets (OFGEM) are required for energy monitoring and billing purposes
- Water – approved meters for the monitoring and billing of the water consumed are required to meet standards set out by the Office of Water Services (OFWAT)
- Heat Networks – regulations developed by the Department for Business, Energy & Industrial Strategy apply (Heat Network (Metering and Billing) Regulations 2014)
- Part L2A -2013 – Building Regulations specific to non-domestic buildings;
- CIBSE TM 39:2009 Building Energy Metering
- BREEAM 2018 – Ene02 Energy Monitoring
- CIBSE TM 22 - Energy assessment and reporting method
- The European Measuring Instruments Directive (MID) 2004/22/EC, Measuring Instruments Directive
- GLA “Be Seen” Energy Monitoring Guidance – October 2020
- NABERS-UK Rules for Metering and Consumptions (May 2022)

10.2 Proposed Metering Strategy

The proposed metering strategy of the building by the MEP consultant will include the following:

- Additional meter on the main resident’s supply (or residents meter readings need to be collected and collated individually)
- Renewables are sub-metered for generation
- Special uses (such as electric vehicle charging) is sub-metered
- Individual bi-directional heat meters per dwelling
- Provide a visual energy display device to raise awareness and make users responsible for their energy consumption
- Meter and report landlord areas separately
- Commercial areas metered and reported separately
- Ensure OFGEM compliant meters
- Upload data to publicly accessible platform for five years

11 Overheating

11.1 The Overheating Strategy

The current drivers for thermally comfortable design are the GLA's Overheating Mitigation Hierarchy and Building Regulations Part O 2021. The following diagram outlines the strategy employed on the scheme and how overheating has been mitigated in line with this hierarchy. As stated within policy, all developments must make reasonable endeavours to mitigate overheating risks and ensure cooling demands are managed to prevent excessive energy consumption from air-conditioning systems.

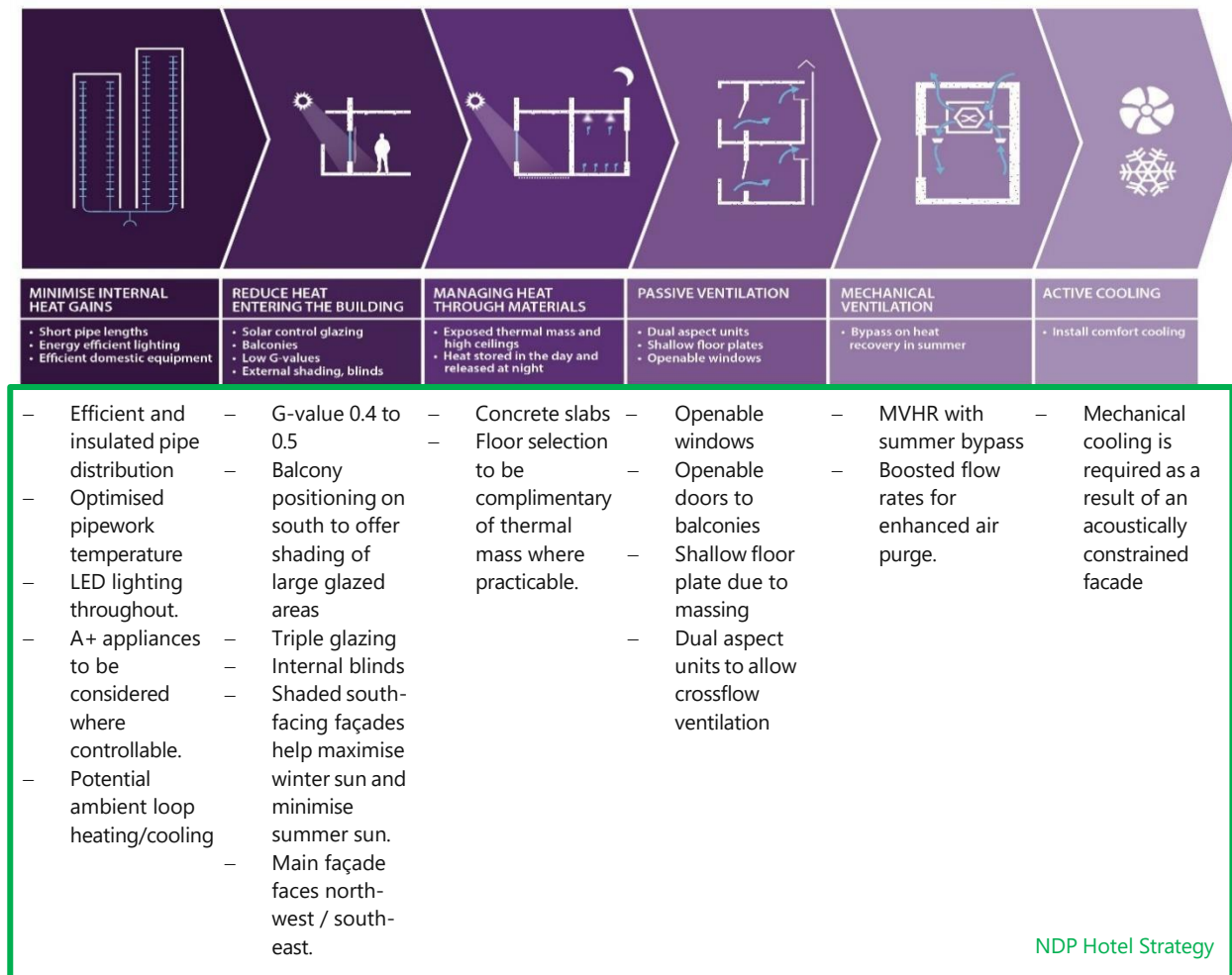


Figure 11—1 Overheating mitigation strategy

11.2 Dynamic Thermal Modelling

Dynamic thermal modelling has been undertaken to help direct the façade design and determine any residual overheating risk. Two sample floors were modelled with the higher risk units on the south-east, south and south-west included. Currently, there is minimal surrounding shading from other buildings to the critical orientations of east, south and west. The future buildings proposed to the east have been excluded to account for a worst-case overheating scenario. The image below shows the dynamic 3D overheating model in IES.

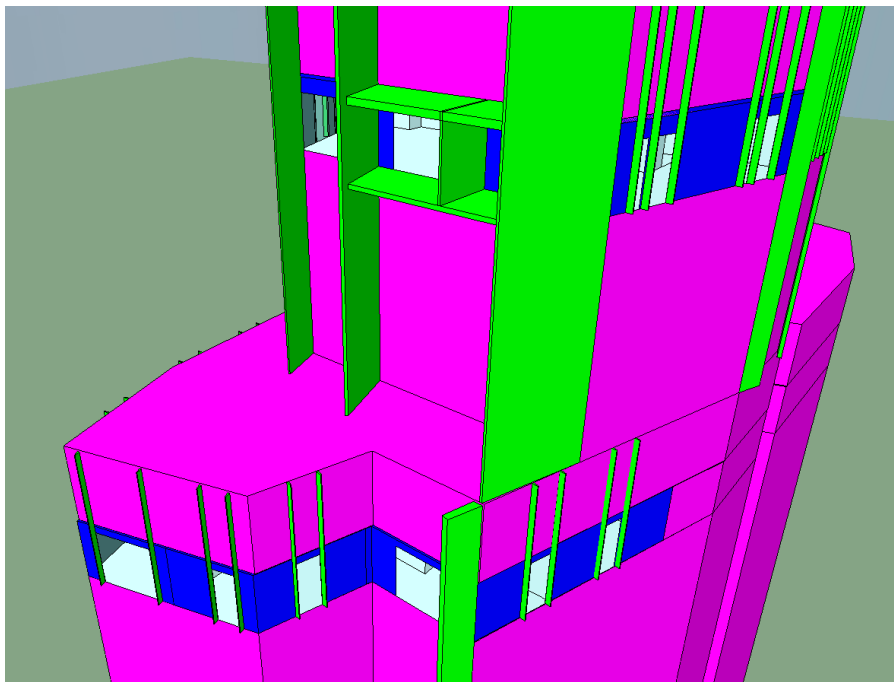


Figure 11—2 Dynamic 3D overheating model in IES

As per GLA guidance, an “unconstrained” façade has been modelled in the first instance to show the performance without any acoustics constraints. The results below show that all spaces comply with the requirements.

Table 11—1 Unconstrained façade TM59 overheating results.

Room Name	Hours occupied	Hours exceeded	Hours exceeded (%)	Criterion a	% Hours < 26C	Criterion b	TM59 Result
Level 14_S-E-suite_bedroom1	3672	0	0.0	Pass	0.5	Pass	Pass
Level 14_S-E-suite_bedroom2	3672	0	0.0	Pass	0.6	Pass	Pass
Level 14_S-E-suite_Living(D)	1989	6	0.3	Pass		N/A	Pass
Level 14_S-W-suite_bedroom3	3672	84	2.3	Pass	0.7	Pass	Pass
Level 14_S-W-suite_bedroom2	3672	74	2.0	Pass	0.7	Pass	Pass
Level 14_S-W-suite_bedroom1	3672	54	1.5	Pass	0.7	Pass	Pass
Level 14_S-E-suite_kitchen	1989	3	0.2	Pass		N/A	Pass
Level 14_S-W-suite_living	1989	49	2.5	Pass		N/A	Pass

Building Regulations Part O 2021 has introduced a requirement to not exceed noise levels at night-time within bedrooms. Acoustics modelling has demonstrated that the noise levels of the location will require night-time acoustic attenuation to bedrooms to comply with the criteria. Façade constraints have been modelled separately below to show the impact of installing acoustic louvres, by limiting the openable free area. Results demonstrate that even with Acoustic Louvres, bedrooms are no longer maintained within the TM59 comfort range.

Furthermore, unfortunately, Acoustic Louvres do not provide significant enough attenuation from event-day noise from the stadium, even when closed, which rules out their application. Full details are available in the acoustics report. This also applies to living room and kitchen spaces where compliance can be demonstrated with TM59 comfort conditions.

Table 11—2 Acoustically constrained façade TM59 overheating results.

Room Name	Hours occupied	Hours exceeded	Hours exceeded (%)	Criterion a	% Hours < 26C	Criterion b	TM59 Result
Level 14_S-E-suite_bedroom1	3672	4	0.1	Pass	1.8	Fail	Fail
Level 14_S-E-suite_bedroom2	3672	18	0.5	Pass	1.6	Fail	Fail
Level 14_S-E-suite_Living(D)	1989	11	0.6	Pass		N/A	Pass
Level 14_S-W-suite_bedroom3	3672	148	4.0	Fail	1.6	Fail	Fail
Level 14_S-W-suite_bedroom2	3672	136	3.7	Fail	1.8	Fail	Fail
Level 14_S-W-suite_bedroom1	3672	97	2.6	Pass	2.2	Fail	Fail
Level 14_S-E-suite_kitchen	1989	8	0.4	Pass		N/A	Pass
Level 14_S-W-suite_living	1989	53	2.7	Pass		N/A	Pass

To resolve the residual overheating risk, as result of an acoustically constrained façade, mechanical cooling will be implemented. Nonetheless, openable windows will still be provided to give occupants control and choice of their environment. Mechanical systems will ensure that cooling is not activated whilst windows are open.

12 Policy compliance summary

The compliance matrix in the table below has been produced to summarise and provide clarity on the performance of the development against the requirements of building regulations and planning policy.

The proposed development is compliant with almost all policy requirements. Where compliance is not achieved this is only due to significant design constraints from the building typology and local area as summarised in the Notes column.

Table 12—1 Policy compliance matrix

Document	Policy	Performance target	Compliance	Notes
LBH Strategic Policies 2013 with alterations adopted July 2017	SP4 Working towards a low carbon Haringey	Residential - 25% reduction in carbon emissions (on Part L 2013 Baseline) through on-site measures	Yes	Exceeded through compliance with London Plan Policy SI 2
		Non-domestic - achieve minimum BREEAM rating of 'Very Good', with aspiration for 'Excellent'	Yes	As set out in Sustainability Statement
		Site-wide net-zero carbon (regulated)	Yes	Cash-in-lieu carbon offset payment calculated using GLA Carbon Emissions Reporting Tool
		Promote low- and zero-carbon energy generation	Yes	Proposed connection to existing Energetik DEN and roof-mounted PV array
LBH Development Management DPD (adopted July 2017)	DM22 Decentralised Energy	Promote provision and use of Decentralised Energy Network infrastructure	Yes	Proposed connection to existing Energetik DEN
London Plan 2021	SI 2 Minimising greenhouse gas emissions	Residential - 10% reduction in carbon emissions (against Part L 2021 Baseline) through energy efficiency measures alone (Lean)	Yes	As demonstrated in carbon emissions results in energy hierarchy summary section
		Residential - Overall 35% reduction in carbon emissions (against Part L 2021 Baseline) through on-site measures	Yes	As demonstrated in carbon emissions results in energy hierarchy summary section
		Non-domestic - 15% reduction in carbon emissions (against Part L 2021 Baseline) through energy efficiency measures alone (Lean)	No	Unfeasible to achieve due to energy demand dominated by domestic hot water load because of building typology

Document	Policy	Performance target	Compliance	Notes
		Non-domestic - Overall 35% reduction in carbon emissions (against Part L 2021 Baseline) through on-site measures	No	Unfeasible to achieve as carbon emissions reductions from DEN are not accounted for in methodology.
		Site-wide - 35% overall carbon reduction through on-site measures	Yes	As demonstrated in carbon emissions results in energy hierarchy summary section
		Maximise on-site renewable energy generation	Yes	Maximum feasible area of roof-mounted PV array proposed
		Net-zero carbon' (regulated) through offset of residual carbon emissions	Yes	Cash-in-lieu carbon offset payment calculated using GLA Carbon Emissions Reporting Tool
	SI 3 Energy Infrastructure	Select heat source in accordance with the Heating Hierarchy to prioritise decentralised energy networks	Yes	Connection to existing Energetik DEN proposed
	SI 4 Managing heat risk	Reduce the potential for internal overheating and reliance on air conditioning systems	Partial	Compliance demonstrated in 'unconstrained' window opening scenario but acoustic constraints mean mechanical cooling is required

Appendix A – SAP Worksheets

Full SAP Calculation Printout



Property Reference	THFC-L20-03	Issued on Date	24/07/2023
Assessment Reference	V1 THFC-L20-03 DHN PlanA	Prop Type Ref	
Property			
SAP Rating		DER	TER
Environmental		% DER < TER	
CO ₂ Emissions (t/year)	0	DFEE	TFEE
Compliance Check	See BREL	% DFEE < TFEE	
% DPER < TPER		DPER	TPER
Assessor Details	Miss Laura Plazas	Assessor ID	T491-0001
Client			

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 409.2624 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 0.0000 / (5) = 0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (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
Glazed (U _w = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements A _{um} (A, m ²)			84.0000				(31)

	Losses (e.g. Evaporation (negative values) (Table 5)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589 (71)
Water heating gains (Table 5)	167.8626	165.0478	159.6483	147.8454	140.6090	133.0482	128.4180	132.2642	136.7710	145.1606	156.4768	166.3559 (72)
Total internal gains	699.5368	716.6303	686.4481	662.6367	628.4870	605.7108	582.2487	582.8879	600.6721	621.0700	659.2996	684.3941 (73)

[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
South	14.8500	46.7521	0.5000	1.0000	0.7700	240.5639 (78)
West	23.7900	19.6403	0.5000	1.0000	0.7700	161.8993 (80)

Solar gains	402.4632	710.6911	1023.4381	1327.9003	1523.3218	1523.1499	1464.3329	1320.1727	1130.8686	800.7486	487.0197	341.0075	(83)
Total gains	1102.0001	1427.3214	1709.8862	1990.5371	2151.8087	2128.8607	2046.5816	1903.0605	1731.5406	1421.8186	1146.3193	1025.4016	(84)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nll,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	43.5645	43.7761	43.9897	45.0901	45.3168	46.4854	46.4854	46.7264	46.0108	45.3168	44.8656	44.4234
alpha	3.9043	3.9184	3.9326	4.0060	4.0211	4.0990	4.0990	4.1151	4.0674	4.0211	3.9910	3.9616
util living area	0.8957	0.7966	0.6689	0.5037	0.3657	0.2503	0.1793	0.2005	0.3334	0.5869	0.8182	0.9124 (86)
MIT	20.1119	20.4846	20.7595	20.9310	20.9834	20.9975	20.9995	20.9993	20.9917	20.8995	20.5274	20.0511 (87)
Th 2	20.3963	20.3990	20.4018	20.4156	20.4183	20.4322	20.4322	20.4350	20.4267	20.4183	20.4128	20.4073 (88)
util rest of house	0.8857	0.7812	0.6490	0.4820	0.3437	0.2282	0.1562	0.1759	0.3063	0.5598	0.8014	0.9037 (89)
MIT 2	19.3542	19.8089	20.1360	20.3434	20.4024	20.4301	20.4319	20.4345	20.4195	20.3154	19.8787	19.2879 (90)
Living area fraction	19.7280	20.1422	20.4436	20.6333	20.6890	20.7100	20.7119	20.7131	fLA = Living area / (4) =			0.4933 (91)
MIT	19.7280	20.1422	20.4436	20.6333	20.6890	20.7100	20.7119	20.7131	20.7018	20.6036	20.1987	19.6644 (92)
Temperature adjustment												0.0000
adjusted MIT	19.7280	20.1422	20.4436	20.6333	20.6890	20.7100	20.7119	20.7131	20.7018	20.6036	20.1987	19.6644 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8735	0.7742	0.6505	0.4902	0.3540	0.2390	0.1676	0.1880	0.3193	0.5685	0.7949	0.8915	(94)
Useful gains	962.5465	1105.0567	1112.2245	975.7160	761.6713	508.8774	343.0208	357.8439	552.9668	808.3540	911.1671	914.1460	(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	1374.0693	1350.9620	1229.8590	1009.6487	769.6334	509.9869	343.2101	358.1449	556.7179	856.4995	1132.7816	1350.6862	(97)
Space heating kWh	306.1730	165.2484	87.5201	24.4316	5.9238	0.0000	0.0000	0.0000	0.0000	35.8202	159.5624	324.7860	(98a)
Space heating requirement - total per year (kWh/year)												1109.4654	
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	306.1730	165.2484	87.5201	24.4316	5.9238	0.0000	0.0000	0.0000	0.0000	35.8202	159.5624	324.7860	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1109.4654	
Space heating per m2											(98c) / (4) =	7.9429	(99)

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9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	0.9500	(303a)
Fraction of heat from community Boilers-Space and Water	0.0500	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
306.1730 165.2484 87.5201 24.4316 5.9238 0.0000 0.0000 0.0000 0.0000 35.8202 159.5624 324.7860	(98)	
Space heat from Waste Heat = (98) x 0.95 x 1.00 x 1.50		
307a 436.2965 235.4789 124.7161 34.8150 8.4414 0.0000 0.0000 0.0000 0.0000 51.0438 227.3764 462.8200		
Space heat from Boilers = (98) x 0.05 x 1.00 x 1.50		
307b 22.9630 12.3936 6.5640 1.8324 0.4443 0.0000 0.0000 0.0000 0.0000 2.6865 11.9672 24.3589		
Space heating requirement		
459.2595 247.8726 131.2801 36.6474 8.8857 0.0000 0.0000 0.0000 0.0000 53.7303 239.3436 487.1789	(307)	
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system		
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(309)	
Water heating		
Annual water heating requirement		
297.8884 263.3715 279.5081 244.9335 236.9059 212.8915 209.6274 218.2335 220.9528 247.0904 263.6240 294.5169	(64)	
Water heat from Waste Heat = (64) x 0.95 x 1.00 x 1.50		
310a 424.4910 375.3045 398.2991 349.0302 337.5909 303.3704 298.7191 310.9828 314.8578 352.1038 375.6642 419.6866		
Water heat from Boilers = (64) x 0.05 x 1.00 x 1.50		
310b 22.3416 19.7529 20.9631 18.3700 17.7679 15.9669 15.7221 16.3675 16.5715 18.5318 19.7718 22.0888		
Water heating fuel		
446.8326 395.0573 419.2622 367.4002 355.3589 319.3373 314.4411 327.3503 331.4293 370.6356 395.4360 441.7754	(310)	
Cooling System Energy Efficiency Ratio		
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 57.0892 61.5643 55.1186 0.0000 0.0000 0.0000 4.6000	(314)	
Pumps and Fa 36.8087 33.2465 36.8087 35.6213 36.8087 35.6213 36.8087 36.8087 35.6213 36.8087 35.6213 36.8087	(331)	
Lighting 33.4734 26.8536 24.1787 17.7144 13.6831 11.1792 12.4822 16.2248 21.0744 27.6507 31.2315 34.4037	(332)	
Electricity generated by PVs (Appendix M) (negative quantity)		
(333a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(333a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)		
(334a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(334a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)		
(335a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(335a)	
Electricity generated by PVs (Appendix M) (negative quantity)		
(333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(333b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)		
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(334b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)		
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(335b)	
Annual totals kWh/year		
Space heating fuel - community heating	1664.1981	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	4484.3160	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	16.6420	(313)
Space cooling fuel	173.7721	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)		
mechanical ventilation fans (SFP = 0.8680)	433.3925	(330a)
Total electricity for the above, kWh/year	433.3925	(331)
Electricity for lighting (calculated in Appendix L)	270.1496	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	7025.8284	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Waste Heat			100.0000 (367)
Space and Water heating from Waste Heat	5841.0884	0.0150	23.7148 (367)
Efficiency of heat source Boilers			85.0000 (367)
Space and Water heating from Boilers	361.6773	0.2100	20.5577 (368)
Electrical energy for heat distribution (space & water)	16.6420	0.0000	8.9596 (372)
Overall CO2 factor for heat network			0.0281 (386)
Total CO2 associated with community systems			172.5282 (373)
Space and water heating			172.5282 (376)
Space cooling	173.7721	0.1143	19.8576 (377)
Pumps, fans and electric keep-hot	433.3925	0.1387	60.1169 (378)
Energy for lighting	270.1496	0.1443	38.9909 (379)
Total CO2, kg/year			291.4936 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.0900 (384)

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13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	5841.0884	0.0630	99.6023	(467)
Efficiency of heat source Boilers			85.0000	(467b)
Space and Water heating from Boilers	361.6773	1.1300	110.6202	(468)
Electrical energy for heat distribution (space & water)	16.6420	0.0000	94.6241	(472)
Overall CO2 factor for heat network			0.1417	(486)
Total CO2 associated with community systems			871.3080	(473)
Space and water heating			871.3080	(476)
Space cooling	173.7721	1.4211	246.9538	(477)
Pumps, fans and electric keep-hot	433.3925	1.5128	655.6362	(478)
Energy for lighting	270.1496	1.5338	414.3645	(479)
Total Primary energy kWh/year			2188.2625	(483)
Dwelling Primary energy Rate (DPER)			15.6700	(484)

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	139.6800	(1b)	x	2.9300 (2b) =
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800			409.2624 (1b) - (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000	Air changes per hour / (5) =	0.0977 (8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3477	(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) =	0.2956	(21)

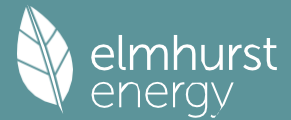
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3769	0.3695	0.3621	0.3251	0.3177	0.2808	0.2808	0.2734	0.2956	0.3177	0.3325	0.3473	(22b)
Effective ac	0.5710	0.5683	0.5656	0.5529	0.5505	0.5394	0.5394	0.5374	0.5437	0.5505	0.5553	0.5603	(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 Curtain (Uw = 1.30)			34.8900	1.2357	43.1150			(27)
Curtain Wall	84.0000	34.8900	49.1100	0.1800	8.8398			(29a)
Total net area of external elements Aum(A, m2)			84.0000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	51.9548		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			100.0000 (35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total

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E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	0.0000	0.0500	0.0000
E7 Party floor between dwellings (in blocks of flats)	51.6100	0.0700	3.6127
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.1500	0.0200	0.1030
E16 Corner (normal)	5.8600	0.0900	0.5274
E18 Party wall between dwellings	5.8600	0.0600	0.3516
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.5947 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	56.5495 (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	77.1189	76.7465	76.3814	74.6669	74.3461	72.8527	72.8527	72.5762	73.4279	74.3461	74.9950	75.6735	(38)
Heat transfer coeff	133.6684	133.2960	132.9310	131.2164	130.8956	129.4022	129.4022	129.1257	129.9774	130.8956	131.5445	132.2230	(39)
Average = Sum(39)m / 12 =												131.2148	
HLP	0.9570	0.9543	0.9517	0.9394	0.9371	0.9264	0.9264	0.9244	0.9305	0.9371	0.9418	0.9466	(40)
HLP (average)												0.9394	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9165 (42)
Hot water usage for mixer showers	73.1195	72.0207	70.4194	67.3558	65.0949	62.5735	61.1404	62.7295	64.4715	67.1786	70.3081	72.8394	(42a)
Hot water usage for baths	31.5670	31.0982	30.4380	29.2207	28.3093	27.2986	26.7526	27.4082	28.1220	29.2035	30.4458	31.4603	(42b)
Hot water usage for other uses	44.4976	42.8795	41.2614	39.6433	38.0252	36.4071	36.4071	38.0252	39.6433	41.2614	42.8795	44.4976	(42c)
Average daily hot water use (litres/day)												137.1337	(43)
Daily hot water use	149.1841	145.9984	142.1188	136.2198	131.4293	126.2792	124.3002	128.1629	132.2368	137.6435	143.6334	148.7973	(44)
Energy conte	236.2712	207.8997	218.4314	186.4781	176.9292	155.2750	150.3303	158.6925	163.0612	186.7809	204.6321	232.9805	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m	35.4407	31.1850	32.7647	27.9717	26.5394	23.2913	22.5495	23.8039	24.4592	28.0171	30.6948	34.9471	(46)
Water storage loss:													
Store volume													150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.3938 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.7527 (55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	282.8661	249.9854	265.0263	231.5700	223.5241	200.3669	196.9252	205.2874	208.1530	233.3759	249.7240	279.5754	(62)
WMHRS	-33.4272	-29.5633	-30.9570	-25.6336	-23.8896	-20.4425	-19.1616	-20.3764	-21.1506	-24.9342	-28.2474	-32.8082	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	249.4389	220.4222	234.0693	205.9364	199.6345	179.9244	177.7636	184.9110	187.0024	208.4416	221.4766	246.7673	(64)
12Total per year (kWh/year)												2515.7881	(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	115.8361	102.7952	109.9044	98.0774	96.1049	87.7024	87.2607	90.0412	90.2913	99.3806	104.1137	114.7420	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.8792	172.5805	155.8792	161.0752	155.8792	161.0752	155.8792	155.8792	161.0752	155.8792	161.0752	155.8792	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	309.0479	312.2549	304.1735	286.9691	265.2517	244.8403	231.2043	227.9974	236.0788	253.2832	275.0006	295.4119	(68)
Pumps, fans	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	(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)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	(71)
Total internal gains	155.6937	152.9691	147.7209	136.2187	129.1732	121.8089	117.2859	121.0231	125.4046	133.5761	144.6023	154.2231	(72)
	690.3679	707.5516	677.5207	654.0100	620.0512	594.4715	571.1166	571.6468	589.3057	612.4855	650.4252	675.2612	(73)

[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
South	13.4200	46.7521	0.6300	0.7000	0.7700	191.7455 (78)
West	21.4700	19.6403	0.6300	0.7000	0.7700	128.8698 (80)

7. Mean internal temperature (heating season)

21.0000 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	29.0271	29.1082	29.1881	29.5695	29.6419	29.9840	29.9840	30.0482	29.8513	29.6419	29.4957	29.3444
alpha	2.9351	2.9405	2.9459	2.9713	2.9761	2.9989	2.9989	3.0032	2.9901	2.9761	2.9664	2.9563
util living area	0.9440	0.8995	0.8328	0.7194	0.5820	0.4332	0.3199	0.3544	0.5414	0.7794	0.9098	0.9522 (86)

8. Space heating requirement

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

0.0000 (201)

1.0000 (202)

92.3000 (206)

0.0000 (207)

0.0000 (208)

Water heating

[illegible][illegible][illegible]

$\langle \mathbf{L} \rangle_{\text{min}}$	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	$\langle \mathbf{L} \rangle_{\text{max}}$
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$\langle \mathbf{L} \rangle_{\text{min}}$	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	$\langle \mathbf{L} \rangle_{\text{max}}$
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Full SAP Calculation Printout



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	32.3886	25.9834	23.3951	17.1403	13.2396	10.8169	12.0776	15.6990	20.3914	26.7546	30.2193	33.2888	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-6.1914	-9.8025	-15.7982	-19.9823	-23.6065	-22.8050	-22.5233	-20.2052	-16.5583	-12.0998	-7.1749	-5.2349	(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	-0.8610	-1.9067	-3.9804	-6.2777	-8.6130	-8.7787	-8.6826	-7.2096	-5.0997	-2.8252	-1.1788	-0.6744	(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												3615.6122	(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												3013.8545	(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)												261.3947	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-238.0701	(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												6738.7912	(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	3615.6122	0.2100	759.2786	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3013.8545	0.2100	632.9094	(264)
Space and water heating			1392.1880	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	261.3947	0.1443	37.7273	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-181.9824	0.1323	-24.0703	
PV Unit electricity exported	-56.0878	0.1245	-6.9819	
Total			-31.0522	(269)
Total CO2, kg/year			1410.7924	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.1000	(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	3615.6122	1.1300	4085.6418	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3013.8545	1.1300	3405.6556	(278)
Space and water heating			7491.2973	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	261.3947	1.5338	400.9359	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-181.9824	1.4887	-270.9176	
PV Unit electricity exported	-56.0878	0.4569	-25.6243	
Total			-296.5419	(283)
Total Primary energy kWh/year			7725.7921	(286)
Target Primary Energy Rate (TPER)			55.3100	(287)

Full SAP Calculation Printout



1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	2.9300 (2b)	409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	409.2624 (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) =	40.0000 / (5) = 0.0977 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2477 (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) = 0.2106 (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	0.2685	0.2632	0.2580	0.2316	0.2264	0.2000	0.2000	0.1948	0.2106	0.2264	0.2369	0.2474 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5360	0.5346	0.5333	0.5268	0.5256	0.5200	0.5200	0.5190	0.5222	0.5256	0.5281	0.5306 (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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m ²)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.1427		(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	0.0000	0.0500	0.0000
E7 Party floor between dwellings (in blocks of flats)	51.6100	0.0000	0.0000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.1500	0.0000	0.0000
E16 Corner (normal)	5.8600	0.0900	0.5274
E18 Party wall between dwellings	5.8600	0.0000	0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			0.5274 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	53.6701 (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	72.3960	72.2070	72.0217	71.1515	70.9887	70.2307	70.2307	70.0903	70.5227	70.9887	71.3180	71.6624 (38)
Heat transfer coeff	126.0661	125.8771	125.6918	124.8216	124.6588	123.9008	123.9008	123.7605	124.1928	124.6588	124.9882	125.3325 (39)
Average = Sum(39)m / 12 =												124.8208

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9025	0.9012	0.8999	0.8936	0.8925	0.8870	0.8870	0.8860	0.8891	0.8925	0.8948	0.8973 (40)
HLP (average)												0.8936
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

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Assumed occupancy												2.9165 (42)
Hot water usage for mixer showers												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths												
31.5670	31.0982	30.4380	29.2207	28.3093	27.2986	26.7526	27.4082	28.1220	29.2035	30.4458	31.4603	(42b)
Hot water usage for other uses												
44.4976	42.8795	41.2614	39.6433	38.0252	36.4071	36.4071	38.0252	39.6433	41.2614	42.8795	44.4976	(42c)
Average daily hot water use (litres/day)												69.7200 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use												
76.0646	73.9777	71.6994	68.8641	66.3345	63.7057	63.1598	65.4334	67.7653	70.4649	73.3253	75.9579	(44)
Energy conte	120.4677	105.3433	110.1993	94.2714	89.2990	78.3336	81.0203	83.5614	95.6202	104.4654	118.9317	(45)
Energy content (annual)												Total = Sum(45)m = 1157.8996
Distribution loss (46)m = 0.15 x (45)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:												
Total storage loss												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month												
102.3976	89.5418	93.6694	80.1307	75.9041	66.5836	64.9283	68.8672	71.0272	81.2772	88.7956	101.0919	(62)
WMHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(63c)
FGHRS	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												
102.3976	89.5418	93.6694	80.1307	75.9041	66.5836	64.9283	68.8672	71.0272	81.2772	88.7956	101.0919	(64)
12Total per year (kWh/year)												984.2147 (64)
Electric shower(s)												
58.5565	52.1744	56.9724	54.3681	55.3883	52.8350	54.5962	55.3883	54.3681	56.9724	55.9011	58.5565	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 666.0772 (64a)												
Heat gains from water heating, kWh/month												
40.2385	35.4290	37.6605	33.6247	32.8231	29.8546	29.8811	31.0639	31.3488	34.5624	36.1742	39.9121	(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	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	155.8792	172.5805	155.8792	161.0752	155.8792	161.0752	155.8792	155.8792	161.0752	155.8792	161.0752	155.8792	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	309.0479	312.2549	304.1735	286.9691	265.2517	244.8403	231.2043	227.9974	236.0788	253.2832	275.0006	295.4119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	(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)													
	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	(71)
Water heating gains (Table 5)													
	54.0840	52.7218	50.6189	46.7010	44.1171	41.4648	40.1628	41.7525	43.5400	46.4548	50.2419	53.6453	(72)
Total internal gains													
	585.7583	604.3043	577.4186	561.4923	531.9950	514.1274	493.9934	492.3762	507.4411	522.3643	553.0648	571.6835	(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			
South													14.8500	46.7521		0.5000	1.0000		0.7700		240.5639 (78)	
West													23.7900	19.6403		0.5000	1.0000		0.7700		161.8993 (80)	
Solar gains	402.4632	710.6911	1023.4381	1327.9003	1523.3218	1523.1499	1464.3329	1320.1727	1130.8686	800.7486	487.0197	341.0075	(83)									
Total gains	988.2215	1314.9954	1600.8567	1889.3927	2055.3168	2037.2773	1958.3263	1812.5488	1638.3097	1323.1129	1040.0844	912.6910	(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, n1l,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.7775	30.8237	30.8691	31.0844	31.1250	31.3154	31.3154	31.3509	31.2418	31.1250	31.0429	30.9576
alpha	3.0518	3.0549	3.0579	3.0723	3.0750	3.0877	3.0877	3.0901	3.0828	3.0750	3.0695	3.0638
util living area	0.9446	0.8867	0.8001	0.6646	0.5172	0.3760	0.2745	0.3080	0.4866	0.7469	0.9051	0.9547 (86)
MIT	19.1289	19.6251	20.1341	20.5921	20.8458	20.9569	20.9877	20.9823	20.9042	20.5059	19.7253	19.0252 (87)
Th 2	20.1653	20.1665	20.1676	20.1729	20.1739	20.1785	20.1785	20.1794	20.1768	20.1739	20.1719	20.1698 (88)
util rest of house	0.9376	0.8738	0.7795	0.6347	0.4794	0.3312	0.2246	0.2551	0.4369	0.7144	0.8920	0.9488 (89)

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MIT 2	18.4511	18.9321	19.4162	19.8399	20.0601	20.1522	20.1729	20.1709	20.1142	19.7760	19.0410	18.3529 (90)
Living area fraction									fLA = Living area / (4) =			0.4933 (91)
MIT	18.7854	19.2740	19.7704	20.2110	20.4477	20.5492	20.5749	20.5712	20.5040	20.1361	19.3786	18.6846 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7854	19.2740	19.7704	20.2110	20.4477	20.5492	20.5749	20.5712	20.5040	20.1361	19.3786	18.6846 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9232	0.8580	0.7688	0.6362	0.4922	0.3516	0.2488	0.2806	0.4571	0.7128	0.8771	0.9356	(94)
Useful gains	912.3055	1128.2767	1230.7717	1201.9958	1011.6107	716.4006	487.2804	508.5673	748.7928	943.1542	912.2880	853.9026	(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	1826.1239	1809.3549	1667.9765	1411.8598	1090.4754	737.1049	492.4938	516.2296	795.3270	1188.7575	1534.6828	1815.3919	(97)
Space heating kWh	679.8809	457.6845	325.2804	151.1021	58.6753	0.0000	0.0000	0.0000	0.0000	182.7289	448.1243	715.3480	(98a)
Space heating requirement - total per year (kWh/year)												3018.8244	
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	679.8809	457.6845	325.2804	151.1021	58.6753	0.0000	0.0000	0.0000	0.0000	182.7289	448.1243	715.3480	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3018.8244	
Space heating per m2										(98c) / (4) =		21.6124	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1164.6678	916.8662	940.5796	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9366	0.9609	0.9496	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1090.7984	881.0237	893.2190	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2314.5868	2225.2838	2058.0069	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	881.1277	1000.1295	866.6022	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fc = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	220.2819	250.0324	216.6505	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												686.9648	(107)
Energy for space heating												21.6124	(99)
Energy for space cooling												4.9181	(108)
Total												26.5306	(109)
Fabric Energy Efficiency (DFEE)												26.5	(109)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)	

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

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Output from w/h	102.3976	89.5418	93.6694	80.1307	75.9041	66.5836	64.9283	68.8672	71.0272	81.2772	88.7956	101.0919 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											984.2147 (64)
Electric shower(s)	58.5565	52.1744	56.9724	54.3681	55.3883	52.8350	54.5962	55.3883	54.3681	56.9724	55.9011	58.5565 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												666.0772 (64a)
Heat gains from water heating, kWh/month	40.2385	35.4290	37.6605	33.6247	32.8231	29.8546	29.8811	31.0639	31.3488	34.5624	36.1742	39.9121 (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)
(66)m	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.8792	172.5805	155.8792	161.0752	155.8792	161.0752	155.8792	155.8792	161.0752	155.8792	161.0752	155.8792	(67)
	309.0479	312.2549	304.1735	286.9691	265.2517	244.8403	231.2043	227.9974	236.0788	253.2832	275.0006	295.4119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	(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)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	(71)
Water heating gains (Table 5)	54.0840	52.7218	50.6189	46.7010	44.1171	41.4648	40.1628	41.7525	43.5400	46.4548	50.2419	53.6453	(72)
Total internal gains	585.7583	604.3043	577.4186	561.4923	531.9950	514.1274	493.9934	492.3762	507.4411	522.3643	553.0648	571.6835	(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	
South					13.4200	46.7521	0.6300	0.7000			0.7700	191.7455 (78)	
West					21.4700	19.6403	0.6300	0.7000			0.7700	128.8698 (80)	
Solar gains	320.6153	566.1264	815.1855	1057.6041	1213.1828	1213.0220	1166.1904	1051.4233	900.7229	637.8444	387.9693	271.6620	(83)
Total gains	906.3735	1170.4306	1392.6041	1619.0964	1745.1779	1727.1494	1660.1838	1543.7995	1408.1640	1160.2087	941.0340	843.3455	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	29.0271	29.1082	29.1881	29.5695	29.6419	29.9840	29.9840	30.0482	29.8513	29.6419	29.4957	29.3444
util living area	2.9351	2.9405	2.9459	2.9713	2.9761	2.9989	2.9989	3.0032	2.9901	2.9761	2.9664	2.9563
	0.9566	0.9158	0.8526	0.7408	0.6027	0.4504	0.3337	0.3710	0.5650	0.8048	0.9271	0.9638 (86)
MIT	18.8640	19.3177	19.8397	20.3886	20.7390	20.9205	20.9758	20.9664	20.8400	20.3261	19.4957	18.7878 (87)
Th 2	20.1194	20.1216	20.1238	20.1341	20.1361	20.1451	20.1451	20.1468	20.1416	20.1361	20.1322	20.1281 (88)
util rest of house	0.9507	0.9052	0.8349	0.7121	0.5617	0.3975	0.2721	0.3067	0.5100	0.7752	0.9161	0.9588 (89)
MIT 2	18.1592	18.6033	19.1074	19.6284	19.9407	20.0960	20.1339	20.1305	20.0356	19.5862	18.7912	18.0903 (90)
Living area fraction	18.5069	18.9558	19.4687	20.0034	20.3345	20.5028	20.5492	20.5429	20.4324	19.9512	19.1388	18.4344 (92)
MIT	18.5069	18.9558	19.4687	20.0034	20.3345	20.5028	20.5492	20.5429	20.4324	19.9512	19.1388	18.4344 (93)
Temperature adjustment												0.0000
adjusted MIT	18.5069	18.9558	19.4687	20.0034	20.3345	20.5028	20.5492	20.5429	20.4324	19.9512	19.1388	18.4344 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(94)
Useful gains	0.9369	0.8884	0.8200	0.7075	0.5715	0.4200	0.3015	0.3370	0.5293	0.7682	0.9008	0.9463	(94)
Ext temp.	849.2182	1039.8534	1141.8686	1145.4511	997.2885	725.4813	500.6166	520.2452	745.2919	891.2418	847.6510	798.0851	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Space heating kWh	1899.0131	1873.5764	1723.9393	1456.9490	1130.2236	763.8319	511.0407	534.9523	823.0752	1224.0340	1583.6366	1882.1135	(97)
Space heating requirement - total per year (kWh/year)	781.0474	560.2618	433.0606	224.2785	98.9038	0.0000	0.0000	0.0000	0.0000	247.5974	529.9096	806.5171	(98a)
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)	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	781.0474	560.2618	433.0606	224.2785	98.9038	0.0000	0.0000	0.0000	0.0000	247.5974	529.9096	806.5171	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3681.5762	(98c)
Space heating per m2										(98c) / (4) =		26.3572	(99)

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8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	1216.3810	957.5765	981.3552	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8926	0.9302	0.9136	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1085.7017	890.7037	896.5362	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1952.0997	1876.8056	1743.8842	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	623.8066	733.6598	630.4269	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	155.9516	183.4149	157.6067	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												496.9733 (107)
Energy for space heating												26.3572 (99)
Energy for space cooling												3.5579 (108)
Total												29.9152 (109)
Fabric Energy Efficiency (TFEE)												29.9 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.1500 (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) = 0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (25)

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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m2)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.1427		(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)

100.0000 (35)

Element	Length	Psi-value	Total
K1 Element	0.0000	0.0500	0.0000
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	51.6100	0.0000	0.0000
E7 Party floor between dwellings (in blocks of flats)	5.1500	0.0000	0.0000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.8600	0.0900	0.5274
E16 Corner (normal)	5.8600	0.0000	0.0000
E18 Party wall between dwellings			

0.5274 (36)

(36a) = 0.0000

$$(33) + (36) + (36a) = 53.6701 \quad (37)$$
[illegible]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.6376	0.6345	0.6315	0.6161	0.6130	0.5976	0.5976	0.5945	0.6037	0.6130	0.6191	0.6253 (40)
HLP (average)												0.6153
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

[illegible]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	153.1875	149.8919	145.8925	139.8442	134.9206	129.6321	127.6244	131.6068	135.8034	141.3522	147.4926	152.7950 (44)
Energy conte	242.6116	213.4441	224.2313	191.4398	181.6291	159.3978	154.3506	162.9567	167.4592	191.8136	210.1303	239.2401 (45)
Energy content (annual)										Total =	Sum(45)m	2338.7043
Distribution loss (46)m	$= 0.15 \times (45)m$											
	36.3917	32.0166	33.6347	28.7160	27.2444	23.9097	23.1526	24.4435	25.1189	28.7720	31.5195	35.8860 (46)

Water storage loss:	
Store volume	110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0152 (51)
--	-------------

Volume factor from Table 2a	1.0254 (52)
Temperature factor from Table 2b	0.6000 (53)

Temperature factor from Table 20	0.0000 (55)
Enter (49) or (54) in (55)	1.0327 (55)

Enter (49) or (54) in (55)	1.0327 (55)
Total storage loss	

Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (56)
--------------------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	--------------

If cylinder contains dedicated solar storage

1+ cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (57)
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	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (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)

[illegible]

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	0.0000 (61)
Total heat required for water heating calculated for each month													

Total heat required for water heating calculated for each month											
297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169 (62)

[illegible][illegible][illegible][illegible]

Output from w/h

output from w/n

297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169 (64)
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Total per year (kwh/year) = Sum(64)m = 2989.5440 (64)

Electric shower(s)

[illegible]

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a

Heat gains from water heating, kWh/month

heat gains from water heating, kWh/month	124.8898	110.9121	118.7784	106.4487	104.6131	95.7947	95.5430	98.4046	98.4751	107.9995	112.6633	123.7688 (65)
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[illegible]

[illegible]

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	0.0000	0.0000	0.0000	0.0000	0.0000	262.6102	283.1957	253.5457	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												799.3516 (107)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Waste Heat-Space and Water												0.9500 (303a)
Fraction of heat from community Boilers-Space and Water												0.0500 (303b)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.5000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement												
277.7075	152.4946	79.4838	22.6926	5.5799	0.0000	0.0000	0.0000	0.0000	32.6265	145.6470	296.2008	(98)
Space heat from Waste Heat = (98) x 0.95 x 1.00 x 1.50												
307a	395.7332	217.3048	113.2644	32.3369	7.9513	0.0000	0.0000	0.0000	0.0000	46.4927	207.5470	422.0861
Space heat from Boilers = (98) x 0.05 x 1.00 x 1.50												
307b	20.8281	11.4371	5.9613	1.7019	0.4185	0.0000	0.0000	0.0000	0.0000	2.4470	10.9235	22.2151
Space heating requirement												
416.5612	228.7419	119.2257	34.0388	8.3698	0.0000	0.0000	0.0000	0.0000	48.9397	218.4705	444.3011	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating												
Annual water heating requirement												
297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169	(64)
Water heat from Waste Heat = (64) x 0.95 x 1.00 x 1.50												
310a	424.4910	375.3045	398.2991	349.0302	337.5909	303.3704	298.7191	310.9828	314.8578	352.1038	375.6642	419.6866
Water heat from Boilers = (64) x 0.05 x 1.00 x 1.50												
310b	22.3416	19.7529	20.9631	18.3700	17.7679	15.9669	15.7221	16.3675	16.5715	18.5318	19.7718	22.0888
Water heating fuel												
446.8326	395.0573	419.2622	367.4002	355.3589	319.3373	314.4411	327.3503	331.4293	370.6356	395.4360	441.7754	(310)
Cooling System Energy Efficiency Ratio												4.6000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	57.0892	61.5643	55.1186	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	36.8087	33.2465	36.8087	35.6213	36.8087	35.6213	36.8087	36.8087	35.6213	36.8087	35.6213	36.8087 (331)
Lighting	33.4734	26.8536	24.1787	17.7144	13.6831	11.1792	12.4822	16.2248	21.0744	27.6507	31.2315	34.4037 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												1518.6488 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												4484.3160 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												15.1865 (313)
Space cooling fuel												173.7721 (321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)	
mechanical ventilation fans (SFP = 0.8680)	433.3925 (330a)
Total electricity for the above, kWh/year	433.3925 (331)
Electricity for lighting (calculated in Appendix L)	270.1496 (332)

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

PV generation	0.0000 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	6880.2791 (338)

10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Waste Heat	1442.7164	3.1100	44.8685 (340a)
Space heating from Boilers	75.9324	4.4400	3.3714 (340b)
Space heating total			48.2399 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Waste Heat	4260.1002	3.1100	132.4891 (342a)
Water heating from Boilers	224.2158	4.4400	9.9552 (342b)
Water heating total			142.4443 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Space cooling	173.7721	16.4900	28.6550 (348)

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Pumps, fans and electric keep-hot	433.3925	16.4900	71.4664 (349)
Energy for lighting	270.1496	16.4900	44.5477 (350)
Additional standing charges			92.0000 (351)
Total energy cost			427.3533 (355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8330 (357)
SAP value		86.4963
SAP rating (Section 12)		86 (358)
SAP band		B

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Waste Heat			100.0000 (367)
Space and Water heating from Waste Heat	5702.8166	0.0150	21.6407 (367)
Efficiency of heat source Boilers			85.0000 (367)
Space and Water heating from Boilers	353.1156	0.2100	18.7598 (368)
Electrical energy for heat distribution (space & water)	15.1865	0.0000	8.7286 (372)
Overall CO2 factor for heat network			0.0281 (386)
Total CO2 associated with community systems			168.4251 (373)
Space and water heating			168.4251 (376)
Space cooling	173.7721	0.1143	19.8576 (377)
Pumps, fans and electric keep-hot	433.3925	0.1387	60.1169 (378)
Energy for lighting	270.1496	0.1443	38.9909 (379)
Total CO2, kg/year			287.3906 (383)
CO2 emissions per m2			2.0600 (384)
EI value			97.9148 (384a)
EI rating			98 (385)
EI band			A

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltation due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =
Pressure test	0.0000 / (5) = 0.0000 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.1500 (18)
	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1275 (21)

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

4. Water heating energy requirements (kwh/year)												
Assumed occupancy												2.9165 (42)
Hot water usage for mixer showers	73.1195	72.0207	70.4194	67.3558	65.0949	62.5735	61.1404	62.7295	64.4715	67.1786	70.3081	72.8394 (42a)
Hot water usage for baths	33.2284	32.7349	32.0400	30.7587	29.7992	28.7353	28.1607	28.8508	29.6021	30.7405	32.0482	33.1161 (42b)
Hot water usage for other uses	46.8396	45.1363	43.4331	41.7298	40.0266	38.3233	38.3233	40.0266	41.7298	43.4331	45.1363	46.8396 (42c)
Average daily hot water use (litres/day)												140.8032 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	153.1875	149.8919	145.8925	139.8442	134.9206	129.6321	127.6244	131.6068	135.8034	141.3522	147.4926	152.7950 (44)
Energy content (annual)	242.6116	213.4441	224.2313	191.4398	181.6291	159.3978	154.3506	162.9567	167.4592	191.8136	210.1303	239.2401 (45)
Distribution loss (46)m = 0.15 x (45)m	36.3917	32.0166	33.6347	28.7160	27.2444	23.9097	23.1526	24.4435	25.1189	28.7720	31.5195	35.8860 (46)
Water storage loss: Store volume												110.0000 (47)
b) If manufacturer declared loss factor is not known : Hot water storage loss factor from Table 2 (kwh/litre/day)												0.0152 (51)
Volume factor from Table 2a												1.0294 (52)
Temperature factor from Table 2b												0.6000 (53)
Enter (49) or (54) in (55)												1.0327 (55)
Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (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	297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169 (62)
WMHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169 (64)
	Total per year (kwh/year) = Sum(64)m =											2989.5440 (64)

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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	124.8898	110.9121	118.7784	106.4487	104.6131	95.7947	95.5430	98.4046	98.4751	107.9995	112.6633	123.7688 (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	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	38.2425	33.9666	27.6235	20.9128	15.6325	13.1977	14.2605	18.5364	24.8795	31.5902	36.8705	39.3054	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	461.2656	466.0520	453.9902	428.3121	395.8980	365.4334	345.0811	340.2946	352.3564	378.0346	410.4486	440.9133	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	(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)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	(71)
Water heating gains (Table 5)	167.8626	165.0478	159.6483	147.8454	140.6090	133.0482	128.4180	132.2642	136.7710	145.1606	156.4768	166.3559	(72)
Total internal gains	781.1154	778.8112	755.0069	710.8150	665.8844	625.4240	601.5045	604.8400	627.7517	668.5302	717.5407	760.3193	(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				
South			14.8500	50.9848	0.5000	1.0000	0.7700	262.3437 (78)				
West			23.7900	22.3313	0.5000	1.0000	0.7700	184.0823 (80)				
Solar gains	446.4260	709.5055	1010.3811	1354.4531	1518.0261	1626.7139	1545.9971	1421.8151	1211.1920	853.7705	553.4522	374.6077 (83)
Total gains	1227.5414	1488.3168	1765.3880	2065.2681	2183.9105	2252.1379	2147.5016	2026.6550	1838.9436	1522.3006	1270.9928	1134.9270 (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	45.5458	46.0108	46.0108	46.7264	46.7264	47.7160	47.4647	47.9699	47.7160	47.2160	47.2160	46.4854
alpha	4.0364	4.0674	4.0674	4.1151	4.1151	4.1811	4.1643	4.1980	4.1811	4.1477	4.1477	4.0990
util living area	0.8388	0.7445	0.6053	0.4372	0.3026	0.1804	0.1180	0.1277	0.2558	0.4920	0.7302	0.8612 (86)
MIT	20.4166	20.6568	20.8590	20.9661	20.9937	20.9995	20.9999	20.9999	20.9978	20.9573	20.7459	20.3687 (87)
Th 2	20.4211	20.4267	20.4267	20.4350	20.4350	20.4461	20.4433	20.4489	20.4461	20.4405	20.4405	20.4322 (88)
util rest of house	0.8252	0.7273	0.5847	0.4164	0.2816	0.1605	0.0968	0.1057	0.2316	0.4654	0.7097	0.8489 (89)
MIT 2	19.7477	20.0389	20.2736	20.4004	20.4293	20.4458	20.4433	20.4488	20.4444	20.3985	20.1607	19.6995 (90)
Living area fraction									fLA = Living area / (4) =			0.4933 (91)
MIT	20.0777	20.3437	20.5624	20.6795	20.7078	20.7190	20.7179	20.7207	20.7174	20.6742	20.4494	20.0296 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0777	20.3437	20.5624	20.6795	20.7078	20.7190	20.7179	20.7207	20.7174	20.6742	20.4494	20.0296 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.8166	0.7247	0.5897	0.4254	0.2917	0.1703	0.1073	0.1166	0.2435	0.4766	0.7100	0.8395	(94)
Useful gains	1002.4453	1078.6504	1040.9751	878.6107	637.1222	383.5248	230.3311	236.2140	447.7160	725.4551	902.4476	952.8173	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1275.9347	1243.3092	1109.9570	895.0919	640.0255	383.7195	230.3499	236.2392	448.6475	745.6778	1023.0361	1246.1318	(97)
Space heating kWh	203.4761	110.6508	51.3225	11.8665	2.1601	0.0000	0.0000	0.0000	0.0000	15.0456	86.8237	218.2260	(98a)
Space heating requirement - total per year (kWh/year)												699.5712	
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	203.4761	110.6508	51.3225	11.8665	2.1601	0.0000	0.0000	0.0000	0.0000	15.0456	86.8237	218.2260	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												699.5712	
Space heating per m2										(98c) / (4) =		5.0084	(99)

8c. Space cooling requirement

[illegible]

20. Energy Requirements												
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Waste Heat-Space and Water												0.9500 (303a)
Fraction of heat from community Boilers-Space and Water												0.0500 (303b)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.5000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement												
203.4761	110.6508	51.3225	11.8665	2.1601	0.0000	0.0000	0.0000	0.0000	15.0456	86.8237	218.2260	(98)
Space heat from Waste Heat = (98) x 0.95 x 1.00 x 1.50												
307a	289.9535	157.6773	73.1346	16.9097	3.0781	0.0000	0.0000	0.0000	0.0000	21.4400	123.7238	310.9720
Space heat from Boilers = (98) x 0.05 x 1.00 x 1.50												
307b	15.2607	8.2988	3.8492	0.8900	0.1620	0.0000	0.0000	0.0000	0.0000	1.1284	6.5118	16.3669
Space heating requirement												
305.2142	165.9761	76.9838	17.7997	3.2401	0.0000	0.0000	0.0000	0.0000	22.5685	130.2355	327.3389	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating												
Annual water heating requirement												
297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169	(64)
Water heat from Waste Heat = (64) x 0.95 x 1.00 x 1.50												
310a	424.4910	375.3045	398.2991	349.0302	337.5909	303.3704	298.7191	310.9828	314.8578	352.1038	375.6642	419.6866
Water heat from Boilers = (64) x 0.05 x 1.00 x 1.50												
310b	22.3416	19.7529	20.9631	18.3700	17.7679	15.9669	15.7221	16.3675	16.5715	18.5318	19.7718	22.0888
Water heating fuel												
446.8326	395.0573	419.2622	367.4002	355.3589	319.3373	314.4411	327.3503	331.4293	370.6356	395.4360	441.7754	(310)
Cooling System Energy Efficiency Ratio												
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	65.9135	69.2897	64.0482	0.0000	0.0000	0.0000	4.6000 (314)
Pumps and Fa	36.8087	33.2465	36.8087	35.6213	36.8087	35.6213	36.8087	36.8087	35.6213	36.8087	35.6213	0.0000 (315)
Lighting	33.4734	26.8536	24.1787	17.7144	13.6831	11.1792	12.4822	16.2248	21.0744	27.6507	31.2315	36.8087 (331)
Electricity generated by PVs (Appendix M) (negative quantity)												34.4037 (332)
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												0.0000 (334a)
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												0.0000 (335a)
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												0.0000 (333b)
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												0.0000 (334b)
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												0.0000 (335b)
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												1049.3568 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												4

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10b. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Waste Heat	996.8890	4.1000	40.8724 (340a)
Space heating from Boilers	52.4678	4.8000	2.5185 (340b)
Space heating total			43.3909 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Waste Heat	4260.1002	4.1000	174.6641 (342a)
Water heating from Boilers	224.2158	4.8000	10.7624 (342b)
Water heating total			185.4265 (342)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (347a)
Space cooling	199.2514	21.5100	42.8590 (348)
Pumps, fans and electric keep-hot	433.3925	21.5100	93.2227 (349)
Energy for lighting	270.1496	21.5100	58.1092 (350)
Additional standing charges			98.0000 (351)
Total energy cost			521.0083 (355)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Waste Heat			100.0000 (367)
Space and Water heating from Waste Heat	5256.9892	0.0150	14.9533 (367)
Efficiency of heat source Boilers			85.0000 (367)
Space and Water heating from Boilers	325.5102	0.2100	12.9626 (368)
Electrical energy for heat distribution (space & water)	10.4936	0.0000	7.9923 (372)
Overall CO2 factor for heat network			0.0280 (386)
Total CO2 associated with community systems			155.2043 (373)
Space and water heating			155.2043 (376)
Space cooling	199.2514	0.1143	22.7742 (377)
Pumps, fans and electric keep-hot	433.3925	0.1387	60.1169 (378)
Energy for lighting	270.1496	0.1443	38.9909 (379)
Total CO2, kg/year			277.0863 (383)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Waste Heat			100.0000 (467a)
Space and Water heating from Waste Heat	5256.9892	0.0630	62.8040 (467)
Efficiency of heat source Boilers			85.0000 (467b)
Space and Water heating from Boilers	325.5102	1.1300	69.7514 (468)
Electrical energy for heat distribution (space & water)	10.4936	0.0000	84.8956 (472)
Overall CO2 factor for heat network			0.1417 (486)
Total CO2 associated with community systems			783.9124 (473)
Space and water heating			783.9124 (476)
Space cooling	199.2514	1.4212	283.1800 (477)
Pumps, fans and electric keep-hot	433.3925	1.5128	655.6362 (478)
Energy for lighting	270.1496	1.5338	414.3645 (479)
Total Primary energy kWh/year			2137.0931 (483)

SAP 10 EPC IMPROVEMENTS

V1 THFC-L20-03 DHN PlanA

Current energy efficiency rating:	B 86
Current environmental impact rating:	A 98

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

Recommended measures: (none)	SAP change	Cost change	CO2 change
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Recommended measures (none)	Typical annual savings	Energy efficiency impact	Environmental impact
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating:	B 86
Potential environmental impact rating:	A 98

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£194	£194	£0
Community scheme	£327	£327	£0
Space heating	£235	£235	£0
Space cooling	£43	£43	£0
Water heating	£185	£185	£0
Lighting	£58	£58	£0
Total cost of fuels	£521	£521	£0
Total cost of uses	£521	£521	£0
Delivered energy	46 kWh/m ²	46 kWh/m ²	0 kWh/m ²
Carbon dioxide emissions	0.3 tonnes	0.3 tonnes	0.0 tonnes
CO ₂ emissions per m ²	2 kg/m ²	2 kg/m ²	0 kg/m ²
Primary energy	15 kWh/m ²	15 kWh/m ²	0 kWh/m ²

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 409.2624 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 0.0000 / (5) = 0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (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
Glazed (Uw = 0.64)							
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(27) (29a)
Total net area of external elements Aum(A, m ²)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 53.1427		(33)

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Water heating gains (Table 5)												
	167.8626	165.0478	159.6483	147.8454	140.6090	133.0482	128.4180	132.2642	136.7710	145.1606	156.4768	166.3559 (72)
Total internal gains												
	781.1154	778.8112	755.0069	710.8150	665.8844	625.4240	601.5045	604.8400	627.7517	668.5302	717.5407	760.3193 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
South	14.8500	46.7521	0.5000	1.0000	0.7700	240.5639 (78)
West	23.7900	19.6403	0.5000	1.0000	0.7700	161.8993 (80)

Solar gains	402.4632	710.6911	1023.4381	1327.9003	1523.3218	1523.1499	1464.3329	1320.1727	1130.8686	800.7486	487.0197	341.0075 (83)
Total gains	1183.5787	1489.5024	1778.4450	2038.7154	2189.2061	2148.5739	2065.8373	1925.0126	1758.6203	1469.2788	1204.5603	1101.3268 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
43.5645	43.7761	43.9897	45.0901	45.3168	46.4854	46.4854	46.7264	46.0108	45.3168	44.8656	44.4234	
3.9043	3.9184	3.9326	4.0060	4.0211	4.0990	4.0990	4.1151	4.0674	4.0211	3.9910	3.9616	
util living area												
0.8758	0.7793	0.6504	0.4932	0.3597	0.2480	0.1777	0.1982	0.3284	0.5714	0.7988	0.8946 (86)	
MIT	20.1998	20.5267	20.7824	20.9359	20.9843	20.9976	20.9995	20.9993	20.9922	20.9086	20.5709	20.1397 (87)
Th 2	20.3963	20.3990	20.4018	20.4156	20.4183	20.4322	20.4322	20.4350	20.4267	20.4183	20.4128	20.4073 (88)
util rest of house												
0.8646	0.7633	0.6304	0.4718	0.3380	0.2262	0.1548	0.1739	0.3017	0.5445	0.7812	0.8847 (89)	
MIT 2	19.4617	19.8588	20.1620	20.3487	20.4033	20.4302	20.4319	20.4345	20.4199	20.3250	19.9300	19.3970 (90)
Living area fraction									fLA = Living area / (4) =			0.4933 (91)
MIT	19.8258	20.1883	20.4681	20.6384	20.6900	20.7101	20.7119	20.7131	20.7022	20.6129	20.2462	19.7634 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8258	20.1883	20.4681	20.6384	20.6900	20.7101	20.7119	20.7131	20.7022	20.6129	20.2462	19.7634 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8529	0.7574	0.6327	0.4800	0.3482	0.2369	0.1660	0.1859	0.3146	0.5536	0.7759	0.8728 (94)
Useful gains	1009.5198	1128.1220	1125.1840	978.5732	762.2152	508.9220	343.0287	357.8593	553.2057	813.4491	934.5983	961.2136 (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	1382.7826	1355.0485	1232.0170	1010.0906	769.7150	509.9934	343.2113	358.1471	556.7533	857.3019	1136.8858	1359.3328 (97)
Space heating kWh	277.7075	152.4946	79.4838	22.6926	5.5799	0.0000	0.0000	0.0000	0.0000	32.6265	145.6470	296.2008 (98a)
Space heating requirement - total per year (kWh/year)												1012.4325
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	277.7075	152.4946	79.4838	22.6926	5.5799	0.0000	0.0000	0.0000	0.0000	32.6265	145.6470	296.2008 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1012.4325
Space heating per m2										(98c) / (4) =		7.2482 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	784.5897	617.6557	631.0773	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9932	0.9967	0.9954	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	779.2188	615.6336	628.1874	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2405.7291	2313.0624	2147.8989	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1171.0875	1262.8870	1130.6653	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			0.8970 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	262.6102	283.1957	253.5457	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												799.3516 (107)

9b. Energy requirements

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Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	0.9500	(303a)
Fraction of heat from community Boilers-Space and Water	0.0500	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
277.7075 152.4946 79.4838 22.6926 5.5799 0.0000 0.0000 0.0000 0.0000 32.6265 145.6470 296.2008	(98)	
Space heat from Waste Heat = (98) x 0.95 x 1.00 x 1.50		
307a 395.7332 217.3048 113.2644 32.3369 7.9513 0.0000 0.0000 0.0000 0.0000 46.4927 207.5470 422.0861		
Space heat from Boilers = (98) x 0.05 x 1.00 x 1.50		
307b 20.8281 11.4371 5.9613 1.7019 0.4185 0.0000 0.0000 0.0000 0.0000 2.4470 10.9235 22.2151		
Space heating requirement		
416.5612 228.7419 119.2257 34.0388 8.3698 0.0000 0.0000 0.0000 0.0000 48.9397 218.4705 444.3011	(307)	
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system		
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(309)	
Water heating		
Annual water heating requirement		
297.8884 263.3715 279.5081 244.9335 236.9059 212.8915 209.6274 218.2335 220.9528 247.0904 263.6240 294.5169	(64)	
Water heat from Waste Heat = (64) x 0.95 x 1.00 x 1.50		
310a 424.4910 375.3045 398.2991 349.0302 337.5909 303.3704 298.7191 310.9828 314.8578 352.1038 375.6642 419.6866		
Water heat from Boilers = (64) x 0.05 x 1.00 x 1.50		
310b 22.3416 19.7529 20.9631 18.3700 17.7679 15.9669 15.7221 16.3675 16.5715 18.5318 19.7718 22.0888		
Water heating fuel		
446.8326 395.0573 419.2622 367.4002 355.3589 319.3373 314.4411 327.3503 331.4293 370.6356 395.4360 441.7754	(310)	
Cooling System Energy Efficiency Ratio		
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 57.0892 61.5643 55.1186 0.0000 0.0000 0.0000 0.0000	(315)	
Pumps and Fa 36.8087 33.2465 36.8087 35.6213 36.8087 35.6213 36.8087 36.8087 35.6213 36.8087 35.6213 36.8087	(331)	
Lighting 33.4734 26.8536 24.1787 17.7144 13.6831 11.1792 12.4822 16.2248 21.0744 27.6507 31.2315 34.4037	(332)	
Electricity generated by PVs (Appendix M) (negative quantity)		
(333a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(333a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)		
(334a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(334a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)		
(335a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(335a)	
Electricity generated by PVs (Appendix M) (negative quantity)		
(333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(333b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)		
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(334b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)		
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(335b)	
Annual totals kWh/year		
Space heating fuel - community heating	1518.6488	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	4484.3160	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	15.1865	(313)
Space cooling fuel	173.7721	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)		
mechanical ventilation fans (SFP = 0.8680)		
Total electricity for the above, kWh/year	433.3925	(330a)
Electricity for lighting (calculated in Appendix L)	433.3925	(331)
	270.1496	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	6880.2791	(338)

10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Waste Heat	1442.7164	3.1100	44.8685 (340a)
Space heating from Boilers	75.9324	4.4400	3.3714 (340b)
Space heating total			48.2399 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Waste Heat	4260.1002	3.1100	132.4891 (342a)
Water heating from Boilers	224.2158	4.4400	9.9552 (342b)
Water heating total			142.4443 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Space cooling	173.7721	16.4900	28.6550 (348)
Pumps, fans and electric keep-hot	433.3925	16.4900	71.4664 (349)
Energy for lighting	270.1496	16.4900	44.5477 (350)
Additional standing charges			92.0000 (351)
Total energy cost			427.3533 (355)

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8330 (357)
SAP value		86.4963
SAP rating (Section 12)		86 (358)
SAP band		B

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Waste Heat			100.0000 (367)
Space and Water heating from Waste Heat	5702.8166	0.0150	21.6407 (367)
Efficiency of heat source Boilers			85.0000 (367)
Space and Water heating from Boilers	353.1156	0.2100	18.7598 (368)
Electrical energy for heat distribution (space & water)	15.1865	0.0000	8.7286 (372)
Overall CO2 factor for heat network			0.0281 (386)
Total CO2 associated with community systems			168.4251 (373)
Space and water heating			168.4251 (376)
Space cooling	173.7721	0.1143	19.8576 (377)
Pumps, fans and electric keep-hot	433.3925	0.1387	60.1169 (378)
Energy for lighting	270.1496	0.1443	38.9909 (379)
Total CO2, kg/year			287.3906 (383)
CO2 emissions per m2			2.0600 (384)
EI value			97.9148 (384a)
EI rating			98 (385)
EI band			A

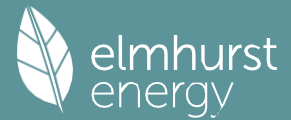
1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

[illegible]

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Effective ac 0.2334 0.2270 0.2270 0.2174 0.2174 0.2047 0.2079 0.2015 0.2047 0.2111 0.2111 0.2206 (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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m2)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.1427		(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)

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

100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	0.0000	0.0500	0.0000
E7 Party floor between dwellings (in blocks of flats)	51.6100	0.0000	0.0000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.1500	0.0000	0.0000
E16 Corner (normal)	5.8600	0.0900	0.5274
E18 Party wall between dwellings	5.8600	0.0000	0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			0.5274 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	53.6701 (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	31.5188	30.6578	30.6578	29.3664	29.3664	27.6444	28.0749	27.2139	27.6444	28.5054	28.5054	29.7969 (38)
Heat transfer coeff	85.1890	84.3280	84.3280	83.0365	83.0365	81.3145	81.7450	80.8840	81.3145	82.1755	82.1755	83.4670 (39)
Average = Sum(39)m / 12 =												82.7495

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.6099	0.6037	0.6037	0.5945	0.5945	0.5821	0.5852	0.5791	0.5821	0.5883	0.5883	0.5976 (40)
HLP (average)												0.5924
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9165 (42)
Hot water usage for mixer showers	73.1195	72.0207	70.4194	67.3558	65.0949	62.5735	61.1404	62.7295	64.4715	67.1786	70.3081	72.8394 (42a)
Hot water usage for baths	33.2284	32.7349	32.0400	30.7587	29.7992	28.7353	28.1607	28.8508	29.6021	30.7405	32.0482	33.1161 (42b)
Hot water usage for other uses	46.8396	45.1363	43.4331	41.7298	40.0266	38.3233	38.3233	40.0266	41.7298	43.4331	45.1363	46.8396 (42c)
Average daily hot water use (litres/day)												140.8032 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	153.1875	149.8919	145.8925	139.8442	134.9206	129.6321	127.6244	131.6068	135.8034	141.3522	147.4926	152.7950 (44)
Energy conte	242.6116	213.4441	224.2313	191.4398	181.6291	159.3978	154.3506	162.9567	167.4592	191.8136	210.1303	239.2401 (45)
Energy content (annual)										Total =	Sum(45)m =	2338.7043
Distribution loss (46)m = 0.15 x (45)m												
	36.3917	32.0166	33.6347	28.7160	27.2444	23.9097	23.1526	24.4435	25.1189	28.7720	31.5195	35.8860 (46)

Water storage loss:

Store volume

110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day)

0.0152 (51)

Volume factor from Table 2a

1.0294 (52)

Temperature factor from Table 2b

0.6000 (53)

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

1.0327 (55)

Total storage loss

32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (56)
If cylinder contains dedicated solar storage											
32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (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 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

Total heat required for water heating calculated for each month

297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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 (63c)
FGHRS	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

297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169 (64)
Total per year (kWh/year) = Sum(64)m =											2989.5440 (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

124.8898	110.9121	118.7784	106.4487	104.6131	95.7947	95.5430	98.4046	98.4751	107.9995	112.6633	123.7688 (65)
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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.2425	33.9666	27.6235	20.9128	15.6325	13.1977	14.2605	18.5364	24.8795	31.5902	36.8705	39.3054 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	461.2656	466.0520	453.9902	428.3121	395.8980	365.4334	345.0811	340.2946	352.3564	378.0346	410.4486	440.9133 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153 (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)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589 (71)
Water heating gains (Table 5)	167.8626	165.0478	159.6483	147.8454	140.6090	133.0482	128.4180	132.2642	136.7710	145.1606	156.4768	166.3559 (72)
Total internal gains	781.1154	778.8112	755.0069	710.8150	665.8844	625.4240	601.5045	604.8400	627.7517	668.5302	717.5407	760.3193 (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			
South				14.8500	50.9848	0.5000	1.0000	0.7700	262.3437 (78)			
West				23.7900	22.3313	0.5000	1.0000	0.7700	184.0823 (80)			
Solar gains	446.4260	709.5055	1010.3811	1354.4531	1518.0261	1626.7139	1545.9971	1421.8151	1211.1920	853.7705	553.4522	374.6077 (83)
Total gains	1227.5414	1488.3168	1765.3880	2065.2681	2183.9105	2252.1379	2147.5016	2026.6550	1838.9436	1522.3006	1270.9928	1134.9270 (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 _{li,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	45.5458	46.0108	46.0108	46.7264	46.7264	47.7160	47.4647	47.9699	47.7160	47.2160	47.2160	46.4854
alpha	4.0364	4.0674	4.0674	4.1151	4.1151	4.1811	4.1643	4.1980	4.1811	4.1477	4.1477	4.0990
util living area	0.8388	0.7445	0.6053	0.4372	0.3026	0.1804	0.1180	0.1277	0.2558	0.4920	0.7302	0.8612 (86)
MIT	20.4166	20.6568	20.8590	20.9661	20.9937	20.9995	20.9999	20.9999	20.9978	20.9573	20.7459	20.3687 (87)
Th 2	20.4211	20.4267	20.4267	20.4350	20.4350	20.4461	20.4433	20.4489	20.4461	20.4405	20.4405	20.4322 (88)
util rest of house	0.8252	0.7273	0.5847	0.4164	0.2816	0.1605	0.0968	0.1057	0.2316	0.4654	0.7097	0.8489 (89)
MIT 2	19.7477	20.0389	20.2736	20.4004	20.4293	20.4458	20.4433	20.4488	20.4444	20.3985	20.1607	19.6995 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.4933 (91)
MIT	20.0777	20.3437	20.5624	20.6795	20.7078	20.7190	20.7179	20.7207	20.7174	20.6742	20.4494	20.0296 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0777	20.3437	20.5624	20.6795	20.7078	20.7190	20.7179	20.7207	20.7174	20.6742	20.4494	20.0296 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8166	0.7247	0.5897	0.4254	0.2917	0.1703	0.1073	0.1166	0.2435	0.4766	0.7100	0.8395 (94)
Useful gains	1002.4453	1078.6504	1040.9751	878.6107	637.1222	383.5248	230.3311	236.2140	447.7160	725.4551	902.4476	952.8173 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1275.9347	1243.3092	1109.9570	895.0919	640.0255	383.7195	230.3499	236.2392	448.6475	745.6778	1023.0361	1246.1318 (97)
Space heating kWh	203.4761	110.6508	51.3225	11.8665	2.1601	0.0000	0.0000	0.0000	0.0000	15.0456	86.8237	218.2260 (98a)
Space heating requirement - total per year (kWh/year)												699.5712
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	203.4761	110.6508	51.3225	11.8665	2.1601	0.0000	0.0000	0.0000	0.0000	15.0456	86.8237	218.2260 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												699.5712
Space heating per m ²										(98c) / (4) =		5.0084 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	650.5162	498.6446	501.4810	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9974	0.9989	0.9986	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	648.8549	498.0836	500.7867	0.0000	0.0000	0.0000	0.0000 (102)

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Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2526.7779	2408.5141	2266.7017	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1352.1046	1421.3603	1313.8408	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			0.8970 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	303.2023	318.7325	294.6218	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												916.5566 (107)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Waste Heat-Space and Water												0.9500 (303a)
Fraction of heat from community Boilers-Space and Water												0.0500 (303b)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.5000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	203.4761	110.6508	51.3225	11.8665	2.1601	0.0000	0.0000	0.0000	0.0000	15.0456	86.8237	218.2260 (98)
Space heat from Waste Heat = (98) x 0.95 x 1.00 x 1.50												
307a	289.9535	157.6773	73.1346	16.9097	3.0781	0.0000	0.0000	0.0000	0.0000	21.4400	123.7238	310.9720
Space heat from Boilers = (98) x 0.05 x 1.00 x 1.50												
307b	15.2607	8.2988	3.8492	0.8900	0.1620	0.0000	0.0000	0.0000	0.0000	1.1284	6.5118	16.3669
Space heating requirement	305.2142	165.9761	76.9838	17.7997	3.2401	0.0000	0.0000	0.0000	0.0000	22.5685	130.2355	327.3389 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement	297.8884	263.3715	279.5081	244.9335	236.9059	212.8915	209.6274	218.2335	220.9528	247.0904	263.6240	294.5169 (64)
Water heat from Waste Heat = (64) x 0.95 x 1.00 x 1.50												
310a	424.4910	375.3045	398.2991	349.0302	337.5909	303.3704	298.7191	310.9828	314.8578	352.1038	375.6642	419.6866
Water heat from Boilers = (64) x 0.05 x 1.00 x 1.50												
310b	22.3416	19.7529	20.9631	18.3700	17.7679	15.9669	15.7221	16.3675	16.5715	18.5318	19.7718	22.0888
Water heating fuel	446.8326	395.0573	419.2622	367.4002	355.3589	319.3373	314.4411	327.3503	331.4293	370.6356	395.4360	441.7754 (310)
Cooling System Energy Efficiency Ratio												4.6000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	65.9135	69.2897	64.0482	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	36.8087	33.2465	36.8087	35.6213	36.8087	35.6213	36.8087	36.8087	35.6213	36.8087	35.6213	36.8087 (331)
Lighting	33.4734	26.8536	24.1787	17.7144	13.6831	11.1792	12.4822	16.2248	21.0744	27.6507	31.2315	34.4037 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												1049.3568 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												4484.3160 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												10.4936 (313)
Space cooling fuel												199.2514 (321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)												
mechanical ventilation fans (SFP = 0.8680)												433.3925 (330a)
Total electricity for the above, kWh/year												433.3925 (331)
Electricity for lighting (calculated in Appendix L)												270.1496 (332)

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

PV generation												0.0000 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												6436.4664 (338)

10b. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Waste Heat	996.8890	4.1000	40.8724 (340a)
Space heating from Boilers	52.4678	4.8000	2.5185 (340b)
Space heating total			43.3909 (340)

Full SAP Calculation Printout



Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Waste Heat	4260.1002	4.1000	174.6641 (342a)
Water heating from Boilers	224.2158	4.8000	10.7624 (342b)
Water heating total			185.4265 (342)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (347a)
Space cooling	199.2514	21.5100	42.8590 (348)
Pumps, fans and electric keep-hot	433.3925	21.5100	93.2227 (349)
Energy for lighting	270.1496	21.5100	58.1092 (350)
Additional standing charges			98.0000 (351)
Total energy cost			521.0083 (355)

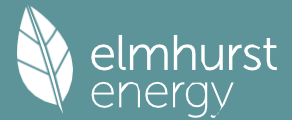
12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Waste Heat			100.0000 (367)
Space and Water heating from Waste Heat	5256.9892	0.0150	14.9533 (367)
Efficiency of heat source Boilers			85.0000 (367)
Space and Water heating from Boilers	325.5102	0.2100	12.9626 (368)
Electrical energy for heat distribution (space & water)	10.4936	0.0000	7.9923 (372)
Overall CO2 factor for heat network			0.0280 (386)
Total CO2 associated with community systems			155.2043 (373)
Space and water heating			155.2043 (376)
Space cooling	199.2514	0.1143	22.7742 (377)
Pumps, fans and electric keep-hot	433.3925	0.1387	60.1169 (378)
Energy for lighting	270.1496	0.1443	38.9909 (379)
Total CO2, kg/year			277.0863 (383)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Waste Heat			100.0000 (467a)
Space and Water heating from Waste Heat	5256.9892	0.0630	62.8040 (467)
Efficiency of heat source Boilers			85.0000 (467b)
Space and Water heating from Boilers	325.5102	1.1300	69.7514 (468)
Electrical energy for heat distribution (space & water)	10.4936	0.0000	84.8956 (472)
Overall CO2 factor for heat network			0.1417 (486)
Total CO2 associated with community systems			783.9124 (473)
Space and water heating			783.9124 (476)
Space cooling	199.2514	1.4212	283.1800 (477)
Pumps, fans and electric keep-hot	433.3925	1.5128	655.6362 (478)
Energy for lighting	270.1496	1.5338	414.3645 (479)
Total Primary energy kWh/year			2137.0931 (483)

Summary for Input Data



Property Reference	THFC-L20-03	Issued on Date	24/07/2023
Assessment Reference	V1 THFC-L20-03 DHN PlanA	Prop Type Ref	
Property			

SAP Rating		DER		TER	
Environmental		% DER < TER			
CO ₂ Emissions (t/year)	0	DFEE		TFEE	
Compliance Check	See BREL	% DFEE < TFEE			
% DPER < TPER		DPER		TPER	
					T491-0001

Assessor Details	Miss Laura Plazas	Assessor ID	
Client			

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

Orientation	West
Property Tenture	ND
Transaction Type	6
Terrain Type	Urban
1.0 Property Type	Flat, End-Terrace
Position of Flat	Mid-floor flat
Which Floor	20
2.0 Number of Storeys	1
3.0 Date Built	2024
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown
6.0 Thermal Mass Parameter	Enter TMP value
Thermal Mass	100.00 kJ/m²K

7.0 Electricity Tariff	Standard
Smart electricity meter fitted	Yes
Smart gas meter fitted	Yes

7.0 Measurements	Ground floor:	Heat Loss Perimeter 63.95 m	Internal Floor Area 139.68 m²	Average Storey Height 2.93 m
------------------	---------------	--------------------------------	----------------------------------	---------------------------------

8.0 Living Area	68.91 m²
-----------------	----------

9.0 External Walls	Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Shelter Area (m²)	Shelter Res	Openings	Area Calculation
	Curtain Wall	Curtain Walling	Other	0.64		84.00	45.36	0.00	None	38.64 Enter Gross Area

10.1 Party Ceilings	Description	Construction	Kappa (kJ/m²K)	Area (m²)
	Party Ceiling 1	Concrete floor slab, carpeted	100.00	139.68

11.1 Party Floors	Description	Storey Index	Construction	Kappa (kJ/m²K)	Area (m²)
	Party Floor 1	Lowest occupied	Concrete floor slab, carpeted	100.00	139.68

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Glazed	Manufacturer	Window	Triple Low-E Soft 0.05			0.50		1.00	0.64
13.0 Openings									
Name	Opening Type		Location	Orientation		Area (m²)	Pitch		
Glazed W	Glazed		Curtain Wall	West		1.93			
Glazed W	Glazed		Curtain Wall	West		3.60			
Glazed S	Glazed		Curtain Wall	South		9.49			
Glazed S	Glazed		Curtain Wall	South		5.36			
Glazed W	Glazed		Curtain Wall	West		3.60			

Summary for Input Data



Glazed W	Glazed	Curtain Wall	West	3.60
Glazed W	Glazed	Curtain Wall	West	3.60
Glazed W	Glazed	Curtain Wall	West	3.60
Glazed W	Glazed	Curtain Wall	West	1.93
Glazed W	Glazed	Curtain Wall	West	1.93

14.0 Conservatory

15.0 Draught Proofing

 %

16.0 Draught Lobby

17.0 Thermal Bridging

17.1 List of Bridges

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E2 Other lintels (including other steel lintels)	Independently assessed	0.00	0.05	0.05	No
E4 Jamb	Independently assessed	0.00	0.05	0.05	No
E7 Party floor between dwellings (in blocks of flats)	Independently assessed	51.61	0.00	0.00	No
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	Independently assessed	5.15	0.00	0.00	No
E16 Corner (normal)	Independently assessed	5.86	0.09	0.09	No
E18 Party wall between dwellings	Independently assessed	5.86	0.00	0.00	No

Y-value W/m²K

18.0 Pressure Testing

Designed AP₅₀ m³/(h.m²) @ 50 Pa

Test Method

19.0 Mechanical Ventilation

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	No
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500794
Configuration	3
Manufacturer SFP	0.62
Duct Type	Rigid
MVHR Efficiency	89.00
Wet Rooms	3
SFP from Installer Commissioning Certificate	No
MVHR System Location	Inside heated envelope (installed exclusively)
Duct Installation Specification	Level 1

20.0 Fans, Open Fireplaces, Flues

21.0 Fixed Cooling System

Yes	
Cooled Area	125.29 m²
Data Source	SAP table
Energy Class	B

22.0 Lighting

No Fixed Lighting	No				
	Name	Efficacy	Power	Capacity	Count
	low energy lighting	75.00	20	1500	10

24.0 Main Heating 1

25.0 Main Heating 2

26.0 Heat Networks

Space Community Heating

Distribution Loss	Calculated
Distribution Loss Value	1.50

Summary for Input Data



SAP Code

2312

Heat Source	Fuel Type	Heating Use	Efficiency	Percentage Of Heat	Heat	Heat Power Ratio	Electrical	Fuel Factor	Efficiency type
-------------	-----------	-------------	------------	--------------------	------	------------------	------------	-------------	-----------------

Heat source 1
Heat source 2
Heat source 3
Heat source 4
Heat source 5

28.0 Water Heating

Water Heating

Community Heating

SAP Code

901

No

Flue Gas Heat Recovery System

No

Waste Water Heat Recovery Instantaneous System 1

No

Waste Water Heat Recovery Instantaneous System 2

No

Waste Water Heat Recovery Storage System

No

Solar Panel

No

Water use <= 125 litres/person/day

From mains

Cold Water Source

3

Bath Count

28.1 Showers

Description

Shower Type

Flow Rate
[l/min]

Rated Power
[kW]

Connected

Connected To

28.3 Waste Water Heat Recovery System

29.0 Hot Water Cylinder

In Airing Cupboard

None

No

Recommendations

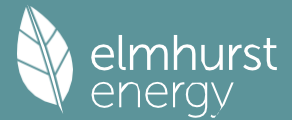
Lower cost measures

None

Further measures to achieve even higher standards

None

Thermal Bridging



Property Reference	THFC-L20-03	Issued on Date	24/07/2023
Assessment Reference	V1 THFC-L20-03 DHN PlanA	Prop Type Ref	End-Terrace Flat
Property			

SAP Rating		DER		TER	
Environmental		% DER < TER			
CO ₂ Emissions (t/year)	0	DFEE		TFEE	
Compliance Check	See BREL	% DFEE < TFEE			
% DPER < TPER		DPER		TPER	
					T491-0001

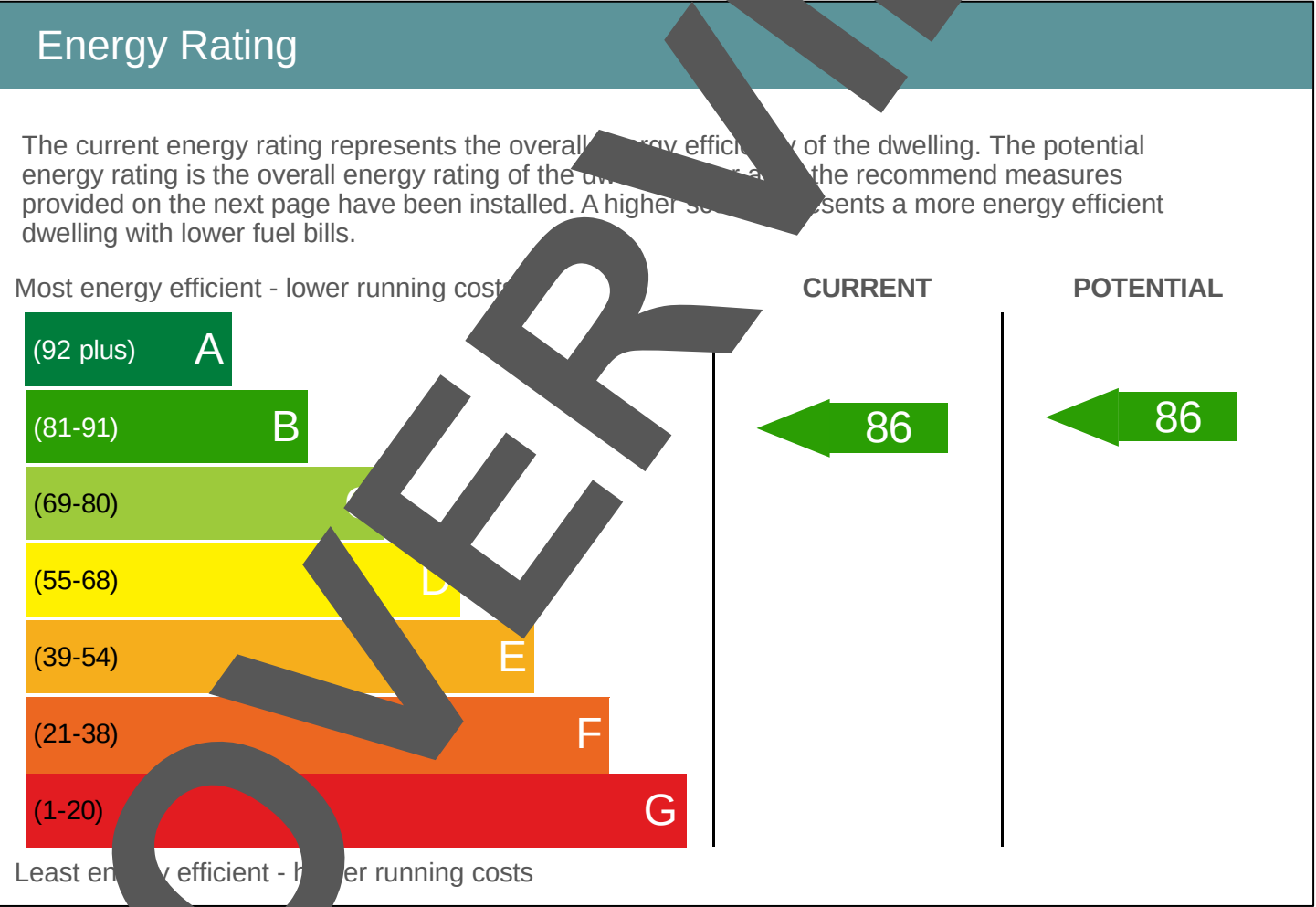
Assessor Details	Miss Laura Plazas	Assessor ID	
Client			

	Junction details	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.050	0.00	0.00	
External wall	E4 Jamb	Independently assessed	0.050	0.00	0.00	
External wall	E7 Party floor between dwellings (in blocks of flats)	Independently assessed	0.000	51.61	0.00	
External wall	E23 Balcony within or between dwellings, balcony support penetrates wall insulation	Independently assessed	0.000	5.15	0.00	
External wall	E16 Corner (normal)	Independently assessed	0.090	5.86	0.53	
External wall	E18 Party wall between dwellings	Independently assessed	0.000	5.86	0.00	

Total 68.48 W/mK:
Y-Value 0.00 W/m²K:

Dwelling Address	
Report Date	24/07/2023
Property Type	Flat, End-Terrace
Floor Area [m ²]	140

This document is not an Energy Performance Certificate (EPC) as required by the Energy Performance of Buildings Regulations



Breakdown of property's energy performance

Each feature is assessed as one of the following:

Very Poor

Poor

Average

Good

Very Good

Feature	Description	Energy performance
Walls	Average thermal transmittance 0.64 W/m ² K	Good
Windows	High performance glazing	Very Good
Main heating	Community scheme	Good
Main heating controls	Charging system linked to use of community heating, programmed, and at least two room thermostats	Good
Secondary heating	None	
Hot water	Community scheme	Good
Lighting	Good lighting efficiency	Good
Air tightness	Air permeability [AP50] ≤ 0.5 m ³ /h.m ² (assumed)	Good

Primary Energy use

The primary energy use for this property per year is 15 kilowatt hour (kWh) per square metre

Estimated CO₂ emissions of the dwelling

The estimated CO₂ rating provides an indication of the dwelling's impact on the environment in terms of carbon dioxide emissions. The higher the rating the less impact it has on the environment.

The estimated CO₂ emissions for this dwellings is: **0.3** per year

With the recommended measures the potential CO₂ emissions could be: **0** per year

Recommendations

The recommended measures provided below will help to improve the energy efficiency of the dwelling. To reach the dwelling's potential energy rating all of the recommended measures shown below would need to be installed. Having these measures installed individually or in any other order may give a different result when compared with the cumulative potential rating.

Recommended measure	Typical Yearly Saving	Potential Rating after measure installed	Cumulative saving (per year)	Cumulative potential rating
---------------------	-----------------------	--	------------------------------	-----------------------------

Estimated energy use and potential savings

Estimated energy cost for this property over a year

£521

Over a year you could save

£0

The estimated cost and savings show how much the average household would spend in this property for heating, lighting and hot water. It is not based on how energy is used by the people living at the property.

Contacting the assessor and the accreditation scheme

Assessor contact details

Assessor name	Miss Laura Plazas
Assessor accreditation number	
Email address	

Accreditation scheme contact details

Accreditation scheme	
Telephone	
Email Address	

OVERVIEW

Assessment details	
Related party disclosure	
Date of assessment	20/07/2023
Date of certificate	20/07/2023
Type of assessment	SAP, new dwelling

Property Reference	THFC-L20-03		Issued on Date	24/07/2023	
Assessment Reference	V1 THFC-L20-03 LEANboilr-PlanB		Prop Type Ref		
Property					
SAP Rating	87 B	DER		TER	
			8.30		10.29
Environmental	92 A	% DER < TER	19.34		
CO ₂ Emissions (t/year)	1.07	DFEE	26.53	TFEE	29.92
Compliance Check	See BREL	% DFEE < TFEE	11.31		
% DPER < TPER	11.34	DPER	49.96	TPER	56.35
Miss Laura Plazas				T491-0001	
Assessor Details					Assessor ID
Client					

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 409.2624 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	Air changes per hour 0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.1500 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m2)			84.0000				(31)

Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	53.1427	(33)
Party Floor 1	139.6800		(32d)
Party Ceiling 1	139.6800		(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	0.0000	0.0500	0.0000
E7 Party floor between dwellings (in blocks of flats)	51.6100	0.0000	0.0000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.1500	0.0000	0.0000
E16 Corner (normal)	5.8600	0.0900	0.5274
E18 Party wall between dwellings	5.8600	0.0000	0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			0.5274 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =		53.6701 (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	35.3933	34.9628	34.5323	32.3798	31.9493	29.7969	29.7969	29.3664	30.6578	31.9493	32.8103	33.6713 (38)
Average = Sum(39)m / 12 =	89.0634	88.6329	88.2024	86.0499	85.6194	83.4670	83.4670	83.0365	84.3280	85.6194	86.4804	87.3414 (39)
												85.9423
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6376	0.6345	0.6315	0.6161	0.6130	0.5976	0.5976	0.5945	0.6037	0.6130	0.6191	0.6253 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	0.6153
												31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9165 (42)
Hot water usage for mixer showers												
73.1195 72.0207	70.4194	67.3558	65.0949	62.5735	61.1404	62.7295	64.4715	67.1786	70.3081	72.8394 (42a)		
Hot water usage for baths												
33.2284 32.7349	32.0400	30.7587	29.7992	28.7353	28.1607	28.8508	29.6021	30.7405	32.0482	33.1161 (42b)		
Hot water usage for other uses												
46.8396 45.1363	43.4331	41.7298	40.0266	38.3233	38.3233	40.0266	41.7298	43.4331	45.1363	46.8396 (42c)		
Average daily hot water use (litres/day)												140.8032 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	153.1875	149.8919	145.8925	139.8442	134.9206	129.6321	127.6244	131.6068	135.8034	141.3522	147.4926	152.7950 (44)
Energy content (annual)	242.6116	213.4441	224.2313	191.4398	181.6291	159.3978	154.3506	162.9567	167.4592	191.8136	210.1303	239.2401 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 2338.7043
36.3917 32.0166	33.6347	28.7160	27.2444	23.9097	23.1526	24.4435	25.1189	28.7720	31.5195	35.8860 (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	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	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990 (64)
	Total per year (kWh/year) = Sum(64)m = 2938.7043 (64)											
12Total per year (kWh/year)	2939 (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	93.4081	82.4770	87.2966	75.9825	73.1314	65.3286	64.0613	66.9228	68.0089	76.5177	82.1971	92.2871 (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	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.8792	172.5805	155.8792	161.0752	155.8792	161.0752	155.8792	155.8792	161.0752	155.8792	161.0752	155.8792 (67)
	309.0479	312.2549	304.1735	286.9691	265.2517	244.8403	231.2043	227.9974	236.0788	253.2832	275.0006	295.4119 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824 (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)												
	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589 (71)
Water heating gains (Table 5)												
	125.5485	122.7337	117.3342	105.5312	98.2949	90.7341	86.1039	89.9500	94.4569	102.8464	114.1626	124.0417 (72)
Total internal gains	657.2227	674.3162	644.1340	620.3226	586.1728	563.3967	539.9345	540.5737	558.3579	578.7559	616.9855	642.0799 (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			
South				14.8500	46.7521	0.5000	1.0000	0.7700	240.5639 (78)			
West				23.7900	19.6403	0.5000	1.0000	0.7700	161.8993 (80)			
Solar gains	402.4632	710.6911	1023.4381	1327.9003	1523.3218	1523.1499	1464.3329	1320.1727	1130.8686	800.7486	487.0197	341.0075 (83)
Total gains	1059.6859	1385.0073	1667.5720	1948.2229	2109.4946	2086.5466	2004.2674	1860.7464	1689.2265	1379.5045	1104.0052	983.0874 (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	43.5645	43.7761	43.9897	45.0901	45.3168	46.4854	46.4854	46.7264	46.0108	45.3168	44.8656	44.4234
alpha	3.9043	3.9184	3.9326	4.0060	4.0211	4.0990	4.0990	4.1151	4.0674	4.0211	3.9910	3.9616
util living area	0.9056	0.8084	0.6807	0.5133	0.3728	0.2553	0.1831	0.2050	0.3415	0.6012	0.8321	0.9217 (86)
MIT	20.0632	20.4537	20.7440	20.9262	20.9822	20.9973	20.9995	20.9992	20.9910	20.8904	20.4930	19.9987 (87)
Th 2	20.3963	20.3990	20.4018	20.4156	20.4183	20.4322	20.4322	20.4350	20.4267	20.4183	20.4128	20.4073 (88)
util rest of house	0.8963	0.7934	0.6609	0.4914	0.3503	0.2328	0.1595	0.1799	0.3138	0.5740	0.8161	0.9138 (89)
MIT 2	19.2943	19.7722	20.1184	20.3384	20.4012	20.4300	20.4319	20.4344	20.4189	20.3059	19.8381	19.2231 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.6736	20.1084	20.4270	20.6284	20.6878	20.7099	20.7119	20.7130	20.7011	20.5943	20.1612	19.6057 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.6736	20.1084	20.4270	20.6284	20.6878	20.7099	20.7119	20.7130	20.7011	20.5943	20.1612	19.6057 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8838	0.7857	0.6617	0.4994	0.3608	0.2438	0.1711	0.1923	0.3271	0.5823	0.8087	0.9016 (94)
Useful gains	936.5745	1088.2610	1103.5026	972.9899	761.0056	508.7751	343.0019	357.8118	552.5589	803.3212	892.7830	886.3205 (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	1369.2285	1347.9663	1228.3975	1009.2260	769.5335	509.9719	343.2073	358.1402	556.6576	855.7029	1129.5369	1345.5563 (97)
Space heating kWh	321.8946	174.5219	92.9218	26.0900	6.3448	0.0000	0.0000	0.0000	0.0000	38.9720	170.4628	341.6715 (98a)
Space heating requirement - total per year (kWh/year)												1172.8794
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	321.8946	174.5219	92.9218	26.0900	6.3448	0.0000	0.0000	0.0000	0.0000	38.9720	170.4628	341.6715 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1172.8794
Space heating per m2	(98c) / (4) =											8.3969 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan 4.3000	Feb 4.9000	Mar 6.5000	Apr 8.9000	May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	784.5897	617.6557	631.0773	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9927	0.9965	0.9951	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	778.8618	615.4892	627.9665	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2363.4150	2270.7482	2105.5848	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1140.8783	1231.5127	1099.3480	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) =											
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	255.8359	276.1602	246.5230	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling requirement												778.5191 (107)

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 %)	88.9000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)

Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)													4.6000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	321.8946	174.5219	92.9218	26.0900	6.3448	0.0000	0.0000	0.0000	0.0000	38.9720	170.4628	341.6715	(98)
Space heating efficiency (main heating system 1)	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000	(210)
Space heating fuel (main heating system)	362.0861	196.3126	104.5240	29.3476	7.1370	0.0000	0.0000	0.0000	0.0000	43.8380	191.7467	384.3324	(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	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990	(64)
Efficiency of water heater	84.5793	83.5502	82.3100	81.0668	80.5068	80.3000	80.3000	80.3000	80.3000	81.3891	83.5030	84.7323	(216)
Fuel for water heating, kWh/month	347.0950	310.5576	334.3341	296.9835	288.9048	259.9165	255.6781	266.3955	269.9555	298.2863	310.7020	342.4894	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	55.6165	60.0348	53.5919	0.0000	0.0000	0.0000	0.0000	(221)
(221)m	44.1128	39.8438	44.1128	42.6898	44.1128	42.6898	44.1128	44.1128	42.6898	44.1128	42.6898	44.1128	(231)
Pumps and Fa	33.4734	26.8536	24.1787	17.7144	13.6831	11.1792	12.4822	16.2248	21.0744	27.6507	31.2315	34.4037	(232)
Lighting	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 PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
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	(235a)
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	(235c)
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	(235b)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
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	(235e)
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	(235f)
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	(235g)
Annual totals kWh/year													
Space heating fuel - main system 1													1319.3244 (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													3581.2982 (219)
Space cooling fuel													169.2433 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)													
mechanical ventilation fans (SFP = 0.8680)													433.3925 (230a)
central heating pump													41.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													519.3925 (231)
Electricity for lighting (calculated in Appendix L)													270.1496 (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													5859.4080 (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	1319.3244	0.2100	277.0581 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3581.2982	0.2100	752.0726 (264)
Space and water heating			1029.1307 (265)
Space cooling	169.2433	0.1143	19.3401 (266)
Pumps, fans and electric keep-hot	519.3925	0.1387	72.0461 (267)
Energy for lighting	270.1496	0.1443	38.9909 (268)
Total CO2, kg/year			1159.5080 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			8.3000 (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	1319.3244	1.1300	1490.8366 (275)

Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3581.2982	1.1300	4046.8669 (278)
Space and water heating			5537.7035 (279)
Space cooling	169.2433	1.4211	240.5179 (280)
Pumps, fans and electric keep-hot	519.3925	1.5128	785.7370 (281)
Energy for lighting	270.1496	1.5338	414.3645 (282)
Total Primary energy kWh/year			6978.3229 (286)
Dwelling Primary energy Rate (DPER)			49.9600 (287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 409.2624 (5)

2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0977 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3477 (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) =	0.2956 (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	0.3769	0.3695	0.3621	0.3251	0.3177	0.2808	0.2808	0.2734	0.2956	0.3177	0.3325	0.3473 (22b)
Effective ac	0.5710	0.5683	0.5656	0.5529	0.5505	0.5394	0.5394	0.5374	0.5437	0.5505	0.5553	0.5603 (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 Curtain (Uw = 1.30)			34.8900	1.2357	43.1150		(27)
Curtain Wall	84.0000	34.8900	49.1100	0.1800	8.8398		(29a)
Total net area of externa			84.0000				(31)
Fabric heat loss, W/K = S			(26)...(30) + (32) =		51.9548		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total
E2 Other lintels (including other steel lintels)				0.0000	0.0500		0.0000
E4 Jamb				0.0000	0.0500		0.0000
E7 Party floor between dwellings (in blocks of flats)				51.6100	0.0700		3.6127
E23 Balcony within or between dwellings, balcony support penetrates wall insulation				5.1500	0.0200		0.1030
E16 Corner (normal)				5.8600	0.0900		0.5274
E18 Party wall between dwellings				5.8600	0.0600		0.3516
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5947 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	56.5495 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 77.1189	Feb 76.7465	Mar 76.3814	Apr 74.6669	May 74.3461	Jun 72.8527	Jul 72.8527	Aug 72.5762	Sep 73.4279	Oct 74.3461	Nov 74.9950	Dec 75.6735 (38)
Heat transfer coeff	133.6684	133.2960	132.9310	131.2164	130.8956	129.4022	129.4022	129.1257	129.9774	130.8956	131.5445	132.2230 (39)
Average = Sum(39)m / 12 =												131.2148

HLP	Jan 0.9570	Feb 0.9543	Mar 0.9517	Apr 0.9394	May 0.9371	Jun 0.9264	Jul 0.9264	Aug 0.9244	Sep 0.9305	Oct 0.9371	Nov 0.9418	Dec 0.9466 (40)
HLP (average)												0.9394
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9165 (42)
Hot water usage for mixer showers	73.1195	72.0207	70.4194	67.3558	65.0949	62.5735	61.1404	62.7295	64.4715	67.1786	70.3081	72.8394 (42a)
Hot water usage for baths	31.5670	31.0982	30.4380	29.2207	28.3093	27.2986	26.7526	27.4082	28.1220	29.2035	30.4458	31.4603 (42b)
Hot water usage for other uses	44.4976	42.8795	41.2614	39.6433	38.0252	36.4071	36.4071	38.0252	39.6433	41.2614	42.8795	44.4976 (42c)
Average daily hot water use (litres/day)												137.1337 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	149.1841	145.9984	142.1188	136.2198	131.4293	126.2792	124.3002	128.1629	132.2368	137.6435	143.6334	148.7973 (44)
Energy conte	236.2712	207.8997	218.4314	186.4781	176.9292	155.2750	150.3303	158.6925	163.0612	186.7809	204.6321	232.9805 (45)
Energy content (annual)												Total = Sum(45)m = 2277.7622
Distribution loss (46)m = 0.15 x (45)m	35.4407	31.1850	32.7647	27.9717	26.5394	23.2913	22.5495	23.8039	24.4592	28.0171	30.6948	34.9471 (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	287.2301	253.9271	269.3903	235.7932	227.8881	204.5901	201.2892	209.6514	212.3763	237.7399	253.9472	283.9394 (62)
WWHRS	-33.4272	-29.5633	-30.9570	-25.6336	-23.8896	-20.4425	-19.1616	-20.3764	-21.1506	-24.9342	-28.2474	-32.8082 (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	253.8029	224.3638	238.4333	210.1596	203.9985	184.1476	182.1276	189.2750	191.2257	212.8056	225.6998	251.1313 (64)
12Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 2567.1707 (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	91.2999	80.6335	85.3682	74.3327	71.5687	63.9577	62.7245	65.5050	66.5466	74.8444	80.3690	90.2058 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan 145.8237	Feb 145.8237	Mar 145.8237	Apr 145.8237	May 145.8237	Jun 145.8237	Jul 145.8237	Aug 145.8237	Sep 145.8237	Oct 145.8237	Nov 145.8237	Dec 145.8237 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.8792	172.5805	155.8792	161.0752	155.8792	161.0752	155.8792	155.8792	161.0752	155.8792	161.0752	155.8792 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	309.0479	312.2549	304.1735	286.9691	265.2517	244.8403	231.2043	227.9974	236.0788	253.2832	275.0006	295.4119 (68)
Pumps, fans	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589 (71)
Total internal gains	122.7149	119.9903	114.7422	103.2399	96.1944	88.8302	84.3072	88.0443	92.4259	100.5973	111.6235	121.2443 (72)
	657.3891	674.5728	644.5419	621.0313	587.0724	561.4928	538.1378	538.6680	556.3269	579.5068	617.4464	642.2825 (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	
South	13.4200		46.7521		0.6300		0.7000		0.7700		191.7455 (78)	
West	21.4700		19.6403		0.6300		0.7000		0.7700		128.8698 (80)	
Solar gains	320.6153	566.1264	815.1855	1057.6041	1213.1828	1213.0220	1166.1904	1051.4233	900.7229	637.8444	387.9693	271.6620 (83)
Total gains	978.0044	1240.6992	1459.7274	1678.6354	1800.2552	1774.5148	1704.3282	1590.0913	1457.0498	1217.3512	1005.4157	913.9445 (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)

21.0000 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	29.0271	29.1082	29.1881	29.5695	29.6419	29.9840	29.9840	30.0482	29.8513	29.6419	29.4957	29.3444
alpha	2.9351	2.9405	2.9459	2.9713	2.9761	2.9989	2.9989	3.0032	2.9901	2.9761	2.9664	2.9563
util living area	0.9481	0.9048	0.8393	0.7270	0.5896	0.4401	0.3257	0.3611	0.5507	0.7887	0.9158	0.9561 (86)
MIT	18.9583	19.3971	19.8991	20.4215	20.7542	20.9253	20.9773	20.9688	20.8508	20.3676	19.5717	18.8835 (87)
Th 2	20.1194	20.1216	20.1238	20.1341	20.1361	20.1451	20.1451	20.1468	20.1416	20.1361	20.1322	20.1281 (88)
util rest of house	0.9413	0.8931	0.8206	0.6977	0.5488	0.3880	0.2653	0.2983	0.4962	0.7578	0.9034	0.9502 (89)
MIT 2	17.7223	18.2710	18.8905	19.5221	19.9008	20.0861	20.1317	20.1274	20.0153	19.4773	18.5049	17.6338 (90)
Living area fraction									fLA = Living area / (4) =			0.4933 (91)
MIT	18.3320	18.8266	19.3881	19.9658	20.3218	20.5001	20.5489	20.5425	20.4275	19.9165	19.0312	18.2503 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3320	18.8266	19.3881	19.9658	20.3218	20.5001	20.5489	20.5425	20.4275	19.9165	19.0312	18.2503 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9233	0.8725	0.8029	0.6917	0.5578	0.4100	0.2941	0.3278	0.5149	0.7492	0.8843	0.9336	(94)
Useful gains	903.0048	1082.5543	1172.0128	1161.0371	1004.2442	727.5807	501.2619	521.2630	750.2796	911.9854	889.1087	853.2525	(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													
	1875.6401	1856.3558	1713.2215	1452.0133	1128.5580	763.4897	510.9962	534.9024	822.4298	1219.4893	1569.4841	1857.7763	(97)
Space heating kwh													
	723.6407	519.9946	402.6593	209.5029	92.4895	0.0000	0.0000	0.0000	0.0000	228.7829	489.8703	747.3657	(98a)
Space heating requirement - total per year (kwh/year)												3414.3059	
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													
	723.6407	519.9946	402.6593	209.5029	92.4895	0.0000	0.0000	0.0000	0.0000	228.7829	489.8703	747.3657	(98c)
Space heating requirement after solar contribution - total per year (kwh/year)												3414.3059	
Space heating per m2													
										(98c) / (4) =		24.4438	(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

[illegible]

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	(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	(235d)
Annual totals kWh/year											
Space heating fuel - main system 1											3695.1363 (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											3062.5683 (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)											261.3947 (232)
Energy saving/generation technologies (Appendices M ,N and Q)											
PV generation											-238.0701 (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											6867.0291 (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	3695.1363	0.2100	775.9786 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3062.5683	0.2100	643.1393 (264)
Space and water heating			1419.1179 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	261.3947	0.1443	37.7273 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-181.9824	0.1323	-24.0703
PV Unit electricity exported	-56.0878	0.1245	-6.9819
Total			-31.0522 (269)
Total CO2, kg/year			1437.7223 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.2900 (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	3695.1363	1.1300	4175.5040 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3062.5683	1.1300	3460.7021 (278)
Space and water heating			7636.2061 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	261.3947	1.5338	400.9359 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-181.9824	1.4887	-270.9176
PV Unit electricity exported	-56.0878	0.4569	-25.6243
Total			-296.5419 (283)
Total Primary energy kWh/year			7870.7008 (286)
Target Primary Energy Rate (TPER)			56.3500 (287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

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

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000	Air changes per hour / (5) =	0.0977 (8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50				3.0000 (17)
Infiltration rate				0.2477 (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) =		0.2106 (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	0.2685	0.2632	0.2580	0.2316	0.2264	0.2000	0.2000	0.1948	0.2106	0.2264	0.2369	0.2474 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.5360	0.5346	0.5333	0.5268	0.5256	0.5200	0.5200	0.5190	0.5222	0.5256	0.5281	0.5306 (23c)

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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m2)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.1427		(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)

List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	0.0000	0.0500	0.0000
E7 Party floor between dwellings (in blocks of flats)	51.6100	0.0000	0.0000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.1500	0.0000	0.0000
E16 Corner (normal)	5.8600	0.0900	0.5274
E18 Party wall between dwellings	5.8600	0.0000	0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			0.5274 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss		(33) + (36) + (36a) =	53.6701 (37)

[illegible]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9025	0.9012	0.8999	0.8936	0.8925	0.8870	0.8870	0.8860	0.8891	0.8925	0.8948	0.8973 (40)
HLP (average)												0.8936
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

[illegible]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	76.0646	73.9777	71.6994	68.8641	66.3345	63.7057	63.1598	65.4334	67.7653	70.4649	73.3253	75.9579 (44)
Energy conte	120.4677	105.3433	110.1993	94.2714	89.2990	78.3336	76.3863	81.0203	83.5614	95.6202	104.4654	118.9317 (45)
Energy content (annual)										Total =	Sum(45)m =	1157.8996

Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
	102.3976	89.5418	93.6694	80.1307	75.9041	66.5836	64.9283	68.8672	71.0272	81.2772	88.7956	101.0919 (62)
WMHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	102.3976	89.5418	93.6694	80.1307	75.9041	66.5836	64.9283	68.8672	71.0272	81.2772	88.7956	101.0919 (64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				984.2147 (64)
Electric shower(s)	58.5565	52.1744	56.9724	54.3681	55.3883	52.8350	54.5962	55.3883	54.3681	56.9724	55.9011	58.5565 (64a)
												666.0772 (64a)
Heat gains from water heating, kWh/month	40.2385	35.4290	37.6605	33.6247	32.8231	29.8546	29.8811	31.0639	31.3488	34.5624	36.1742	39.9121 (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	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	155.8792	172.5805	155.8792	161.0752	155.8792	161.0752	155.8792	155.8792	161.0752	155.8792	161.0752	155.8792	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	309.0479	312.2549	304.1735	286.9691	265.2517	244.8403	231.2043	227.9974	236.0788	253.2832	275.0006	295.4119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	(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)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	(71)
Water heating gains (Table 5)	54.0840	52.7218	50.6189	46.7010	44.1171	41.4648	40.1628	41.7525	43.5400	46.4548	50.2419	53.6453	(72)
Total internal gains	585.7583	604.3043	577.4186	561.4923	531.9950	514.1274	493.9934	492.3762	507.4411	522.3643	553.0648	571.6835	(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			
South	14.8500		46.7521		0.5000		1.0000		0.7700		240.5639	
West	23.7900		19.6403		0.5000		1.0000		0.7700		161.8993	
Solar gains	402.4632	710.6911	1023.4381	1327.9003	1523.3218	1523.1499	1464.3329	1320.1727	1130.8686	800.7486	487.0197	341.0075 (83)
Total gains	988.2215	1314.9954	1600.8567	1889.3927	2055.3168	2037.2773	1958.3263	1812.5488	1638.3097	1323.1129	1040.0844	912.6910 (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 _{li,m} (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.7775	30.8237	30.8691	31.0844	31.1250	31.3154	31.3154	31.3509	31.2418	31.1250	31.0429	30.9576	
alpha	3.0518	3.0549	3.0579	3.0723	3.0750	3.0877	3.0877	3.0901	3.0828	3.0750	3.0695	3.0638	
util living area	0.9446	0.8867	0.8001	0.6646	0.5172	0.3760	0.2745	0.3080	0.4866	0.7469	0.9051	0.9547	(86)
MIT	19.1289	19.6251	20.1341	20.5921	20.8458	20.9569	20.9877	20.9823	20.9042	20.5059	19.7253	19.0252	(87)
Th 2	20.1653	20.1665	20.1676	20.1729	20.1739	20.1785	20.1785	20.1794	20.1768	20.1739	20.1719	20.1698	(88)
util rest of house	0.9376	0.8738	0.7795	0.6347	0.4794	0.3312	0.2246	0.2551	0.4369	0.7144	0.8920	0.9488	(89)
MIT 2	18.4511	18.9321	19.4162	19.8399	20.0601	20.1522	20.1729	20.1709	20.1142	19.7760	19.0410	18.3529	(90)
Living area fraction									f _{LA} =	Living area / (4) =			0.4933 (91)
MIT	18.7854	19.2740	19.7704	20.2110	20.4477	20.5492	20.5749	20.5712	20.5040	20.1361	19.3786	18.6846	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7854	19.2740	19.7704	20.2110	20.4477	20.5492	20.5749	20.5712	20.5040	20.1361	19.3786	18.6846	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9232	0.8580	0.7688	0.6362	0.4922	0.3516	0.2488	0.2806	0.4571	0.7128	0.8771	0.9356	(94)

Useful gains	912.3055	1128.2767	1230.7717	1201.9958	1011.6107	716.4006	487.2804	508.5673	748.7928	943.1542	912.2880	853.9026 (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	1826.1239	1809.3549	1667.9765	1411.8598	1090.4754	737.1049	492.4938	516.2296	795.3270	1188.7575	1534.6828	1815.3919 (97)
Space heating kwh	679.8809	457.6845	325.2804	151.1021	58.6753	0.0000	0.0000	0.0000	0.0000	182.7289	448.1243	715.3480 (98a)
Space heating requirement - total per year (kwh/year)												3018.8244
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	679.8809	457.6845	325.2804	151.1021	58.6753	0.0000	0.0000	0.0000	0.0000	182.7289	448.1243	715.3480 (98c)
Space heating requirement after solar contribution - total per year (kwh/year)												3018.8244
Space heating per m2										(98c) / (4) =		21.6124 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1164.6678	916.8662	940.5796	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9366	0.9609	0.9496	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1090.7984	881.0237	893.2190	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2314.5868	2225.2838	2058.0069	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kwh	0.0000	0.0000	0.0000	0.0000	0.0000	881.1277	1000.1295	866.6022	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kwh	0.0000	0.0000	0.0000	0.0000	0.0000	220.2819	250.0324	216.6505	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												686.9648 (107)
Energy for space heating												21.6124 (99)
Energy for space cooling												4.9181 (108)
Total												26.5306 (109)
Fabric Energy Efficiency (DFEE)												26.5 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 40.0000 / (5) = 0.0977 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3477 (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) = 0.2956 (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	0.3769	0.3695	0.3621	0.3251	0.3177	0.2808	0.2808	0.2734	0.2956	0.3177	0.3325	0.3473 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.5710	0.5683	0.5656	0.5529	0.5505	0.5394	0.5394	0.5374	0.5437	0.5505	0.5553	0.5603 (23c)
												0.5603 (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 Curtain (Uw = 1.30)			34.8900	1.2357	43.1150		(27)
Curtain Wall	84.0000	34.8900	49.1100	0.1800	8.8398		(29a)
Total net area of externa			84.0000				(31)
Fabric heat loss, W/K = S			(26)...(30) + (32) =			51.9548	(33)

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

100.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	0.0000	0.0500	0.0000
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	51.6100	0.0700	3.6127
E7 Party floor between dwellings (in blocks of flats)	5.1500	0.0200	0.1030
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.8600	0.0900	0.5274
E16 Corner (normal)	5.8600	0.0600	0.3516
E18 Party wall between dwellings			

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

4.5947 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 56.5495 (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	77.1189	76.7465	76.3814	74.6669	74.3461	72.8527	72.8527	72.5762	73.4279	74.3461	74.9950	75.6735 (38)
Heat transfer coeff	133.6684	133.2960	132.9310	131.2164	130.8956	129.4022	129.4022	129.1257	129.9774	130.8956	131.5445	132.2230 (39)
Average = Sum(39)m / 12 =												131.2148

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9570	0.9543	0.9517	0.9394	0.9371	0.9264	0.9264	0.9244	0.9305	0.9371	0.9418	0.9466 (40)
HLP (average)												0.9394
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9165 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	31.5670	31.0982	30.4380	29.2207	28.3093	27.2986	26.7526	27.4082	28.1220	29.2035	30.4458	31.4603 (42b)
Hot water usage for other uses	44.4976	42.8795	41.2614	39.6433	38.0252	36.4071	36.4071	38.0252	39.6433	41.2614	42.8795	44.4976 (42c)
Average daily hot water use (litres/day)												69.7200 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	76.0646	73.9777	71.6994	68.8641	66.3345	63.7057	63.1598	65.4334	67.7653	70.4649	73.3253	75.9579 (44)
Energy conte	120.4677	105.3433	110.1993	94.2714	89.2990	78.3336	76.3863	81.0203	83.5614	95.6202	104.4654	118.9317 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	102.3976	89.5418	93.6694	80.1307	75.9041	66.5836	64.9283	68.8672	71.0272	81.2772	88.7956	101.0919 (62)
WWhRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	102.3976	89.5418	93.6694	80.1307	75.9041	66.5836	64.9283	68.8672	71.0272	81.2772	88.7956	101.0919 (64)
												984.2147 (64)
12Total per year (kWh/year)												984 (64)
Electric shower(s)	58.5565	52.1744	56.9724	54.3681	55.3883	52.8350	54.5962	55.3883	54.3681	56.9724	55.9011	58.5565 (64a)
												666.0772 (64a)
Heat gains from water heating, kWh/month	40.2385	35.4290	37.6605	33.6247	32.8231	29.8546	29.8811	31.0639	31.3488	34.5624	36.1742	39.9121 (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	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237	145.8237 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	155.8792	172.5805	155.8792	161.0752	155.8792	161.0752	155.8792	155.8792	161.0752	155.8792	161.0752	155.8792 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	309.0479	312.2549	304.1735	286.9691	265.2517	244.8403	231.2043	227.9974	236.0788	253.2832	275.0006	295.4119 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824	37.5824 (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)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589 (71)
Water heating gains (Table 5)	54.0840	52.7218	50.6189	46.7010	44.1171	41.4648	40.1628	41.7525	43.5400	46.4548	50.2419	53.6453 (72)
Total internal gains	585.7583	604.3043	577.4186	561.4923	531.9950	514.1274	493.9934	492.3762	507.4411	522.3643	553.0648	571.6835 (73)

[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
South	13.4200	46.7521	0.6300	0.7000	0.7700	191.7455 (78)
West	21.4700	19.6403	0.6300	0.7000	0.7700	128.8698 (80)

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, nll,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	29.0271	29.1082	29.1881	29.5695	29.6419	29.9840	29.9840	30.0482	29.8513	29.6419	29.4957	29.3444
alpha	2.9351	2.9405	2.9459	2.9713	2.9761	2.9989	2.9989	3.0032	2.9901	2.9761	2.9664	2.9563
util living area	0.9566	0.9158	0.8526	0.7408	0.6027	0.4504	0.3337	0.3710	0.5650	0.8048	0.9271	0.9638 (86)
MIT	18.8640	19.3177	19.8397	20.3886	20.7390	20.9205	20.9758	20.9664	20.8400	20.3261	19.4957	18.7878 (87)
Th 2	20.1194	20.1216	20.1238	20.1341	20.1361	20.1451	20.1451	20.1468	20.1416	20.1361	20.1322	20.1281 (88)
util rest of house	0.9507	0.9052	0.8349	0.7121	0.5617	0.3975	0.2721	0.3067	0.5100	0.7752	0.9161	0.9588 (89)
MIT 2	18.1592	18.6033	19.1074	19.6284	19.9407	20.0960	20.1339	20.1305	20.0356	19.5862	18.7912	18.0903 (90)
Living area fraction									fLA = Living area / (4) =			0.4933 (91)
MIT	18.5069	18.9558	19.4687	20.0034	20.3345	20.5028	20.5492	20.5429	20.4324	19.9512	19.1388	18.4344 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5069	18.9558	19.4687	20.0034	20.3345	20.5028	20.5492	20.5429	20.4324	19.9512	19.1388	18.4344 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9369	0.8884	0.8200	0.7075	0.5715	0.4200	0.3015	0.3370	0.5293	0.7682	0.9008	0.9463	(94)
Useful gains	849.2182	1039.8534	1141.8686	1145.4511	997.2885	725.4813	500.6166	520.2452	745.2919	891.2418	847.6510	798.0851	(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	1899.0131	1873.5764	1723.9393	1456.9490	1130.2236	763.8319	511.0407	534.9523	823.0752	1224.0340	1583.6366	1882.1135	(97)
Space heating kWh	781.0474	560.2618	433.0606	224.2785	98.9038	0.0000	0.0000	0.0000	0.0000	247.5974	529.9096	806.5171	(98a)
Space heating requirement - total per year (kWh/year)												3681.5762	
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	781.0474	560.2618	433.0606	224.2785	98.9038	0.0000	0.0000	0.0000	0.0000	247.5974	529.9096	806.5171	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3681.5762	
Space heating per m2												26.3572	(99)
										(98c) / (4) =			

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

Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	623.8066	733.6598	630.4269	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	155.9516	183.4149	157.6067	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												496.9733 (107)
Energy for space cooling												26.3572 (99)
Total												3.5579 (108)
Fabric Energy Efficiency (TFEE)												29.9152 (109)
												29.9 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.1500 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m ²)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	53.1427	(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	

E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000	
E4 Jamb	0.0000	0.0500	0.0000	
E7 Party floor between dwellings (in blocks of flats)	51.6100	0.0000	0.0000	
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.1500	0.0000	0.0000	
E16 Corner (normal)	5.8600	0.0900	0.5274	
E18 Party wall between dwellings	5.8600	0.0000	0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				0.5274 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =		53.6701 (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	35.3933	34.9628	34.5323	32.3798	31.9493	29.7969	29.7969	29.3664	30.6578	31.9493	32.8103	33.6713 (38)
Average = Sum(39)m / 12 =	89.0634	88.6329	88.2024	86.0499	85.6194	83.4670	83.4670	83.0365	84.3280	85.6194	86.4804	87.3414 (39)
												85.9423
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6376	0.6345	0.6315	0.6161	0.6130	0.5976	0.5976	0.5945	0.6037	0.6130	0.6191	0.6253 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	0.6153 (40)
												31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9165 (42)
Hot water usage for mixer showers													
	73.1195	72.0207	70.4194	67.3558	65.0949	62.5735	61.1404	62.7295	64.4715	67.1786	70.3081	72.8394	(42a)
Hot water usage for baths													
	33.2284	32.7349	32.0400	30.7587	29.7992	28.7353	28.1607	28.8508	29.6021	30.7405	32.0482	33.1161	(42b)
Hot water usage for other uses													
	46.8396	45.1363	43.4331	41.7298	40.0266	38.3233	38.3233	40.0266	41.7298	43.4331	45.1363	46.8396	(42c)
Average daily hot water use (litres/day)													140.8032 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	153.1875	149.8919	145.8925	139.8442	134.9206	129.6321	127.6244	131.6068	135.8034	141.3522	147.4926	152.7950	(44)
Energy conte	242.6116	213.4441	224.2313	191.4398	181.6291	159.3978	154.3506	162.9567	167.4592	191.8136	210.1303	239.2401	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2338.7043
	36.3917	32.0166	33.6347	28.7160	27.2444	23.9097	23.1526	24.4435	25.1189	28.7720	31.5195	35.8860	(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													
	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990	(64)
													Total per year (kWh/year) = Sum(64)m = 2938.7043 (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													
	93.4081	82.4770	87.2966	75.9825	73.1314	65.3286	64.0613	66.9228	68.0089	76.5177	82.1971	92.2871	(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	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	38.2425	33.9666	27.6235	20.9128	15.6325	13.1977	14.2605	18.5364	24.8795	31.5902	36.8705	39.3054 (67)
	461.2656	466.0520	453.9902	428.3121	395.8980	365.4334	345.0811	340.2946	352.3564	378.0346	410.4486	440.9133 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153 (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)												
	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589 (71)
Water heating gains (Table 5)												
	125.5485	122.7337	117.3342	105.5312	98.2949	90.7341	86.1039	89.9500	94.4569	102.8464	114.1626	124.0417 (72)
Total internal gains	738.8013	736.4971	712.6927	668.5009	623.5702	583.1099	559.1903	562.5258	585.4375	626.2160	675.2265	718.0052 (73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
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				m2		Table 6a W/m2		Specific data or Table 6b		Specific data or Table 6c		factor Table 6d		W	
South				14.8500		46.7521		0.5000		1.0000		0.7700		240.5639	(78)
West				23.7900		19.6403		0.5000		1.0000		0.7700		161.8993	(80)
Solar gains	402.4632	710.6911	1023.4381	1327.9003	1523.3218	1523.1499	1464.3329	1320.1727	1130.8686	800.7486	487.0197	341.0075		(83)	
Total gains	1141.2645	1447.1882	1736.1308	1996.4012	2146.8920	2106.2598	2023.5232	1882.6985	1716.3061	1426.9646	1162.2462	1059.0127		(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	43.5645	43.7761	43.9897	45.0901	45.3168	46.4854	46.4854	46.7264	46.0108	45.3168	44.8656	44.4234			
alpha	3.9043	3.9184	3.9326	4.0060	4.0211	4.0990	4.0990	4.1151	4.0674	4.0211	3.9910	3.9616			
util living area	0.8862	0.7910	0.6618	0.5024	0.3665	0.2529	0.1814	0.2027	0.3363	0.5851	0.8129	0.9046	(86)		
MIT	20.1552	20.4984	20.7686	20.9316	20.9832	20.9974	20.9995	20.9992	20.9915	20.9005	20.5397	20.0912	(87)		
Th 2	20.3963	20.3990	20.4018	20.4156	20.4183	20.4322	20.4322	20.4350	20.4267	20.4183	20.4128	20.4073	(88)		
util rest of house	0.8757	0.7754	0.6418	0.4808	0.3444	0.2307	0.1580	0.1778	0.3090	0.5581	0.7958	0.8954	(89)		
MIT 2	19.4072	19.8253	20.1463	20.3441	20.4022	20.4301	20.4319	20.4344	20.4193	20.3165	19.8932	19.3374	(90)		
Living area fraction										fLA = Living area / (4) =		0.4933	(91)		
MIT	19.7762	20.1574	20.4533	20.6339	20.6889	20.7099	20.7119	20.7131	20.7016	20.6046	20.2122	19.7093	(92)		
Temperature adjustment												0.0000			
adjusted MIT	19.7762	20.1574	20.4533	20.6339	20.6889	20.7099	20.7119	20.7131	20.7016	20.6046	20.2122	19.7093	(93)		
8. Space heating requirement															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Utilisation	0.8637	0.7688	0.6436	0.4889	0.3547	0.2416	0.1695	0.1901	0.3221	0.5669	0.7897	0.8833	(94)		
Useful gains	985.6598	1112.6308	1117.3507	976.0773	761.5968	508.8239	343.0107	357.8289	552.8250	808.9335	917.7857	935.4334	(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	1378.3642	1352.3075	1230.7146	1009.7047	769.6222	509.9791	343.2086	358.1427	556.6970	856.5909	1133.9446	1354.6024	(97)		
Space heating kWh	292.1721	161.0627	84.3428	24.2117	5.9709	0.0000	0.0000	0.0000	0.0000	35.4571	155.6343	311.8617	(98a)		
Space heating requirement - total per year (kWh/year)												1070.7134			
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	292.1721	161.0627	84.3428	24.2117	5.9709	0.0000	0.0000	0.0000	0.0000	35.4571	155.6343	311.8617	(98c)		
Space heating requirement after solar contribution - total per year (kWh/year)												1070.7134			
Space heating per m2										(98c) / (4) =		7.6655	(99)		
8c. Space cooling requirement															
Calculated for June, July and August. See Table 10b															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000			
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	784.5897	617.6557	631.0773	0.0000	0.0000	0.0000	0.0000	(100)		
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9927	0.9965	0.9951	0.0000	0.0000	0.0000	0.0000	(101)		
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	778.8618	615.4892	627.9665	0.0000	0.0000	0.0000	0.0000	(102)		
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2363.4150	2270.7482	2105.5848	0.0000	0.0000	0.0000	0.0000	(103)		
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1140.8783	1231.5127	1099.3480	0.0000	0.0000	0.0000	0.0000	(104)		
Cooled fraction										fC = cooled area / (4) =		0.8970	(105)		
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)		
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	255.8359	276.1602	246.5230	0.0000	0.0000	0.0000	0.0000	(107)		
Space cooling requirement												778.5191	(107)		
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 %)														88.9000 (206)	
Efficiency of main space heating system 2 (in %)														0.0000 (207)	
Efficiency of secondary/supplementary heating system, %														0.0000 (208)	
Cooling System Energy Efficiency Ratio (see Table 10c)														4.6000 (209)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Space heating requirement	292.1721	161.0627	84.3428	24.2117	5.9709	0.0000	0.0000	0.0000	0.0000	35.4571	155.6343	311.8617	(98)		
Space heating efficiency (main heating system 1)	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000	(210)		

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1204.4021	0.2100	252.9244 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3585.3591	0.2100	752.9254 (264)
Space and water heating			1005.8499 (265)
Space cooling	169.2433	0.1143	19.3401 (266)
Pumps, fans and electric keep-hot	519.3925	0.1387	72.0461 (267)
Energy for lighting	270.1496	0.1443	38.9909 (268)
Total CO2, kg/year			1136.2271 (272)
CO2 emissions per m2			8.1300 (273)
EI value			91.7558
EI rating			92 (274)
EI band			A

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.1500 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.1339	0.1275	0.1275	0.1179	0.1179	0.1052	0.1084	0.1020	0.1052	0.1116	0.1116	0.1211 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2334	0.2270	0.2270	0.2174	0.2174	0.2047	0.2079	0.2015	0.2047	0.2111	0.2111	0.2206 (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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m2)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.1427		(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	0.0000	0.0500	0.0000
E7 Party floor between dwellings (in blocks of flats)	51.6100	0.0000	0.0000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.1500	0.0000	0.0000
E16 Corner (normal)	5.8600	0.0900	0.5274
E18 Party wall between dwellings	5.8600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.5274 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 53.6701 (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	31.5188	30.6578	30.6578	29.3664	29.3664	27.6444	28.0749	27.2139	27.6444	28.5054	28.5054	29.7969 (38)
Heat transfer coeff	85.1890	84.3280	84.3280	83.0365	83.0365	81.3145	81.7450	80.8840	81.3145	82.1755	82.1755	83.4670 (39)
Average = Sum(39)m / 12 =												82.7495

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.6099	0.6037	0.6037	0.5945	0.5945	0.5821	0.5852	0.5791	0.5821	0.5883	0.5883	0.5976 (40)
HLP (average)												0.5924
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9165 (42)

Hot water usage for mixer showers 72.8394 (42a)

Hot water usage for baths 33.1161 (42b)

Hot water usage for other uses 46.8396 (42c)

Average daily hot water use (litres/day) 140.8032 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	153.1875	149.8919	145.8925	139.8442	134.9206	129.6321	127.6244	131.6068	135.8034	141.3522	147.4926	152.7950 (44)
Energy conte	242.6116	213.4441	224.2313	191.4398	181.6291	159.3978	154.3506	162.9567	167.4592	191.8136	210.1303	239.2401 (45)
Energy content (annual)										Total = Sum(45)m =		2338.7043
Distribution loss (46)m = 0.15 x (45)m	36.3917	32.0166	33.6347	28.7160	27.2444	23.9097	23.1526	24.4435	25.1189	28.7720	31.5195	35.8860 (46)

Water storage loss:
Total storage loss 0.0000 (56)

If cylinder contains dedicated solar storage 0.0000 (57)

Primary loss 0.0000 (59)

Combi loss 50.9589 (61)

Total heat required for water heating calculated for each month 290.1990 (62)

WVHRS 0.0000 (63a)

PV diverter 0.0000 (63b)

Solar input 0.0000 (63c)

FGHRS 0.0000 (63d)

Output from w/h 290.1990 (64)

Electric shower(s) 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 92.2871 (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	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 39.3054 (67)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 440.9133 (68)

Pumps, fans 55.4153 (69)

Losses e.g. evaporation (negative values) (Table 5) 0.0000 (70)

Water heating gains (Table 5) -116.6589 (71)

Total internal gains 125.5485 (72)

738.8013 736.4971 712.6927 668.5009 623.5702 583.1099 559.1903 562.5258 585.4375 626.2160 675.2265 718.0052 (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
South				14.8500	50.9848		0.5000		1.0000		0.7700	262.3437 (78)
West				23.7900	22.3313		0.5000		1.0000		0.7700	184.0823 (80)
Solar gains	446.4260	709.5055	1010.3811	1354.4531	1518.0261	1626.7139	1545.9971	1421.8151	1211.1920	853.7705	553.4522	374.6077 (83)
Total gains	1185.2273	1446.0026	1723.0738	2022.9540	2141.5964	2209.8238	2105.1875	1984.3409	1796.6295	1479.9865	1228.6787	1092.6129 (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	45.5458	46.0108	46.0108	46.7264	46.7264	47.7160	47.4647	47.9699	47.7160	47.2160	47.2160	46.4854
alpha	4.0364	4.0674	4.0674	4.1151	4.1151	4.1811	4.1643	4.1980	4.1811	4.1477	4.1477	4.0990
util living area	0.8510	0.7573	0.6169	0.4457	0.3084	0.1839	0.1204	0.1304	0.2618	0.5045	0.7457	0.8734 (86)
MIT	20.3789	20.6335	20.8489	20.9636	20.9933	20.9995	20.9999	20.9999	20.9976	20.9532	20.7243	20.3268 (87)
Th 2	20.4211	20.4267	20.4267	20.4350	20.4350	20.4461	20.4433	20.4489	20.4461	20.4465	20.4405	20.4322 (88)
util rest of house	0.8381	0.7404	0.5963	0.4245	0.2870	0.1635	0.0988	0.1080	0.2370	0.4775	0.7255	0.8618 (89)
MIT 2	19.7024	20.0116	20.2624	20.3979	20.4289	20.4457	20.4433	20.4488	20.4442	20.3944	20.1361	19.6488 (90)
Living area fraction	20.0361	20.3184	20.5518	20.6770	20.7073	20.7189	20.7179	20.7207	fLA = Living area / (4) =	20.6701	20.4263	0.4933 (91)
MIT	20.0361	20.3184	20.5518	20.6770	20.7073	20.7189	20.7179	20.7207	20.7173	20.6701	20.4263	19.9833 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0361	20.3184	20.5518	20.6770	20.7073	20.7189	20.7179	20.7207	20.7173	20.6701	20.4263	19.9833 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8288	0.7371	0.6008	0.4336	0.2974	0.1735	0.1094	0.1190	0.2491	0.4886	0.7250	0.8518 (94)
Useful gains	982.3355	1065.8753	1035.3040	877.2148	636.8676	383.5070	230.3292	236.2114	447.6140	723.1848	890.7752	930.6940 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1272.3932	1241.1712	1109.0618	894.8841	639.9883	383.7170	230.3497	236.2388	448.6328	745.3388	1021.1367	1242.2629 (97)
Space heating kWh	215.8029	117.7988	54.8758	12.7219	2.3218	0.0000	0.0000	0.0000	0.0000	16.4825	93.8603	231.8072 (98a)
Space heating requirement - total per year (kWh/year)												745.6713
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	215.8029	117.7988	54.8758	12.7219	2.3218	0.0000	0.0000	0.0000	0.0000	16.4825	93.8603	231.8072 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												745.6713
Space heating per m2										(98c) / (4) =		5.3384 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	650.5162	498.6446	501.4810	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9973	0.9988	0.9985	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	648.7438	498.0434	500.7335	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2484.4638	2366.2000	2224.3876	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	1321.7184	1389.9085	1282.3986	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												
Intermittency factor (Table 10b)									fc = cooled area / (4) =			0.8970 (105)
	0.2500	0.2500		0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	296.3884	311.6796	287.5711	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												895.6391 (107)

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 %)												88.9000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)												4.6000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Space heating requirement	215.8029	117.7988	54.8758	12.7219	2.3218	0.0000	0.0000	0.0000	0.0000	16.4825	93.8603	231.8072 (98)
Space heating efficiency (main heating system 1)	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000 (210)
Space heating fuel (main heating system)	242.7479	132.5071	61.7275	14.3104	2.6117	0.0000	0.0000	0.0000	0.0000	18.5405	105.5796	260.7506 (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	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990 (64)
Efficiency of water heater	83.7317	82.8010	81.6126	80.6918	80.3769	80.3000	80.3000	80.3000	80.3000	80.7969	82.4181	80.3000 (216)
Fuel for water heating, kWh/month	350.6086	313.3674	337.1909	298.3635	289.3719	259.9165	255.6781	266.3955	269.9555	300.4725	314.7917	83.9044 (217)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	64.4323	67.7564	62.5155	0.0000	0.0000	0.0000	345.8686 (219)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	64.4323	67.7564	62.5155	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	44.1128	39.8438	44.1128	42.6898	44.1128	42.6898	44.1128	44.1128	42.6898	44.1128	42.6898	44.1128 (231)
Lighting	33.4734	26.8536	24.1787	17.7144	13.6831	11.1792	12.4822	16.2248	21.0744	27.6507	31.2315	34.4037 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
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												838.7754 (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												3601.9807 (219)
Space cooling fuel												194.7041 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)												
mechanical ventilation fans (SFP = 0.8680)												433.3925 (230a)
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												519.3925 (231)
Electricity for lighting (calculated in Appendix L)												270.1496 (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												5425.0024 (238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	838.7754	4.8000	40.2612 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3601.9807	4.8000	172.8951 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Space cooling	194.7041	21.5100	41.8809 (248)
Pumps, fans and electric keep-hot	519.3925	21.5100	111.7213 (249)
Energy for lighting	270.1496	21.5100	58.1092 (250)
Additional standing charges			98.0000 (251)
Total energy cost			522.8677 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	838.7754	0.2100	176.1428 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3601.9807	0.2100	756.4159 (264)
Space and water heating			932.5588 (265)

Space cooling	194.7041	0.1143	22.2546 (266)
Pumps, fans and electric keep-hot	519.3925	0.1387	72.0461 (267)
Energy for lighting	270.1496	0.1443	38.9909 (268)
Total CO2, kg/year			1065.8504 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	838.7754	1.1300	947.8162 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3601.9807	1.1300	4070.2381 (278)
Space and water heating			5018.0544 (279)
Space cooling	194.7041	1.4212	276.7178 (280)
Pumps, fans and electric keep-hot	519.3925	1.5128	785.7370 (281)
Energy for lighting	270.1496	1.5338	414.3645 (282)
Total Primary energy kWh/year			6494.8737 (286)

SAP 10 EPC IMPROVEMENTS

V1 THFC-L20-03 LEANboilr-PlanB

Current energy efficiency rating: B 87
Current environmental impact rating: A 92

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

Recommended measures: (none)	SAP change	Cost change	CO2 change
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Recommended measures (none)	Typical annual savings	Energy efficiency impact	Environmental impact
	Total Savings	£0	0.00 kg/m²

Potential energy efficiency rating: B 87
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£212	£212	£0
Mains gas	£311	£311	£0
Space heating	£250	£250	£0
Space cooling	£42	£42	£0
Water heating	£173	£173	£0
Lighting	£58	£58	£0
Total cost of fuels	£523	£523	£0
Total cost of uses	£523	£523	£0
Delivered energy	39 kWh/m²	39 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	8 kg/m²	8 kg/m²	0 kg/m²
Primary energy	46 kWh/m²	46 kWh/m²	0 kWh/m²

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	139.6800 (1b)	x 2.9300 (2b)	= 409.2624 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

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

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000	Air changes per hour / (5) =	0.0000 (8)
Pressure test				Yes
Pressure Test Method				Blower Door
Measured/design AP50				3.0000 (17)
Infiltration rate				0.1500 (18)
Number of sides sheltered				2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.1275 (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 infiltr rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (25)

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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m ²)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.1427		(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)

Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 100.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	0.0000	0.0500	0.0000
E2 Other lintels (including other steel lintels)	0.0000	0.0500	0.0000
E4 Jamb	51.6100	0.0000	0.0000
E7 Party floor between dwellings (in blocks of flats)	5.1500	0.0000	0.0000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	5.8600	0.0900	0.5274
E16 Corner (normal)	5.8600	0.0000	0.0000
E18 Party wall between dwellings			

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	0.0000	0.0000	0.0000	0.5274 (36)
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Point Thermal bridges

Total fabric heat loss	(33) + (36) + (36a) =	53.6701 (37)
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Ventilation heat loss calculated monthly $(38)_m = 0.33 \times (25)_m \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m Heat transfer coeff	35.3933	34.9628	34.5323	32.3798	31.9493	29.7969	29.7969	29.3664	30.6578	31.9493	32.8103	33.6713 (38)
Average = Sum(39)m / 12 =	89.0634	88.6329	88.2024	86.0499	85.6194	83.4670	83.4670	83.0365	84.3280	85.6194	86.4804	87.3414 (39) 85.9423

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.6376	0.6345	0.6315	0.6161	0.6130	0.5976	0.5976	0.5945	0.6037	0.6130	0.6191	0.6253 (40)
HLP (average)												0.6153
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

Assumed occupancy	2.9165 (42)
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[illegible]

Average daily hot water use (litres/day)	46.8396	45.1363	43.4331	41.7298	40.0266	38.3233	38.3233	40.0266	41.7298	43.4331	45.1363	46.8396 (42c) 140.8032 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	153.1875	149.8919	145.8925	139.8442	134.9206	129.6321	127.6244	131.6068	135.8034	141.3522	147.4926	152.7950 (44)
Energy content (annual)	242.6116	213.4441	224.2313	191.4398	181.6291	159.3978	154.3506	162.9567	167.4592	191.8136	210.1303	239.2401 (45)
Distribution loss (46)m = 0.15 x (45)m	36.3917	32.0166	33.6347	28.7160	27.2444	23.9097	23.1526	24.4435	25.1189	28.7720	31.5195	35.8860 (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	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	293.5705	259.4715	275.1902	240.7548	232.5880	208.7129	205.3095	213.9156	216.7742	242.7725	259.4454	290.1990 (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	93.4081	82.4770	87.2966	75.9825	73.1314	65.3286	64.0613	66.9228	68.0089	76.5177	82.1971	92.2871 (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	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884	174.9884 (66)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	38.2425	33.9666	27.6235	20.9128	15.6325	13.1977	14.2605	18.5364	24.8795	31.5902	36.8705	39.3054 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	461.2656	466.0520	453.9902	428.3121	395.8980	365.4334	345.0811	340.2946	352.3564	378.0346	410.4486	440.9133 (68)
Pumps, fans	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153	55.4153 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589	-116.6589 (71)
Total internal gains	125.5485	122.7337	117.3342	105.5312	98.2949	90.7341	86.1039	89.9500	94.4569	102.8464	114.1626	124.0417 (72)
	738.8013	736.4971	712.6927	668.5009	623.5702	583.1099	559.1903	562.5258	585.4375	626.2160	675.2265	718.0052 (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		
South				14.8500	46.7521	0.5000			1.0000	0.7700		240.5639 (78)
West				23.7900	19.6403	0.5000			1.0000	0.7700		161.8993 (80)
Solar gains	402.4632	710.6911	1023.4381	1327.9003	1523.3218	1523.1499	1464.3329	1320.1727	1130.8686	800.7486	487.0197	341.0075 (83)
Total gains	1141.2645	1447.1882	1736.1308	1996.4012	2146.8920	2106.2598	2023.5232	1882.6985	1716.3061	1426.9646	1162.2462	1059.0127 (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	43.5645	43.7761	43.9897	45.0901	45.3168	46.4854	46.4854	46.7264	46.0108	45.3168	44.8656	44.4234
alpha	3.9043	3.9184	3.9326	4.0060	4.0211	4.0990	4.0990	4.1151	4.0674	4.0211	3.9910	3.9616
util living area	0.8862	0.7910	0.6618	0.5024	0.3665	0.2529	0.1814	0.2027	0.3363	0.5851	0.8129	0.9046 (86)
MIT	20.1552	20.4984	20.7686	20.9316	20.9832	20.9974	20.9995	20.9992	20.9915	20.9005	20.5397	20.0912 (87)
Th 2	20.3963	20.3990	20.4018	20.4156	20.4183	20.4322	20.4322	20.4350	20.4267	20.4183	20.4128	20.4073 (88)
util rest of house	0.8757	0.7754	0.6418	0.4808	0.3444	0.2307	0.1580	0.1778	0.3090	0.5581	0.7958	0.8954 (89)
MIT 2	19.4072	19.8253	20.1463	20.3441	20.4022	20.4301	20.4319	20.4344	20.4193	20.3165	19.8932	19.3374 (90)
Living area fraction	19.7762	20.1574	20.4533	20.6339	20.6889	20.7099	20.7119	20.7131	20.7016	20.6046	20.2122	19.7093 (92)
MIT												0.0000
Temperature adjustment												0.0000
adjusted MIT	19.7762	20.1574	20.4533	20.6339	20.6889	20.7099	20.7119	20.7131	20.7016	20.6046	20.2122	19.7093 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8637	0.7688	0.6436	0.4889	0.3547	0.2416	0.1695	0.1901	0.3221	0.5669	0.7897	0.8833 (94)
Useful gains	985.6598	1112.6308	1117.3507	976.0773	761.5968	508.8239	343.0107	357.8289	552.8250	808.9335	917.7857	935.4334 (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	1378.3642	1352.3075	1230.7146	1009.7047	769.6222	509.9791	343.2086	358.1427	556.6970	856.5909	1133.9446	1354.6024 (97)
Space heating kWh	292.1721	161.0627	84.3428	24.2117	5.9709	0.0000	0.0000	0.0000	0.0000	35.4571	155.6343	311.8617 (98a)
Space heating requirement - total per year (kWh/year)												1070.7134
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	292.1721	161.0627	84.3428	24.2117	5.9709	0.0000	0.0000	0.0000	0.0000	35.4571	155.6343	311.8617 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1070.7134
Space heating per m2										(98c) / (4) =		7.6655 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	784.5897	617.6557	631.0773	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9927	0.9965	0.9951	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	778.8618	615.4892	627.9665	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh						2363.4150	2270.7482	2105.5848	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	1140.8783	1231.5127	1099.3480	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			0.8970 (105)
Space cooling kWh	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	255.8359	276.1602	246.5230	0.0000	0.0000	0.0000	0.0000 (107) 778.5191 (107)

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

[illegible]

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												1204.4021	(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												3585.3591	(219)
Space cooling fuel												169.2433	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)													
mechanical ventilation fans (SFP = 0.8680)												433.3925	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												519.3925	(231)
Electricity for lighting (calculated in Appendix L)												270.1496	(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												5748.5466	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1204.4021	3.6400	43.8402 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3585.3591	3.6400	130.5071 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Space cooling	169.2433	16.4900	27.9082 (248)
Pumps, fans and electric keep-hot	519.3925	16.4900	85.6478 (249)
Energy for lighting	270.1496	16.4900	44.5477 (250)
Additional standing charges			92.0000 (251)
Total energy cost			424.4510 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.8274 (257)
SAP value		86.5880
SAP rating (Section 12)		87 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1204.4021	0.2100	252.9244 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3585.3591	0.2100	752.9254 (264)
Space and water heating			1005.8499 (265)
Space cooling	169.2433	0.1143	19.3401 (266)
Pumps, fans and electric keep-hot	519.3925	0.1387	72.0461 (267)
Energy for lighting	270.1496	0.1443	38.9909 (268)
Total CO2, kg/year			1136.2271 (272)
CO2 emissions per m2			8.1300 (273)
EI value			91.7558
EI rating			92 (274)
EI band			A

1. Overall dwelling characteristics

Area Storey height Volume

Ground floor		(m2)		(m)		(m3)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	139.6800	139.6800 (1b)	x	2.9300 (2b)	=	409.2624 (1b) - (4)	
Dwelling volume						(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	409.2624 (5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)	
Number of open flues	0 * 20 =	0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)	
Number of blocked chimneys	0 * 20 =	0.0000 (6f)	
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)	
Number of passive vents	0 * 10 =	0.0000 (7b)	
Number of flueless gas fires	0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)	
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000 (17)	
Infiltration rate		0.1500 (18)	
Number of sides sheltered		2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.1339	0.1275	0.1275	0.1179	0.1179	0.1052	0.1084	0.1020	0.1052	0.1116	0.1116	0.1211 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2334	0.2270	0.2270	0.2174	0.2174	0.2047	0.2079	0.2015	0.2047	0.2111	0.2111	0.2206 (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
Glazed (Uw = 0.64)			38.6400	0.6240	24.1123		(27)
Curtain Wall	84.0000	38.6400	45.3600	0.6400	29.0304		(29a)
Total net area of external elements Aum(A, m2)			84.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.1427		(33)
Party Floor 1			139.6800				(32d)
Party Ceiling 1			139.6800				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				0.0000	0.0500	0.0000	
E4 Jamb				0.0000	0.0500	0.0000	
E7 Party floor between dwellings (in blocks of flats)				51.6100	0.0000	0.0000	
E23 Balcony within or between dwellings, balcony support penetrates wall insulation				5.1500	0.0000	0.0000	
E16 Corner (normal)				5.8600	0.0900	0.5274	
E18 Party wall between dwellings				5.8600	0.0000	0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.5274 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	53.6701 (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	31.5188	30.6578	30.6578	29.3664	29.3664	27.6444	28.0749	27.2139	27.6444	28.5054	28.5054	29.7969 (38)
Average = Sum(39)m / 12 =	85.1890	84.3280	84.3280	83.0365	83.0365	81.3145	81.7450	80.8840	81.3145	82.1755	82.1755	83.4670 (39)
												82.7495
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6099	0.6037	0.6037	0.5945	0.5945	0.5821	0.5852	0.5791	0.5821	0.5883	0.5883	0.5976 (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	2.9165 (42)
Hot water usage for mixer showers	

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	(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	(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	(235d)
Annual totals kWh/year											
Space heating fuel - main system 1											838.7754 (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											3601.9807 (219)
Space cooling fuel											194.7041 (221)
Electricity for pumps and fans:											
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8680)											
mechanical ventilation fans (SFP = 0.8680)											433.3925 (230a)
central heating pump											41.0000 (230c)
main heating flue fan											45.0000 (230e)
Total electricity for the above, kWh/year											519.3925 (231)
Electricity for lighting (calculated in Appendix L)											270.1496 (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											5425.0024 (238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	838.7754	4.8000	40.2612 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3601.9807	4.8000	172.8951 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Space cooling	194.7041	21.5100	41.8809 (248)
Pumps, fans and electric keep-hot	519.3925	21.5100	111.7213 (249)
Energy for lighting	270.1496	21.5100	58.1092 (250)
Additional standing charges			98.0000 (251)
Total energy cost			522.8677 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	838.7754	0.2100	176.1428 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3601.9807	0.2100	756.4159 (264)
Space and water heating			932.5588 (265)
Space cooling	194.7041	0.1143	22.2546 (266)
Pumps, fans and electric keep-hot	519.3925	0.1387	72.0461 (267)
Energy for lighting	270.1496	0.1443	38.9909 (268)
Total CO2, kg/year			1065.8504 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	838.7754	1.1300	947.8162 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3601.9807	1.1300	4070.2381 (278)
Space and water heating			5018.0544 (279)
Space cooling	194.7041	1.4212	276.7178 (280)
Pumps, fans and electric keep-hot	519.3925	1.5128	785.7370 (281)
Energy for lighting	270.1496	1.5338	414.3645 (282)
Total Primary energy kWh/year			6494.8737 (286)

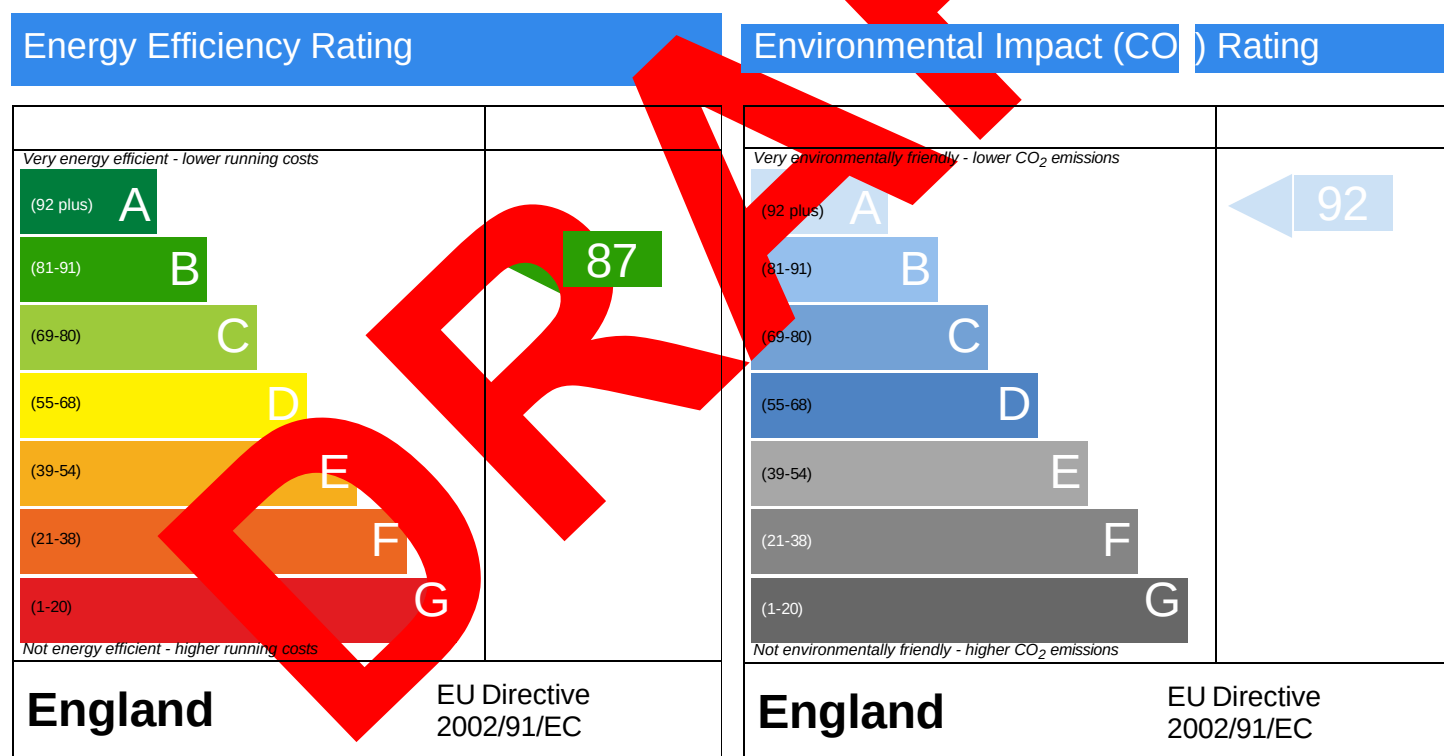
Predicted Energy Assessment



Dwelling type: Flat, End-Terrace
Date of assessment: 24/07/2023
Produced by: Laura Plazas
Total floor area: 139.68 m²
DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Glazed	Manufacturer	Window	Triple Low-E Soft 0.05			0.50		1.00	0.64
13.0 Openings									
Name	Opening Type		Location	Orientation		Area (m²)	Pitch		
Glazed W	Glazed		Curtain Wall	West		1.93			
Glazed W	Glazed		Curtain Wall	West		3.60			
Glazed S	Glazed		Curtain Wall	South		9.49			
Glazed S	Glazed		Curtain Wall	South		5.36			
Glazed W	Glazed		Curtain Wall	West		3.60			

Glazed W	Glazed	Curtain Wall	West	3.60
Glazed W	Glazed	Curtain Wall	West	3.60
Glazed W	Glazed	Curtain Wall	West	3.60
Glazed W	Glazed	Curtain Wall	West	1.93
Glazed W	Glazed	Curtain Wall	West	1.93

14.0 Conservatory

15.0 Draught Proofing %

16.0 Draught Lobby

17.0 Thermal Bridging

17.1 List of Bridges

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E2 Other lintels (including other steel lintels)	Independently assessed	0.00	0.05	0.05	No
E4 Jamb	Independently assessed	0.00	0.05	0.05	No
E7 Party floor between dwellings (in blocks of flats)	Independently assessed	51.61	0.00	0.00	No
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	Independently assessed	5.15	0.00	0.00	No
E16 Corner (normal)	Independently assessed	5.86	0.09	0.09	No
E18 Party wall between dwellings	Independently assessed	5.86	0.00	0.00	No

Y-value W/m²K

18.0 Pressure Testing

Designed AP₅₀ m³/(h.m²) @ 50 Pa

Test Method

19.0 Mechanical Ventilation

Mechanical Ventilation

Mechanical Ventilation System Present

Approved Installation

Mechanical Ventilation data Type

Type

MV Reference Number

Configuration

Manufacturer SFP

Duct Type

MVHR Efficiency

Wet Rooms

SFP from Installer Commissioning Certificate

MVHR System Location

Duct Installation Specification

20.0 Fans, Open Fireplaces, Flues

21.0 Fixed Cooling System

Cooled Area m²

Data Source

Energy Class

22.0 Lighting

No Fixed Lighting

Name	Efficacy	Power	Capacity	Count
low energy lighting	75.00	20	1500	10

24.0 Main Heating 1

Description

Percentage of Heat

Fuel Type %

SAP Code

In Winter

In Summer

Model Name	Gas boilers (LEAN)
Manufacturer	Gas boilers (LEAN)
System Type	Gas boilers (LEAN)
Controls SAP Code	2110
Delayed Start Stat	No
Burner Control	Modulating
Flue Type	None or Unknown
Fan Assisted Flue	Yes
Is MHS Pumped	Pump in unheated space
Heating Pump Age	2013 or later
Heat Emitter	Radiators
Flow Temperature	Enter value
Flow Temperature Value	55.00
Boiler Interlock	Yes
Combi boiler type	Standard Combi
Combi keep hot type	None

25.0 Main Heating 2

26.0 Heat Networks

Heat Source	Fuel Type	Heating Use	Efficiency	Percentage Of Heat	Heat	Heat Power Ratio	Electrical	Fuel Factor	Efficiency type
Heat source 1									
Heat source 2									
Heat source 3									
Heat source 4									
Heat source 5									

28.0 Water Heating	
Water Heating	Main Heating 1
SAP Code	901
	No
Flue Gas Heat Recovery System	
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
Cold Water Source	From mains
Bath Count	3

28.1 Showers							
Description	Shower Type	Flow Rate [l/min]	Rated Power [kW]	Connected	Connected To		

28.3 Waste Water Heat Recovery System

29.0 Hot Water Cylinder	None
In Airing Cupboard	No

Recommendations							
Lower cost measures							
None							
Further measures to achieve even higher standards							
	Typical Cost	Typical savings per year			Ratings after improvement		
					SAP rating	Environmental	Impact
					0	0	
					0	0	
					0	0	

Thermal Bridging



Property Reference	THFC-L20-03	Issued on Date	24/07/2023
Assessment Reference	V1 THFC-L20-03 LEANboilr-PlanB	Prop Type Ref	End-Terrace Flat
Property			

SAP Rating	DER	TER
87 B	8.30	10.29
Environmental	% DER < TER	
92 A	19.34	
CO ₂ Emissions (t/year)	DFEE	TFEE
1.07	26.53	29.92

Compliance Check	See BREL	% DFEE < TFEE	11.31
% DPER < TPER	11.34	DPER	TPER
	49.96	56.35	

		T491-0001
Assessor Details	Miss Laura Plazas	Assessor ID
Client		

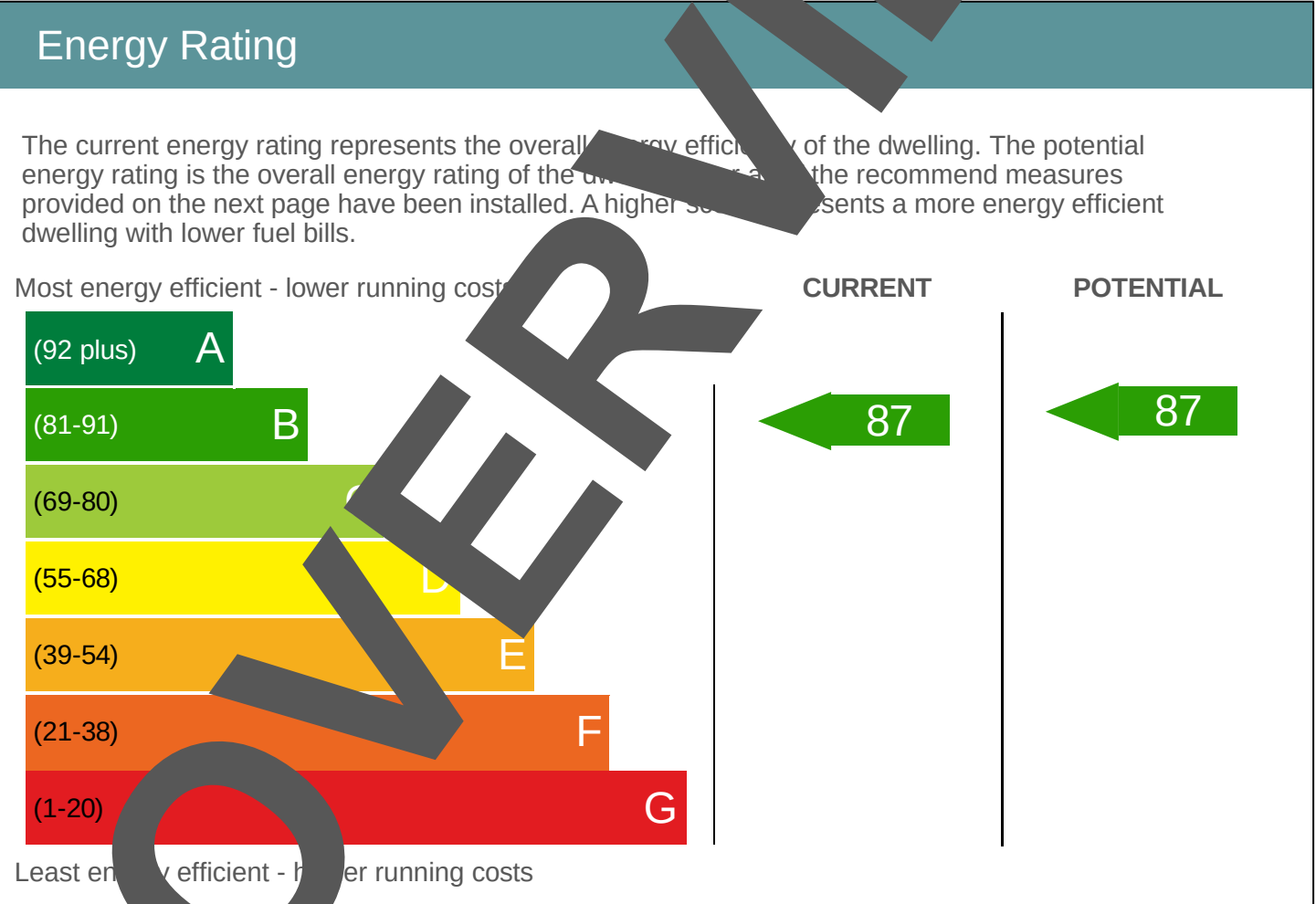
	Junction details	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.050	0.00	0.00	
External wall	E4 Jamb	Independently assessed	0.050	0.00	0.00	
External wall	E7 Party floor between dwellings (in blocks of flats)	Independently assessed	0.000	51.61	0.00	
External wall	E23 Balcony within or between dwellings, balcony support penetrates wall insulation	Independently assessed	0.000	5.15	0.00	
External wall	E16 Corner (normal)	Independently assessed	0.090	5.86	0.53	
External wall	E18 Party wall between dwellings	Independently assessed	0.000	5.86	0.00	

Total 68.48 W/mK:

Y-Value 0.01 W/m²K:

Dwelling Address	
Report Date	24/07/2023
Property Type	Flat, End-Terrace
Floor Area [m ²]	140

This document is not an Energy Performance Certificate (EPC) as required by the Energy Performance of Buildings Regulations



Breakdown of property's energy performance

Each feature is assessed as one of the following:

Very Poor

Poor

Average

Good

Very Good

Feature	Description	Energy performance
Walls	Average thermal transmittance 0.64 W/m ² K	Good
Windows	High performance glazing	Very Good
Main heating	Boiler and radiators, mains gas	Very Good
Main heating controls	Time and temperature zone control	Very Good
Secondary heating	None	
Hot water	From main system	Good
Lighting	Good lighting efficiency	Good
Air tightness	Air permeability [AP50] 1.0 m ³ /h.m ² (assumed)	Good

Primary Energy use

The primary energy use for this property per year is 46 kilowatt hour (kWh) per square metre

Estimated CO₂ emissions of the dwelling

The estimated CO₂ rating provides an indication of the dwelling's impact on the environment in terms of carbon dioxide emissions. The higher the rating the less impact it has on the environment.

The estimated CO₂ emissions for this dwellings is: **1.1** per year

With the recommended measures the potential CO emissions could be: **1** per year

Recommendations

The recommended measures provided below will help to improve the energy efficiency of the dwelling. To reach the dwelling's potential energy rating all of the recommended measures shown below would need to be installed. Having these measures installed individually or in any other order may give a different result when compared with the cumulative potential rating.

Recommended measure	Typical Yearly Saving	Potential Rating after measure installed	Cumulative saving (per year)	Cumulative potential rating
---------------------	-----------------------	--	------------------------------	-----------------------------

Estimated energy use and potential savings

Estimated energy cost for this property over a year

£523

Over a year you could save

£0

The estimated cost and savings show how much the average household would spend in this property for heating, lighting and hot water. It is not based on how energy is used by the people living at the property.

Contacting the assessor and the accreditation scheme

Assessor contact details

Assessor name	Miss Laura Plazas
Assessor accreditation number	
Email address	

Accreditation scheme contact details

Accreditation scheme	
Telephone	
Email Address	

OVERVIEW

Assessment details	
Related party disclosure	
Date of assessment	20/07/2023
Date of certificate	20/07/2023
Type of assessment	SAP, new dwelling

Appendix B – BRUKLs

See sperate files entitled as follows, as these PDF files are security protected and cannot be combined:

- Appendix B - GREEN_bruk1_P03.pdf
- Appendix B - LEAN_bruk1_P03.pdf

Appendix C – DEN Correspondence

Design Note

Project Lea Valley Heat Network
Subject Carbon Factor of Heat: Methodology, inputs and assumptions
Project no 0042616
Date 5 November 2019

Revision	Description	Issued by	Date	Approved (signature)
00	Issue for comment and agreement	LB	06.11.19	

1 Introduction

The purpose of this design note is to explain options available to Energetik in setting a carbon factor for heat associated with the proposed heat network from the Edmonton Energy Recovery Facility (ERF).

The scope for this piece of work is:

1. Review policy updates to Part L / SAP 10 / SAP10.1 and impacts on
 - a. Gas and electric carbon factors
 - b. Update waste heat carbon factor to the latest SAP / BEIS factors
 - c. Part L baseline for establishing target carbon factors
2. Outline key assumptions / changes on the regulations, ERF and plant efficiencies in advance of commencing modelling / report updates
3. Carbon modelling calculations to be updated to reflect fuel emission factors and district heat network efficiency modelling as identified in the above
4. Update 'Energetik Carbon Factor of heat' design note and carbon factor modelling to incorporate the above changes
5. Prepare 'Carbon Factor of DHN Delivered Heat Calculation Method' note (as per example for CHP / Heat Pumps issued on 26/04/19) to set out how designers / developers should input SAP factors for ERF network connection.

This note has been prepared in response to points (1) and (2) of the above, to explain the policy updates and gain agreement on key assumptions to be used in carbon modelling calculations. Four potential methodologies for calculating the carbon factor of the network are set out:

1. Current default SAP rule, which would mandate the CHP method be used as the electrical efficiency of the plant is less than 35%
2. SAP waste heat from power station, if there was no threshold of 35% electrical efficiency
3. Method 5 as per BuroHappold's previous report '160106 CC 033993 Heat Network Carbon Factor 02', denoted 'Reduced electrical efficiency method'
4. Displaced electricity method

2 Assumptions

2.1 Technical assumptions

Assumptions made in calculations are currently based on those extracted from the Arup document 'Interim_chp_development-strategy_may-2015', summarised in Table 2-1.

Table 2-1 Technical assumptions

Heat Output (MWth)	0	10	20	30	35	160
Gross Electricity Output (MW e)	70.6	68.5	66.4	64.3	63.2	15
Auxilliary Power Allowance (MW e)	9	9	9	9	9	9
Net Power (MW e)	61.5	59.4	57.3	55.2	54.2	6

Paragraph 2.1.2 of the Arup report states that an efficiency of 29% of the ERF could be achieved in power-only mode, however it is not known if this is net or gross. Efficiencies have therefore been calculated assuming the efficiency is net to give a worst-case scenario, however this assumption needs to be checked and agreed with Energetik.

It is understood that if Energetik sign a commercial agreement to take heat from the ERF, it will be for a 35MW heat supply to be taken as and when required. Therefore the efficiencies at 35 MW heat offtake have been taken for calculation of the heat carbon factor within this note.

It is recommended that the assumptions in Table 2-1 are checked and verified to ensure that up-to-date figures are being used to calculate the carbon factor.

Within this note, the calculations of heat carbon factor do not include losses from distribution to give a clear comparison between methodologies. However, when Energetik reports carbon factors to developers, losses in the network and energy used for pumping will also need to be considered.

3 SAP carbon factors

An updated version of the Standard Assessment Procedure (SAP), SAP 10.0¹, was published for consultation in July 2018. More recently, a further updated version, SAP 10.1, has been published in October 2019² to coincide with the publication of the Government's Future Homes Standard consultation, which discusses proposed changes to Building Regulations Approved Document L1, which makes reference to SAP.

It should be noted that both SAP 10.0 and SAP 10.1 are consultation versions only and are not used for any official purpose. SAP 2012³ continues to be the version used for all official purposes. The Building Research Establishment (BRE) expects a further update to SAP, SAP 10.2, to be published before it is brought into official use⁴. Building Regulations Part L is usually updated once every four years, meaning that SAP 10 could be in use in 2020.

Amongst other changes within these new versions of SAP, carbon emissions factors have been updated for a number of key fuels including grid electricity, waste heat from power stations and heat from waste combustion boilers. These carbon factors are summarised in Table 3-1 and Figure 3-1.

Table 3-1 Carbon factor by version of SAP

	SAP 2012 version 9.92	SAP 2016	SAP 10	SAP 10.1
Heat from boilers - waste combustion	0.047	0.074	0.074	0.074
Waste heat from power station	0.058	0.044	0.026	0.015
Mains gas	0.216	0.208	0.210	0.210
Electricity, any tariff	0.519	0.398	0.233	0.136

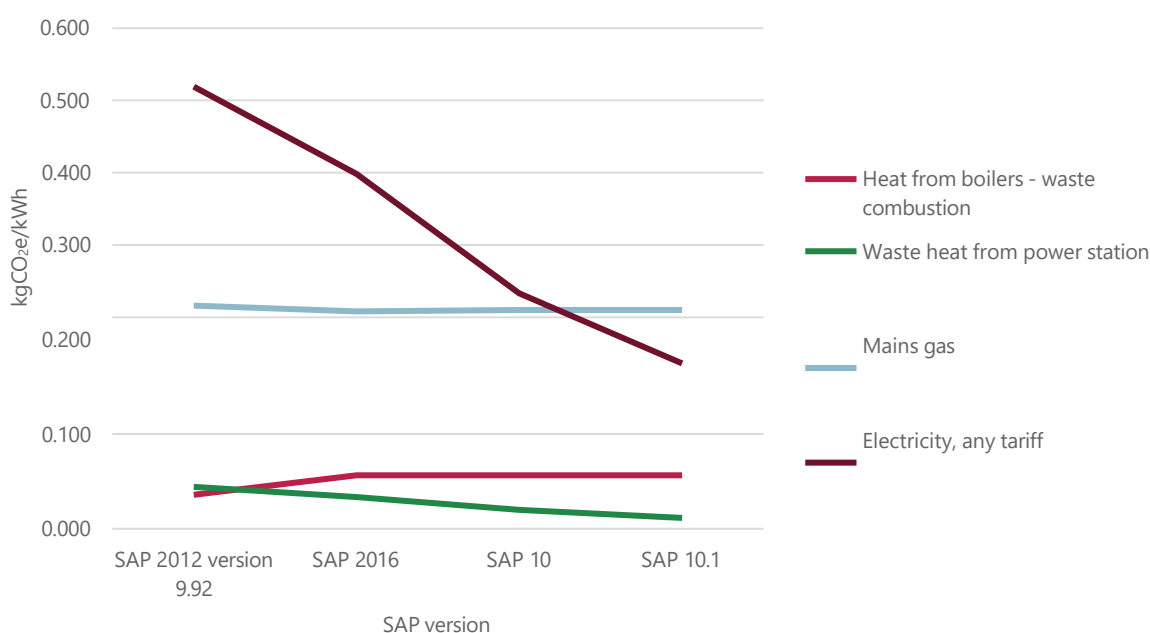


Figure 3-1 Carbon factor by version of SAP

Heat from boilers – waste combustion

There was an increase in carbon factor associated with heat from waste combustion boilers between SAP 2012 and SAP 2016, which has been maintained through SAP 10.0 and SAP 10.1.

The Consultation Paper for SAP 2016⁵ notes that the emission factor for heat from waste combustion is derived from Defra's Biomass Environmental Assessment Tool (BEAT)⁶. The carbon factor is based on 'Lifecycle greenhouse gas emissions for production of heat by combustion of high biomass refuse derived fuel (RDF) from municipal solid waste using the Fairport process'.

¹ [SAP 10.0 specification \(superseded\)](#)

² [SAP 10.1 specification](#)

³ [SAP 2012 document](#)

⁴ [SAP 10 hosting site](#)

⁵ [Consultation Paper: CONSP:07 CO₂ and Primary Energy Factors for SAP 2016](#)

⁶ [BEAT v2.1 download](#)

The following definition is given to High Biomass RDF: "Within BEAT2 the term high biomass refuse derived fuel is used to refer to any potential fuel resulting from the processing of mixed waste streams to a fraction with a biomass content >90% and a low fossil derived content. This fuel may be available as a floc or as a pellet. In this tool, only the pelletised version is considered."

File Name	Biomass Source	Harvesting	Intermediate Product	Processing Technology	End Product(s)	Reference System	Allocation Procedures	Key Assumptions	Data Gaps
rdf_p_cb_e.xls	Municipal solid waste	Collection	RRBF pellets	Combustion	Electricity	Disposal of municipal solid waste to landfill with energy recovery	Price	Use of Fairport process, and option for Waste Incineration Directive compliance	None but direct emissions based on combustion of old paper

Figure 3-2 Excerpt from BEAT v2 User Guide

Waste heat from power station

Capturing waste heat from power stations requires heat to be produced at a higher temperatures than would otherwise be the case, resulting in a reduction in electricity generation when the power station is producing heat at a high enough temperature to provide district heating.

SAP 2012 assumed that a 1kW reduction in electricity output was experienced for every 7kW of heat generated, thereby setting the emissions factor of waste heat from a power station to one seventh of the emission factor of grid electricity.

The SAP emission factor since the 2016 consultation version has now been based on the assumption that there is a 1kW reduction in electricity output for every 9kW of heat generated, reflecting higher efficiency of the process. Therefore the emission factor for waste heat is set to one ninth of the emission factor for grid electricity, as shown in Figure 3-3.

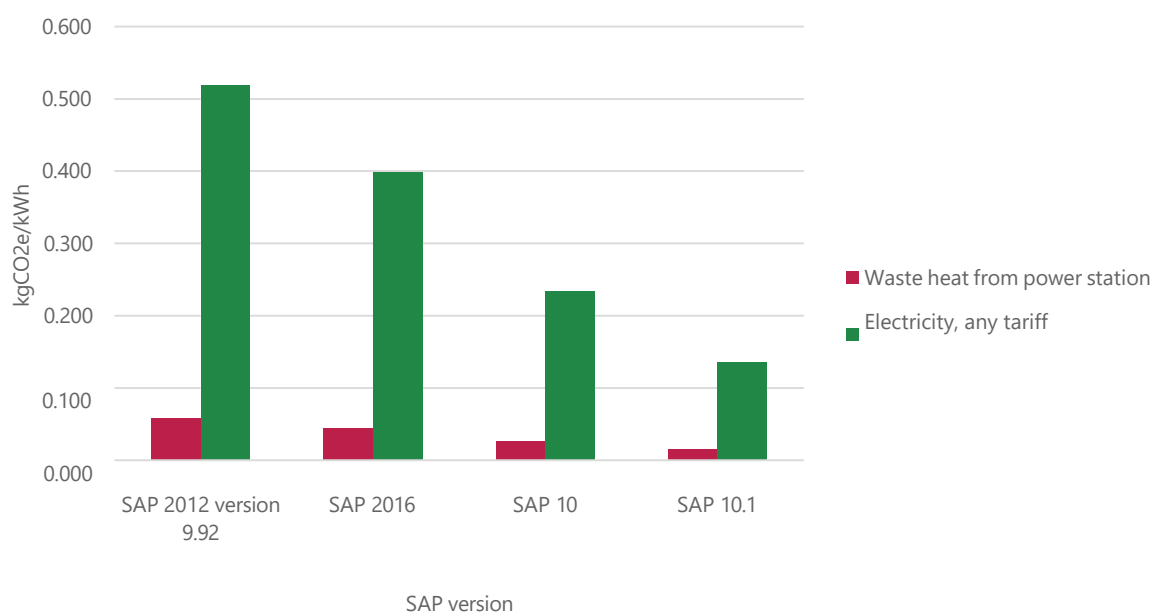


Figure 3-3 Electricity and waste heat from power station carbon factor by SAP version

CHP

It has been noted by BuroHappold that there is an error in the SAP 10.1 Table 12, which states a carbon factor for "Heat from CHP" as 0.011, as shown in Figure 3-4. This would not consider the fuel source for CHP and therefore is considered to be an error in the consultation document.

Table 12: Fuel prices, emission factors and primary energy factors

Fuel	Standing charge, £ (a)	Unit price p/kWh	Emissions kg CO ₂ per kWh (b)	Primary energy factor	Fuel code
Heat networks: (k)	87 (l)				
waste heat from power station		3.35	0.015	1.063	45
geothermal heat source		3.35	0.011	1.051	46
heat from CHP		3.35	0.011	1.051	48
electricity generated by CHP			0.136	1.501	49
electricity for pumping in distribution network			0.136	1.501	50

Figure 3-4 Excerpt from SAP 10.1, showing presumed typo in "heat from CHP" carbon factor

Figure 3-5 shows where this error may have arisen from. In the SAP 2012 document, the carbon factor for CHP is noted "as above" with Note (q) referenced.

Table 12: Fuel prices, emission factors and primary energy factors

Fuel	Standing charge, £ (a)	Unit price p/kWh	Emissions kg CO ₂ per kWh (b)	Primary energy factor	Fuel code
Community heating schemes: (k)	120 (l)				
waste heat from power station		2.97	0.058 (p)	1.34	45
geothermal heat source		2.97	0.041	1.24	46
heat from CHP		2.97	as above (q)	as above (q)	48
electricity generated by CHP			0.519 (i)	3.07 (i)	49
electricity for pumping in distribution network			0.519	3.07	50

Figure 3-5 Excerpt from SAP 2012 showing "Heat from CHP" aligning to Note (q)

Note (q) in SAP 2012 states:

Use factor for community heat from boilers according to fuel used.

Note (q) in SAP 10.1 states:

Use factor for heat network with boilers according to fuel used.

Appendix C of each version of SAP describes in detail the process to be used for calculating emissions associated with CHP. For CHP units, the efficiency to be used is the actual efficiency (if known) of the heat generator.

Section 4.1 describes the methodology that should be followed if calculating emissions from CHP in SAP.

4 Methodology options

4.1 SAP CHP method

As the ERF cannot be considered “Waste heat from power station” in SAP 10.1 (or any of the previous versions) as the electrical efficiency of the plant falls below 35%, SAP defaults to the methodology used to calculate emissions from CHP. Figure 4-1 describes the default methodology that would be followed in SAP, if following the guidance exactly as written.

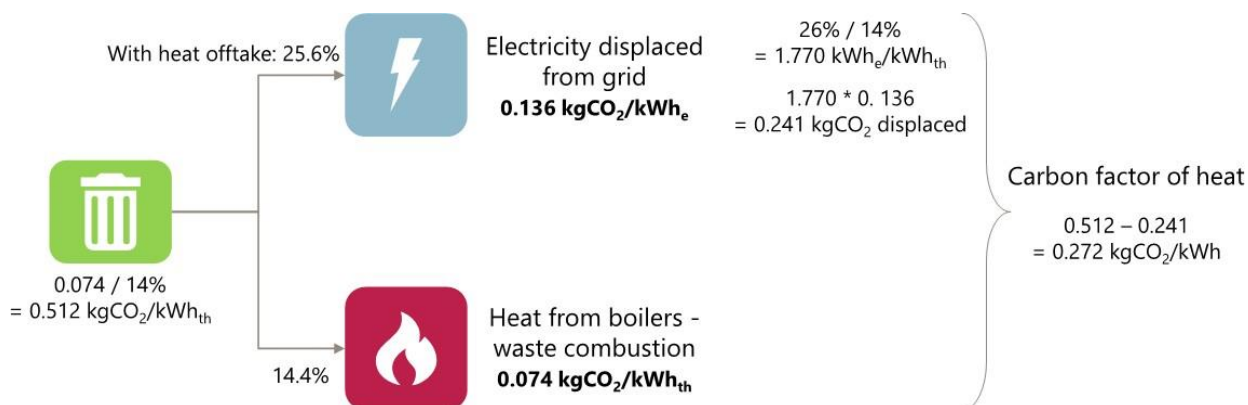


Figure 4-1 CHP calculation methodology, with SAP 10.1 figures

This methodology assumes that the heat from waste combustion is generated at 14.4% efficiency, resulting in 0.512 kgCO₂ of emissions arising from the combustion of fuel for every kWh of heat produced. Using an electrical efficiency with heat offtake of 25.6%, this means that 1.770 kWh of electricity are produced for every kWh of heat whilst the plant is in heat offtake mode. Using a grid carbon factor of 0.136 kgCO₂/kWh, this means that 0.241 kgCO₂ is displaced for every kWh of heat offtake.

In CHP, the emissions associated with the fuel consumption (in this case, 0.512 kgCO₂/kWh) are partly offset by displacement of electricity from the grid (0.241 kgCO₂/kWh), resulting in a carbon factor of heat of 0.272 kgCO₂/kWh.

Table 4-1 describes key considerations of such an approach.

Table 4-1 Methodology appraisal - SAP CHP method

Positive	Negative
Default method in SAP when calculating emissions associated with heat offtake from a power station with electrical efficiency of less than 35%.	Low power efficiency of the ERF is a function of the technology, which means that it is penalised in SAP despite being a key part of the UK's waste strategy going forward.
	As grid carbon factor decreases, the emissions of heat from CHP increase, as the electricity being displaced is increasingly low carbon.
	Emissions factor for fuel is based on “Heat from boilers – waste combustion”. Need to question whether this carbon factor is appropriate as in this scenario, heat is being taken from the steam turbine, not boilers.
	The ERF is expected to still be built as a means to generate electricity, whether there is heat offtake or not. Therefore, penalising the facility for the low thermal efficiency is not seen as an approach that is representative of the proposal to take waste heat from the facility.

4.2 SAP Waste heat from power station

It is BuroHappold's understanding that the Association for Decentralised Energy (ADE) has responded to the SAP consultation with concerns about the threshold of 35% power efficiency before heat offtake from a power station can be considered as the default SAP fuel "Waste heat from Power Station".

This requirement has been part of the methodology since at least SAP 2012, and there are currently no signs that the threshold will change. However, should the next official version of SAP remove the 35% threshold, the ERF may become eligible to use the default value from Table 12 of the document, which currently means a carbon factor of 0.015 kgCO₂/kWh.

As described in Section 3, SAP 2012 assumes a 1kW reduction in electricity output for every 7kW of heat generated, whilst subsequent consultation versions have increased the efficiency to a 1kW reduction in electricity output for every 9kW of heat generated.

Table 4-2 describes key considerations in pursuing this approach to calculation of heat carbon factor.

Table 4-2 Methodology appraisal – Waste heat from power station method

Positive	Negative
As emissions factor of grid electricity decreases, the carbon factor for SAP Waste Heat from Power Station continues to decrease.	The underlying methodology assumes that there is a 1kW reduction in electricity output for every 9kW of heat generated in SAP 10.1. However, the technical data for the Edmonton ERF currently shows that the efficiency is lower, with a drop of 1kW electricity output for every 5kW of heat generated. The actual technical specification are used in the methodology described in Section 4.4
Fuel as "Waste heat from power station" would be the closest description to the process proposed for the ERF.	This methodology would not currently be allowable under the C4 note in SAP 10.2, which states that where power station electrical efficiency is less than 35%, the plant must be considered as CHP. This is, however, being challenged by the ADE.

4.3 Reduced electrical efficiency method

This method, as proposed by the BuroHappold report '160106 CC 033993 Heat Network Carbon Factor 02' as Method 5, assigns only the emissions associated with the reduction in ERF electrical efficiency to the heat offtake.

Figure 4-2 describes the calculation process as followed in the 160616 carbon factor report.

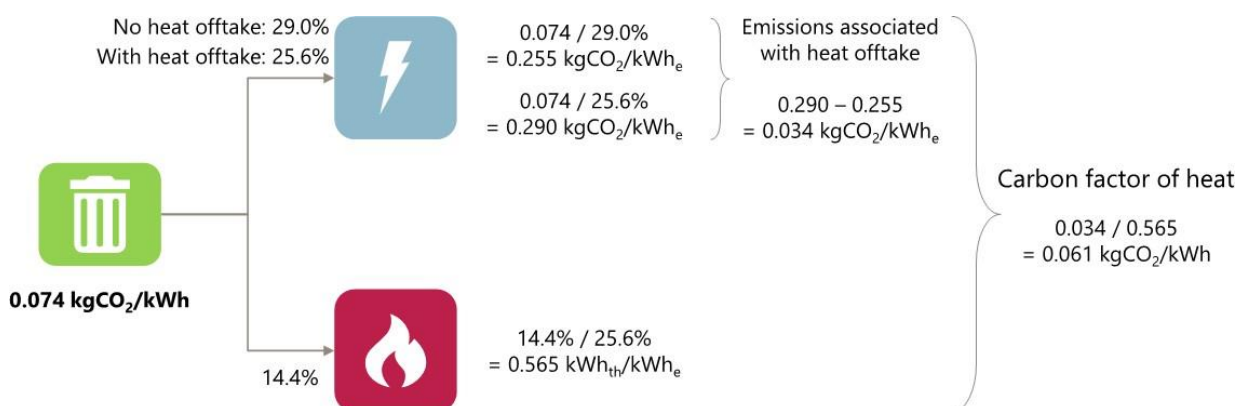


Figure 4-2 Reduced electrical efficiency method

Assuming a carbon factor of $0.074 \text{ kgCO}_2/\text{kWh}$, which aligns with the SAP "Waste heat from boilers – waste combustion" fuel, there are 0.255 kgCO_2 emissions for every kWh of electricity generated when the plant is running with no heat offtake. When the ERF electrical efficiency drops with heat offtake, there are 0.290 kgCO_2 emissions for every kWh electricity generated. Therefore, heat offtake can be considered to result in an additional 0.034 kgCO_2 emissions for every kWh generated by the ERF.

Assuming a thermal efficiency of 14.4% in heat offtake mode, there is 0.565 kW of heat generated for every kW of electricity. Therefore, the carbon factor of heat can be considered to be $0.061 \text{ kgCO}_2/\text{kWh}$.

Table 4-3 sets out key considerations in using such an approach.

Table 4-3 Methodology appraisal – Reduced electrical efficiency method

Positive	Negative
BuroHappold considers this to be a robust approach as it considers the whole ERF system and compares emissions from the plant prior to conversion to CHP to emissions post-conversion.	The input factor for combustion of waste should be reviewed and agreed, requiring agreement from both the BRE and the ERF operator – as the factor may need to be aligned with other reporting sources. It should be noted that the BEIS emissions factor ⁷ for waste ('Domestic refuse (raw)') is $0.16 \text{ kgCO}_2/\text{kWh}_{th}$ which would result in a heat carbon factor of $0.132 \text{ kgCO}_2/\text{kWh}_{th}$ using this methodology.
	Question of whether "heat from boilers – waste combustion" is applicable to this case, where heat is taken from the turbine, not boilers.

⁷ [BEIS Greenhouse gas reporting: conversion factors 2019](#)

4.4 Displaced electricity method

This method, as proposed by the BuroHappold report '160106 CC 033993 Heat Network Carbon Factor 02' as *Method 1*, follows a similar methodology to the SAP Waste heat from power station carbon factor. This aligns with Note (p) to Table 12 of SAP, which states that the emissions factor for "Waste heat from power station" takes account of the reduction in electricity generation that occurs where heat is produced at a high enough temperature to supply a community heat network.

As described in Section 3, SAP 2012 assumes a 1kW reduction in electricity output for every 7kW of heat generated, whilst subsequent consultation versions have increased the efficiency to a 1kW reduction in electricity output for every 9kW of heat generated.

However, the technical specifications received by BuroHappold suggest that this figure should be 1 kW reduction in electricity output for every 5kW of heat generated.

Figure 4-3 describes the calculation process.

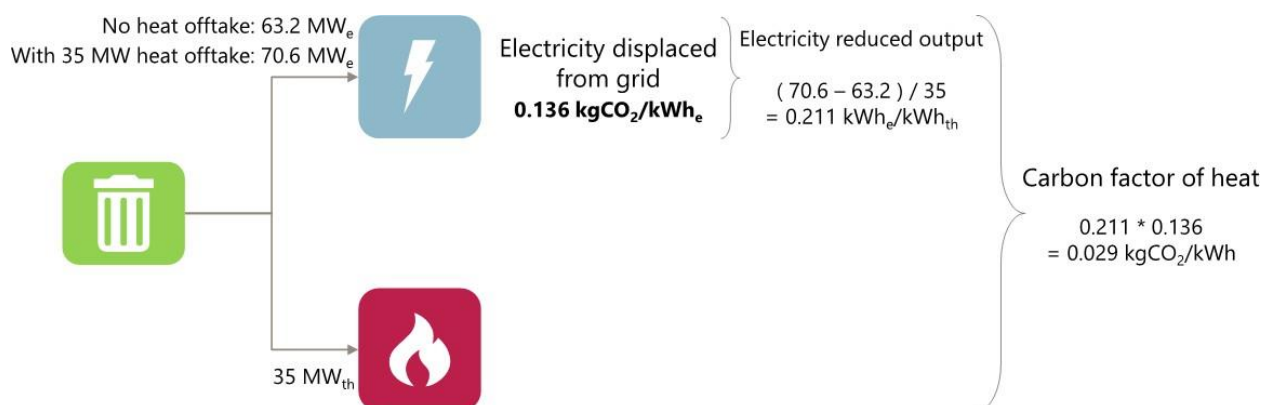


Figure 4-3 Displaced electricity method

Using the technical data for a 35 MW heat offtake, a reduction in output of 0.211 kW of electricity is experienced for every kW of heat. Therefore, it could be considered that the carbon factor of heat is 0.029 kgCO₂/kWh.

Table 4-4 sets out the major considerations in using this approach in calculating the heat carbon factor from the ERF.

Table 4-4 Methodology appraisal – Displaced electricity method

Positive	Negative
Follows the methodology as for SAP "Waste Heat from Power Station", but is bespoke to the ERF plant in terms of heat offtake per unit decreased electricity output.	The methodology for SAP "Waste Heat from Power Station", which closely mirrors this approach, is currently only allowable for cases where electrical efficiency of the plant is greater than 35%.
Does not rely on input of fuel carbon factor, which is uncertain and may need agreement between the BRE and ERF operator.	Does not consider the emissions associated with fuel consumption.
As grid carbon factor continues to decrease, emissions associated with heat offtake from ERF will also decrease.	SAP carbon factors for electricity are the same for consumption and displacement, whereas in reality a "marginal" electricity emissions factor would be used to represent the generation that is generally displaced by additional generation on the grid.

4.5 Summary

This report has considered four distinct methodologies for calculating the carbon factor for heat from the ERF. Results of heat carbon factor for each method are shown in Figure 4-4.

1. Current default SAP rule, which would mandate the CHP method be used as the electrical efficiency of the plant is less than 35%
2. SAP waste heat from power station, if there was no threshold of 35% electrical efficiency
3. Method 5 as per BuroHappold's previous report '160106 CC 033993 Heat Network Carbon Factor 02', denoted 'Reduced electrical efficiency method'
4. Displaced electricity method

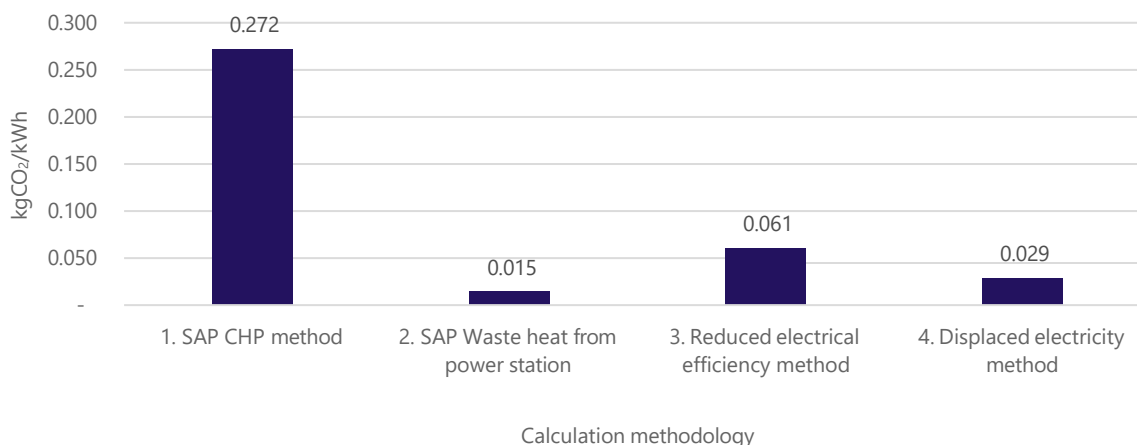


Figure 4-4 Comparison of methodologies, using SAP 10.1 emissions factors

Figure 4-5 shows the emissions factor from each calculation methodology using each of the previous versions of SAP described in this report. For both the SAP "Waste heat from power station" and 'Displaced electricity method', the carbon factor decreases as it is calculated as a fraction of the grid electricity carbon factor, which has been continually decreasing.

The SAP CHP method using waste combustion as fuel resulted in zero emissions in SAP 2012 and SAP 2016, as the carbon factor for electricity was high, meaning that the amount of displaced emissions was large for each unit heat generated.

The carbon factor from the 'Reduced electrical efficiency method' has remained constant since SAP 2016, when the carbon factor for waste combustion increased from 0.047 to 0.074 kgCO₂/kWh.

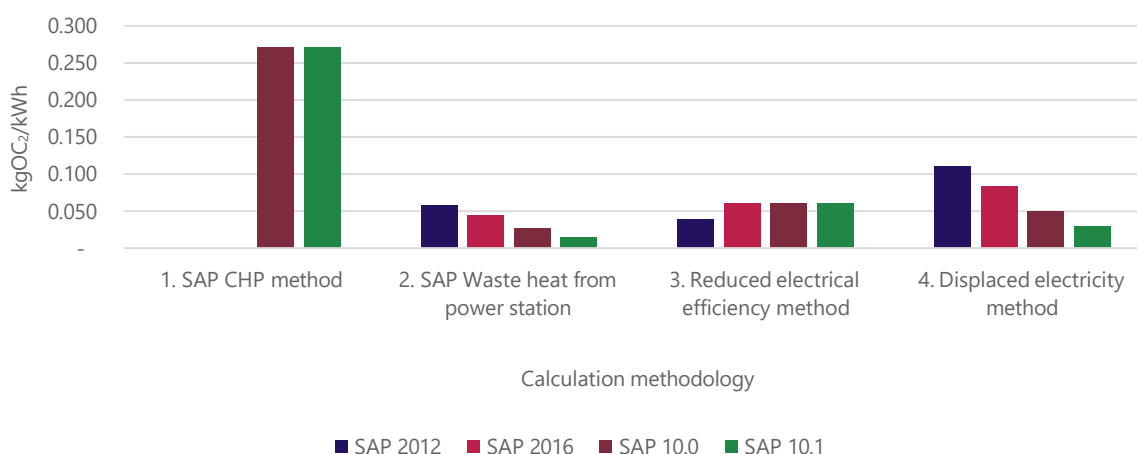


Figure 4-5 Comparison of methodologies, using previous versions of SAP

BuroHappold considers neither the SAP CHP method nor the SAP "Waste heat from power station" to be representative of the compliance carbon factor to be used for the ERF.

We recommend that both the "Reduced electrical efficiency method" and the "Displaced electricity method" are brought to the BRE for consideration in order to confirm the approach to be taken in reporting a carbon factor for the purposes of developers' compliance calculations.

5 Further work

Prior to final reporting, the technical assumptions described in Section 2 need to be verified by Energetik to ensure that they represent the most recent design of the ERF.

It is also recommended that Energetik keep abreast of the ongoing consultation response from ADE on the “Waste heat from power station” threshold in SAP, which could affect the approach used to calculate the carbon factor of the network if reduced or removed.

Should Energetik wish to provide a carbon factor to developers for use in compliance calculations, it is strongly recommended that the methodology used be agreed and verified with the BRE, who administer the technical assumptions behind SAP.

Should the “Reduced electrical efficiency method” be followed, the input waste emission factor needs to be carefully considered. By default, it is recommended that the SAP carbon factor for waste combustion be used – however, if available, plant-specific waste emissions factors may be appropriate. This would need to be agreed between the BRE and ERF operator.

Appendix C3 of each version of SAP describes in detail the process to be used for calculating emissions associated with heat networks. This includes consideration of:

- Distribution loss
- Energy for pumping

The Distribution Loss Factor (DLF) of the network will therefore also need to be provided to developers. This factor represents heat produced divided by heat delivered.

- The default in SAP 10.1 will be 1.5 if the network is designed and commissioned to CIBSE CP1, 2.0 if not. Existing dwellings have other default DLFs depending on building age
- Defaults will be used until the network registers under the Product Characteristics Database (PCDB), in which case the DLF is based on actual measured data

Energy for pumping should also be added to the carbon factor of heat for the network. According to Appendix C3.2 of SAP 10.1, CO₂ emissions associated with electricity used for pumping water through the distribution system are allowed for by adding electrical energy equal to 1% of the energy required for space and water heating. For heat networks recorded in the PCDB, actual pumping energy will be included in the data record (though this may be an estimate).

In reporting carbon factors of heat to developers, Energetik needs to also include:

- Version of SAP under which emissions factors have been calculated
- Any correspondence with the BRE confirming approach to carbon factor calculation
- Clarity that the network is not yet registered under the PCDB and that operational data may result in changes to the carbon factor

From: Ian Guest <Ian.Guest@energetik.london>
Sent: 13 April 2021 18:45
To: Ian Tavener
Cc: Ross Boulton; Emily Richardson; Stephen Webber
Subject: RE: Energetik/BH - High Road West

****External Email. This email originated from outside Buro Happold.****

Ian, thanks for a useful meeting this morning. As agreed please see tariff below:

Charges correct from 1st April 2021 – 31st March 2022

Connection Charges:

Residential and Commercial Units (supplied via a secondary heating network supplied from a heat exchanger substation, with each Residential Unit and Commercial Unit supplied via a HIU):

per Residential Unit £4,383.39
per m2 of commercial Unit space £65.75

Commercial Connection (large building with separate heat exchanger substation):

Based on heat capacity required

Charge for first 100kW of capacity £520.24 per kW

Charge for capacity element from 101 to 500kW £312.14 per kW

Charge for capacity element over 501 kW £114.45 per kW

Heat Supply Tariff to Customers, (assuming commercial units are supplied from secondary network via HIU)

Heating Charges	Fixed Charge (p/day) (excl. VAT)	Unit Charge (p/kWh) (excl. VAT)
Private or Social Tenant	45.994	4.177
Private or Social Landlord	55.304	4.177
Leaseholder/Freeholder	101.298	4.177
Commercial Unit (per HIU during supply agreement)		
	101.298	4.177
≤100m2	126.622	4.177
101m2 – 300m2	151.946	4.177
>300m2		

Regards

Ian

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Technical Director



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Energetik is the trading name of Lee Valley Heat Network Operating Company Ltd.
Company number: 09763702
VAT number: 253247023

-----Original Appointment-----

From: Ian Guest

Sent: 09 April 2021 18:23

To: Ian Guest; Ian Tavener

Cc: Ross Boulton; Emily Richardson

Subject: Energetik/BH - High Road West

When: 13 April 2021 09:00-10:00 (UTC+00:00) Dublin, Edinburgh, Lisbon, London.

Where: Microsoft Teams Meeting

Microsoft Teams meeting

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Our heat networks



Complete

Under Construction

Decarbonisation plan

Planned Extension

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