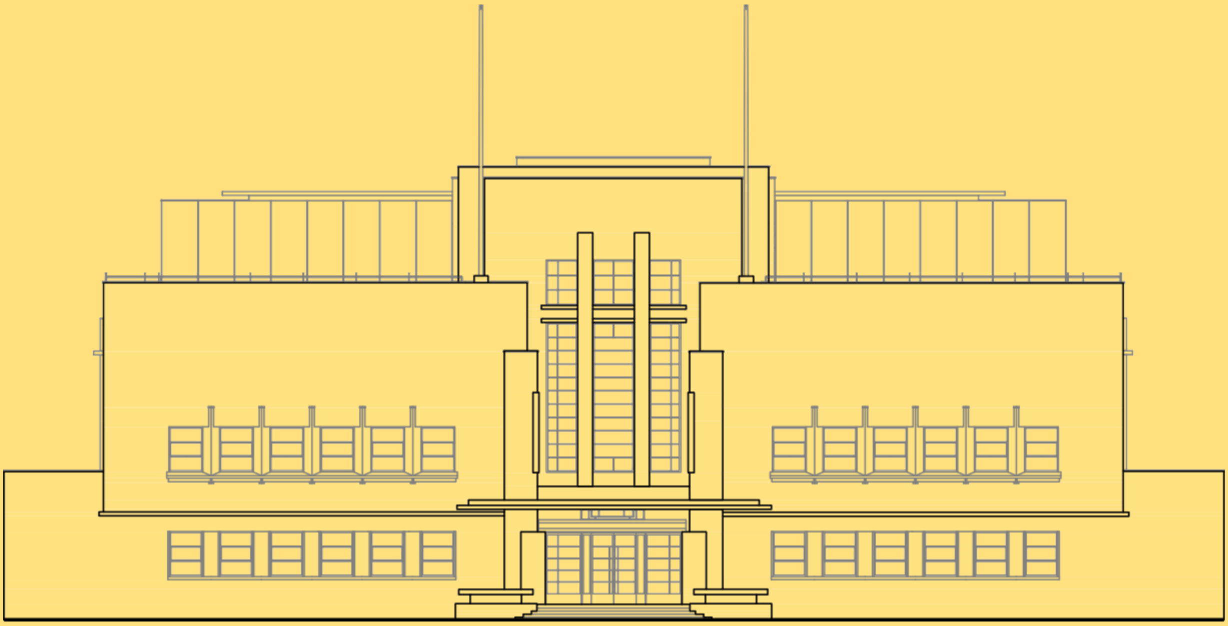


RAVENSCOURT PARK

FORMER ROYAL MASONIC HOSPITAL

Cudd Bentley Consulting

Energy Statement
6391-CBC-HR-RP-S-003 P01
November 2023

CONTENTS

RECORD OF REVISIONS.

Date.	Revision.	Description of change.
15-11-2023	1	Final Issue.

1 EXECUTIVE SUMMARY

This Energy Statement considers the predicted energy demand for the proposed Ravenscourt Park Hospital, London W6 0TN development, hereafter referred to as the 'development'.

This document complies with the requirements at both national and local level, as set out in the National Planning Policy Framework (2023), The London Plan (March 2021) and Hammersmith and Fulham Local Plan (February 2018).

The energy requirements of the development have been modelled in compliance with Part L2 and L1 of the Building Regulations 2021 and are based on the site layout plans provided by SPPARC Architects.

This report includes annualised baseline calculations which predict the likely energy consumption and associated CO_2 emissions for this development. The total baseline energy and carbon emissions for the development, taking into account regulated energy demands are:

- *17,929,373.63 kWh/annum*
- *87.4 Tonnes CO_2/annum*

Unregulated energy use is not covered by existing regulations and includes energy consumed by the occupants through activities and appliances; in this case it would typically be small power usage (appliances, computers, equipment etc.). The following unregulated energy use for the development was calculated:

- *8,964,686.8 kWh/annum*
- *43.7 Tonnes CO_2/annum*

The following energy hierarchy from London Plan 2021 has been adhered to in order to determine the most appropriate strategy for the development:

1. **Be Lean**, Reduce energy and carbon emissions through the use of passive design and energy efficiency measures;
2. **Be Clean**, Reduce energy and carbon emissions by investigating the possibility of installing a site wide Combined Heat and Power (CHP) system or connecting to an existing decentralised CHP network;
3. **Be Green**, Reduce energy and carbon emissions by installing Low or Zero Carbon Technologies such as Air Source Heat Pumps (ASHP), Solar panels, Photovoltaics (PV), Wind Turbines etc.

Be Lean

In order to initially reduce carbon emissions from a base Part L 2021 compliant development, the following passive design and energy efficiency measures have been incorporated:

- Improved double glazing with low G values and shading co-efficient to limit the effects of solar gain;
- Mechanical Whole House Ventilation with Heat Recovery (in areas where required);
- The provision of energy efficient lighting;
- The provision of zonal thermal and lighting controls;
- The provision of variable speed pumps and fans;
- The enhancement of pipework and ductwork, thermal insulation;
- The provision of time and temperature zone control on HVAC systems;
- Improved specific fan powers;
- Electric power factor >0.95 (commercial element only);
- Sub metering of energy and lighting (commercial element only).

Further examples of the proposed measures to be provided are in Section 7.0 'Passive Design and Energy Efficiency Measures' of this report.

Following the above measures being incorporated the total baseline energy and carbon emissions for the development, taking into account regulated energy demands, are reduced to:

- *13,675,266.65kWh/annum*
- *68.8 Tonnes CO_2/annum*

From taking passive measure, the sitewide carbon emission have reduced by 21%.

Be Clean

The following 'be clean' strategies have been considered for the development:

1. Connection to an existing Combined Cooling Heat and Power (CCHP)/ Combined Heat and Power (CHP) distribution Networks.

    - *There are currently no existing CHP distribution networks available to connect to*

Be Green

A range of low or zero carbon technologies have been considered for incorporation within the proposed development; it has been proposed in this case that Air Source Heat Pumps (ASHP), Ground Source Heat Pump (GSHP) and Photovoltaic (PV) Panels are feasible and have been utilised.

Further details of the feasibility analysis of low or zero carbon technologies are in section 9.0 'Renewable Energy' of this report.

Following the inclusion of the on-site renewable technologies, the total baseline energy and carbon emissions for the development, taking into account regulated energy demands have further reduced to:

- *2,535,946.48kWh/annum*
- *38.2 Tonnes CO_2/annum*

A total carbon reduction of 56% has been achieved for the development.

Energy Contribution from Renewables

The following table 1.1 shows the total energy contribution from both GSHP's/ASHP's and PV's.

Renewable Energy Contribution to the site	
ASHP and GSHP	401,844 kWh/annum
PV	29,250 kWh/annum

Table 1.1 Renewable Energy Contribution

A total of 39 kWp Photovoltaic array has been utilised for the Block F care home to comply with the Part L 2021.

Proposed Energy Strategy of the Development

In summary the energy strategy comprises of:

1. Passive Design and Energy Efficient Measures (Section 7.0);
2. Air Source Heat Pumps and Ground Source Heat Pump (Section 8.0);

3. Photovoltaics (Section 8.0).

The scheme takes into consideration the site layout and requirements for the building type to produce a design that incorporates the most appropriate technologies available to the site. This provides a scheme that is commercially viable whilst targeting compliance with all policies applicable to this development.

The Energy Strategy consists of passive design and energy efficient measures such as the provision of energy efficient lighting and the provision of time and temperature zone heating controls. The use of further/ emerging technologies may be included for use within this development if their feasibility increases in the future, in line with best practice.

This review has resulted in the formulation of an Energy Strategy to be adopted for the development involving the use of passive design and energy efficiency measures, the installation of ASHP, GSHP and PV; which achieves compliance with Part L2 and L1 2021, Hammersmith and Fulham Local Plan, and targets compliance with The London Plan 2021 requirements.

The following psi values were used for the key junctions for new built apartments,

- *Lintel: 0.002 (W/m.K)*
- *Sill: 0.013 (W/m.K)*
- *Jamb: 0.008(W/m.K)*
- *Roof: 0.048(W/m.K)*
- *Corner: 0.032(W/m.K)*

The strategy for the residential and non-residential elements of the development is shown in table 1.2 below.

Residential Element Energy Strategy	
Heating	**Block E:** On-Site Communal Heating Network via ASHP (100% of the annual heating and hot water demand). **Block B,C,D:** Ground Source Communal Heating Network via Heat pump installed within bore holes (100% of the annual heating demand).
Hot water (DHW)	**Block A (non-residential):** 100% Electric Point of Use **Block B,C and D (residential):** Low Temperature On-Site Communal Heating Network via Ground source heat pump. **Block C (non-residential):** 100% Electric Point of Use **Block E (residential)**: Low Temperature On-Site Communal Heating Network via Air Source Heat Pump. **Block F (Care Home):** Low Temperature On-Site Communal Heating Network via Air Source Heat Pump.
Cooling	Within superior apartments Altherma units will provide Heating, Cooling and Hot Water.

Ventilation	Natural Ventilation will be provided via trickle vents and openable windows alongside: **Block B,C,D** (new built element): MVHR **Blocks B, C & D (existing)**: Mechanical Exhaust will be utilized for Part F compliance. **Block E and F:** MVHR.
Lighting	Energy efficient LED lighting where applicable

Table 1.2 Proposed Energy Strategy for the residential and non-residential elements of the development

The strategy for the commercial elements of the development is shown in table 1.3 below.

Commercial Element Energy Strategy	
Heating	**Block A:** Cafe, community and meeting rooms heating will be provided through the communal network GSHP
	Block C: Workspace, playroom, and reception via GSHP
	Block F: Bedrooms, reception, and office through ASHP, and Electric panel heaters for the corridors.
Hot water (DHW)	**Block A:** Electric Point of use
	Block C: Electric Point of use
	Block F: ASHP for the Hot water
Cooling	**Block A:** Meeting rooms cooling will be provided through the GSHP
	Block C: GSHP for the cooling within the playroom and workspace
	Block F: Reception and office cooling through ASHP
Ventilation	**Block A:** MVHR within the meeting room
	Block C: Workspace and Playroom through MVHR
	Block F: MVHR within the bedrooms
Lighting	Energy efficient LED lighting where applicable

Table 1.3 Proposed Energy Strategy for the commercial elements of the development

The following Tables 1.4 and 1.5 highlight the carbon savings that are currently anticipated for the development from a base Part L2 and L1 2021 compliant build.

	Carbon Dioxide Emissions (Tonnes CO_2 per annum)	
	Regulated	Unreguled
Baseline : Part L 2021 of the Building Regulations Compliant Development	87.4	43.7
After Energy Demand Reduction	68.8	It is anticipated that a circa 3% saving can be achieved through the use of energy efficient equipment, for example A or A+ appliances. This would reduce theunregulated carbon emissions to: 42.4
After Renewable Energy	38.2	

Table 1.4 Carbon Dioxide Emissions (Development)

	Regulated Carbon Dioxide Savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	18.6	21
Savings from Renewable Energy	30.6	35
Total Cumulative Savings	49.2	56
Total Target Savings	30.59	35.00%
Policy Exceedance	18.61	21%

Table 1.5 Regulated Carbon Savings (Development)

The proposed development shall include care home/ commercial/ residential element and the following Tables 1.6 to 1.7 demonstrates the carbon savings achieved independently by the non-residential and residential elements of the development.

	Regulated Carbon Dioxide Savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	7.2	18
Savings from Renewables	6.4	16
Total Cumulative Savings	13.6	34

Table 1.6 Regulated Carbon Savings Non-Residential Development (Part L 2)

	Regulated Carbon Dioxide Savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	11.4	24
Savings from Renewable Energy	24.2	51
Total Cumulative Savings	35.6	75

Table 1.7 Regulated Carbon Savings Residential Development (Part L1A)

The London Plan requires all major developments to achieve a minimum on-site carbon reduction of 35% beyond Part L 2021 with a target of net-zero carbon. Through energy efficiency measures residential development is required to achieve minimum 10% CO_2 reduction, and non-residential development is required to achieve minimum 15% CO_2 reduction. The London Plan Policy SI 2 requires a cash in lieu contribution if the net-zero carbon target is not achieved. The cash in lieu contribution is calculated using a carbon off-set price of £95 per tonne of carbon dioxide for a period of 30 years. As a result of the zero-carbon target having not been achieved in line with The London Plan Policy SI 2, the cash in lieu contribution required has been calculated as £108,945. The overall development has an anticipated on-site CO_2 improvement of 56% beyond Part L 2021, with the net-zero carbon shortfall being met via the cash-in-lieu contribution.

The Air Source Heat Pump and Ground Source Heat Pump will provide 401,844 kWh/annum of heating.

A total of 39 kWp, with 106 panels have been utilized for the non-residential building Block F care home. The PV plans can be seen in Appendix E.

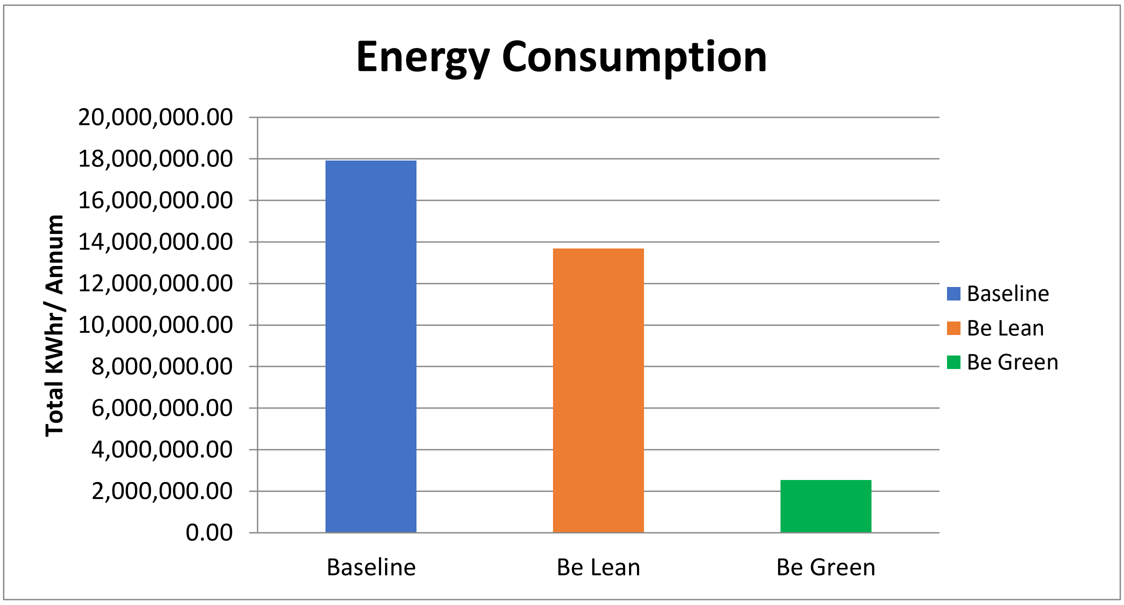


Figure 1.1 Annual Energy Consumption

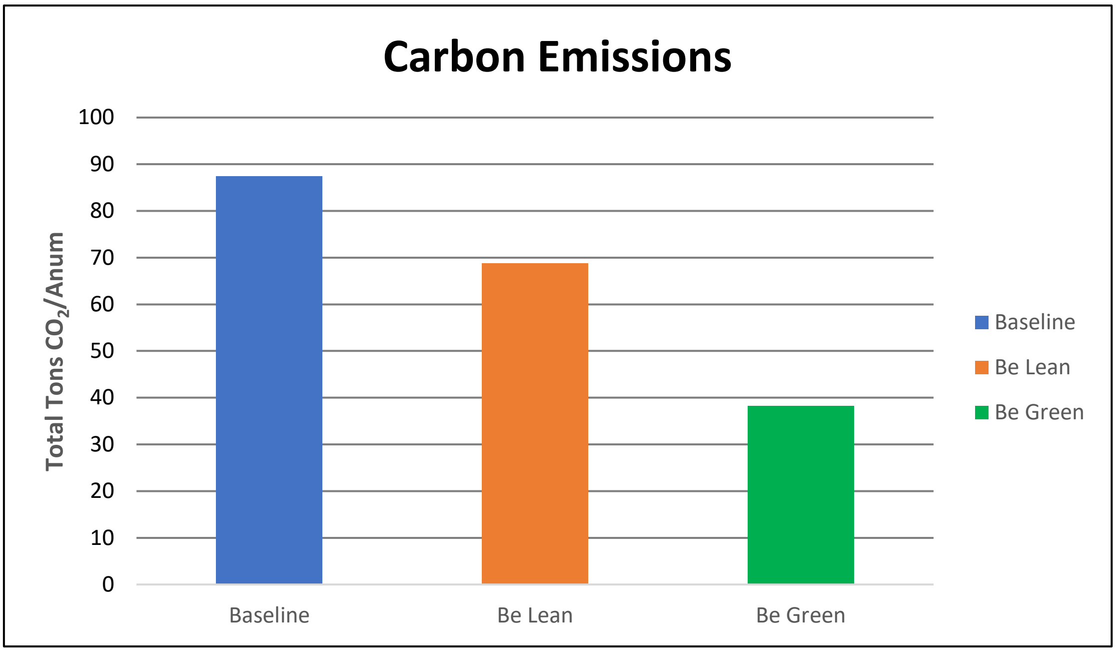


Figure 1.2 Annual Carbon Emissions

2 INTRODUCTION

This report has been prepared by the Cudd Bentley Consulting Sustainability Team to develop an energy strategy for the proposed construction of Ravenscourt Park Hospital development to take into account up to date policy and Building Regulations requirements. The Proposed development includes Part demolition, part extension and alteration of the existing buildings and structures, change of use of the existing buildings and the erection of a new building including provision of a basement, to provide residential units (Use Class C3) and associated ancillary communal floorspace, a Care Home (Use Class C2) and flexible non-residential floorspace (Classes E, F1 and F2), together with associated roof top installations and structures, private and communal amenity space, landscaping, access, refuse storage, parking and associated works.

The Cudd Bentley Consulting (CBC) Sustainability Team consists of a variety of qualified Engineers and Environmental Consultants with a broad range of backgrounds including Mechanical Engineering, Building Services Engineering and Environmental Science. The CBC Sustainability Team are CIBSE Low Carbon Consultants, CIBSE Low Carbon Energy Assessors, Domestic Energy Assessors, BREEAM Assessors and Accredited Professionals. This broad range of knowledge and qualification allows the CBC Sustainability Team to produce sustainability documentation for planning submissions that are tailored to the individual requirements of the development and to ensure National and Local Policy compliance is demonstrated with clarity.

Government policies now require significant energy reductions from proposed buildings. Building a greener future sets a planned trajectory outlined via Part L 2021 of the Building Regulations. These commitments have been the key focus point in addressing policies and strategies to reduce energy use and carbon emissions through energy efficiency and low or zero carbon technologies (LZC).

In line with National and Local Policy, and best practice, the following approach has been adopted in forming the energy strategy for the development:

1. To propose to improve the building fabric from minimum Part L 2021 Building Regulations requirements; (BE LEAN)
2. To propose to reduce energy consumption and carbon dioxide emissions through passive and energy efficiency measures; (BE LEAN)
3. Investigate the feasibility of connecting into an existing district heat network and where this is not available investigate the feasibility of providing a Central CHP Plant to serve the base heating and hot water requirements for the development; (BE CLEAN)
4. To propose to reduce energy consumption and carbon dioxide emissions further through the use of on-site renewable / LZC energy technologies. (BE GREEN)

The recommended strategy takes into consideration the site layout and requirements for the building to produce a design that incorporates the most appropriate technologies available to the site that are commercially viable, whilst targeting compliance with all policies applicable to this development.

3 POLICY REVIEW

3.1 NATIONAL PLANNING POLICY

An effective planning system is required to contribute to achieving sustainable development. The ***National Planning Policy Framework*** (NPPF), 2023, outlines what the government deems as sustainable development in England.

Sustainable development is defined as having the following three overarching objectives which are interdependent and need to be pursued in mutually supportive ways: an economic objective, a social objective, and an environmental objective.

1. Economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
2. Social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
3. Environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

The above measures can be described as an energy dilemma, this is demonstrated in Figure 3.1 below. Each dimension is dependent on each other and sustainable development proposals should adhere to each role. This energy statement shall ensure the proposed Development is one that contributes economically, socially and environmentally in accordance with the NPPF, 2023.

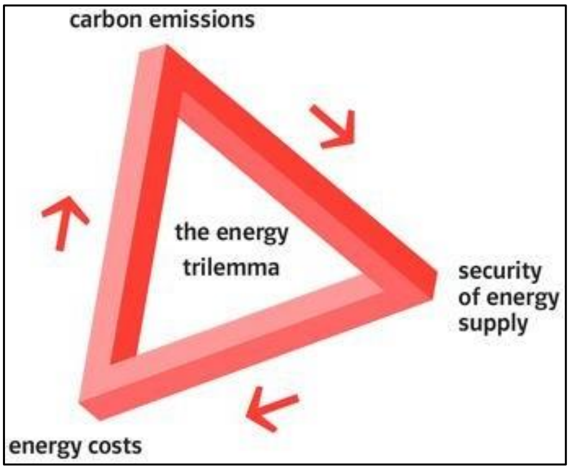


Figure 3.1 The Energy Trilemma

Guidance has been followed from the (NPPF) 2023, to provide an energy strategy which reduces energy use and carbon emissions, in line with best practice. This will provide a balanced scheme which focuses on optimal use of non-renewable resources (energy efficiency measures) whilst providing a renewable energy strategy best suited to the sites and their building uses. Below are some key extracts relevant to the development from Chapter fourteen 'Meeting the Challenge of Climate Change, Flooding & Coastal Change':

Paragraph 153

Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the longterm implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

<u>Paragraph 154</u>

New development should be planned for in ways that:

a. avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
b. can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

<u>Paragraph 155</u>

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
b. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
c. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co- locating potential heat customers and suppliers.

<u>Paragraph 156</u>

Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

<u>Paragraph 157</u>

In determining planning applications, local planning authorities should expect new development to:

a. comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
b. take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

3.2 THE LONDON PLAN (MARCH 2021)

The following policies outline requirements made by the Greater London Authority in relation to climate change, pollution and energy use.

<u>Policy D14 Noise</u>

A. In order to reduce, manage and mitigate noise to improve health and quality of life, residentialand other non-aviation development proposals should manage noise by:
   1. avoiding significant adverse noise impacts on health and quality of life
   2. reflecting the Agent of Change principle as set out in Policy D13 Agent of Change
   3. mitigating and minimizing the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses
   4. improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquility)
   5. separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening, layout, orientation, uses and materials – in preference to sole reliance on sound insulation
   6. where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles
   7. promoting new technologies and improved practices to reduce noise at source, and on thetransmission path from source to receiver.

<u>Policy SI 1 Improving Air Quality</u>

A. Development Plans, through relevant strategic, site-specific and area based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor’s or boroughs’ activities to improve airquality.

B. To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:

   1. Development proposals should not:

      a. lead to further deterioration of existing poor air quality
      b. create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits
      c. create unacceptable risk of high levels of exposure to poor air quality.

   2. In order to meet the requirements in Part 1, as a minimum:

      a. development proposals must be at least Air Quality Neutral

      b. development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures

      c. major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

      d. development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

Policy SI 2 Minimising Greenhouse Gas Emissions

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

1. be lean: use less energy and manage demand during operation
2. be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
3. be green: maximise opportunities for renewable energy by producing, storing and usingrenewable energy on-site
4. be seen: monitor, verify and report on energy performance.

B. Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non- residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on- site, any shortfall should be provided, in agreement with the borough, either:
1. through a cash in lieu contribution to the borough's carbon offset fund, or
2. off-site provided that an alternative proposal is identified and delivery is certain.

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must bering-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported annually.

E. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

F. Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Policy SI 3 – Energy Infrastructure

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

B. Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:
1. major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2. heat loads from existing buildings that can be connected to future phases of a heat network
3. major heat supply plant including opportunities to utilise heat from energy from waste plants
4. secondary heat sources, including both environmental and waste heat
5. opportunities for low and ambient temperature heat networks
6. possible land for energy centres and/or energy storage

7. possible heating and cooling network routes
8. opportunities for future proofing utility infrastructure networks to minimise the impact from road works
9. infrastructure and land requirements for electricity and gas supplies
10. implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11. opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

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

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

<u>Policy SI 4 Managing Heat Risk</u>

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

B. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:
  1. reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.
  2. minimise internal heat generation through energy efficient design.
  3. manage the heat within the building through exposed internal thermal mass and high ceilings.
  4. provide passive ventilation.
  5. provide mechanical ventilation.
  6. provide active cooling systems.

3.3 ENERGY ASSESSMENT GUIDANCE (APRIL 2020)

Since January 2019, applicants submitting referable applications have been encouraged to use the SAP10.0 emission factors in areas where there are no opportunities to connect to existing or planned district heat networks. This approach will remain in place until the national government updates building regulations, so that new development better reflects the actual carbon emissions associated with their operations.

Greater London Authority Sustainable Design and Construction Supplementary Planning Guidance (2014)

2.4 Energy and Carbon Dioxide Emissions

In line with The London Plan Policy the following carbon savings are required:

Residential:

- 2013 – 2016 40% improvement beyond 2010 Building Regulations;
- 2016 – 2031 Zero carbon.

Non-Domestic:

- 2013 – 2016 40% improvement beyond 2010 Building Regulations;
- 2016 – 2019 As per the Building Regulations requirements;
- 2019 – 2031 Zero carbon.

To avoid complexity and extra costs, the Mayor has adopted a flat carbon dioxide improvement beyond Part L 2021 of 35% for both residential and non-residential developments.

In order to be compliant with SPG minimum standards must be met the core values are as follows:

- Minimising carbon dioxide emissions across the site including the building and services (such as heating and cooling systems).
- Avoiding internal overheating contributing to the urban heat island effect.
- Efficient use of natural resources including water.
- Minimising pollution including noise, air and urban run-off.
- Avoiding impacts from natural hazards such as flooding.
- Ensuring developments are comfortable and secure for residents.
- Securing sustainable procurement of materials.
- Promoting and protecting biodiversity and green infrastructure.

3.4 HAMMERSMITH AND FULHAM LOCAL PLAN (FEBRUARY 2018)

Policy CC1 – Reducing Carbon Dioxide Emissions

The council will require all major developments to implement energy conservation measures by:

1. implementing the London Plan (2016) sustainable energy policies and meeting the associated carbon dioxide (CO2) reduction targets;
2. ensuring developments are designed to make the most effective use of passive design measures, and where an assessment such as BREEAM (or equivalent) is used to determine a development's environmental performance, this must be supplemented with a more detailed Energy Assessment in order to show compliance with the London Plan's CO2 reduction targets;
3. requiring energy assessments for all major developments to demonstrate and quantify how the proposed energy efficiency measures and low/zero carbon technologies will reduce the expected energy demand and CO2 emissions;
4. requiring major developments to demonstrate that their heating and/or cooling systems have been any existing decentralised energy systems or integrating new systems such as Combined (Cooling) Heat and Power units or communal heating systems, including heat networks if this can be done without having an unacceptable impact on air quality; and
5. using on-site renewable energy generation to further reduce CO2 emissions from major developments, where feasible.

Where it is not feasible to make the required CO_2 reductions by implementing these measures on-site or off-site as part of the development, a payment in lieu contribution should be made to the council which will be used to fund CO_2 reduction measures in the borough or elsewhere in London.

Encouraging energy efficiency and other low carbon measures in all other (i.e. non-major) developments, where feasible. The council will also encourage developers to use energy performance standards such as Passivhaus to guide development of their Energy Strategies.

<u>Policy CC2 – Ensuring Sustainable Design and Construction</u>

The council will require the implementation of sustainable design and construction measures in all major developments by:

a. implementing the London Plan sustainable design and construction policies to ensure developments incorporate sustainability measures, including:
   - minimising energy use;
   - making the most effective use of resources such as water and aggregates;
   - sourcing building materials sustainably;
   - using prefabrication construction methods where appropriate;
   - reducing pollution and waste;
   - promoting recycling and conserving and promoting biodiversity and the natural environment;
   - ensuring developments are comfortable and secure for users and avoiding impacts from natural hazards (including flooding); and

b. Requiring Sustainability Statements (or equivalent assessments such as BREEAM) for all major developments to ensure the full range of sustainability issues has been taken into account during the design stage.

   The integration of sustainable design and construction measures will be encouraged in all other (i.e. non-major) developments, where feasible

4 DEVELOPMENT APPROACH

This report adopts the following approach to provide compliance with the Local and National Planning Policies:

1. To propose to improve building fabric from minimum Part L (2021) Building Regulations requirements;
2. To propose to reduce energy consumption and carbon dioxide emissions through passive and energy efficiency measures;
3. Investigate the feasibility of connecting into an existing district heat network and where this is not available investigate the feasibility of providing a Central CHP Plant to serve the base heating and hot water requirements for the development;
4. To propose to reduce energy consumption and carbon dioxide emissions further through the use of on-site renewable/ LZC energy technologies.

Table 4.1 below outlines the Part L Building Regulations that the development shall be assessed under:

Building Element	Part L Building Regulations Applicable
Residential Element	Part L1 (2021)
Commercial units	Part L2 (2021)

Table 4.1 Part L Building Regulations Applicable

5 DETAILS OF PROPOSED DEVELOPMENT

The Site is located within the London Borough of Hammersmith and Fulham ('LBR'), situated at a highly accessible location near Hammersmith Town Centre, well-suited for both conventional housing and commercial areas. The site comprises a hospital site that has been vacant for the past 17 years, since 2006 when the hospital use on the site ceased. Prior to its vacancy, the site operated as an in-patient hospital and, as confirmed in the planning history section below, there have been no changes of use approved on the site. As such, the site is considered to fall within Use Class C2.

The property is Grade II* listed (1192740) and is constructed in the Art-Deco architectural style, constructed and completed between 1931- 1933. The listed hospital buildings comprise four interconnecting blocks: the T-shaped three-storey administrative block facing Ravenscourt Park (Block A); a south-facing, U-shaped, five-storey ward block to the west (Block B); a five-storey annex block with a projecting ground floor with bowed ends to the north of this (Block C); and, further north again, a three-storey surgical block (Block D).

Later additions include Block E to the north (1978), connected to the building by a raised walkway, and the Wakefield Wing to the west (1959) (beyond the site boundary), now unconnected to the building, but historically joined by a bridge; these are considered by Historic England to lack special interest and are not included in the listing.

Specifically, the proposal includes the following:

- Provision of 140 residential units (of which 21 are affordable (shared ownership) and 119 private).
- A care home (Block F) with 65 beds is proposed for this development.
- A 1,171sqm area is proposed for the flexible non-residential floorspace (Classes E, F1 and F2).
- A total 21,008sqm area is proposed for the Residential use of the development.
- Block F Care Home has a total area of 3,692sqm.
- Whole area proposed for the development is 25,871sqm.
- A 1,608sqm of green roofs is also proposed.

Figures 5.1 and 5.2 below show the proposed ground floor layout of the development and a typical upper floor layout of the development.

Figure 5.1 Proposed Ground Floor Plan of the development

Figure 5.2 Proposed level 01 Floor Layout

5.1 BUILDING REGULATION'S PART L

The proposed development consists of Part demolition, part extension and alteration of the existing building and structure, change of use of the existing building and provision of a new built block F care home. The residential element of the development is to be assessed under Part L1 2021 of the Building Regulations. The proposed commercial elements of the development shall be assessed under Part L2 2021 of the Building Regulations.

5.2 RAVENSCOURT PARK HOSPITAL HEAT NETWORK STRATEGY

Table 5.1 below outlines how Ravenscourt Park hospital development complies with GLA requirements on Heat Network.

GLA Requirement	Ravenscourt Hospital Heat Network Strategy
Commit to a communal heat network to allow connection to existing or planned district heating networks identified in the area.	The Ravenscourt Park hospital development will utilise a sitewide low temperature Communal Ground Source Heat Pump and Air Source Heat Pump network. The heat network will target industry leading performance, with target flow/return temperatures of 30/25 °C (detailed design to finalise figures) to achieve low network losses and reduce the risk of overheating. Telereal Trillium adopts the latest industry standard to peak load and pipework sizing (CP1 2020), which will further contribute to low network losses. The site has been future proofed with a District Heating Network connection, if one becomes available at a later stage.
Minimise the number of energy centres and provide a single point of connection to the District Heating Network (DHN).	This requirement forms a core strategy of the Ravenscourt Park Hospital heat network design. There is to be basement plant for the GSHP only, with the storage and distribution plant to be at basement level, which will serve Blocks A-D. This will permit a single point of

	connection within this low level plantroom for a future heat network when available. There is to be rooftop plant for the ASHP serving Block E only. This will permit a single point of connection within this low level plantroom for a future heat network when available.
Investigate suitable low carbon and/or renewable heating plant for installation within the energy centre if connection can't be made to an area wide network.	Telereal Trillium have clearly outlined their ambition to place Ground Source and Air Source Heat Pump technologies at the heart of any new scheme's strategy that cannot connect to an existing heat network. As part of the design process for this scheme the design team undertook a detailed analysis of each heat system considering the pros/ cons of each and reviewing each in terms of Capital and operation cost for the end user.
Investigate and commit to maximizing the installation of renewable technologies including the potential for storage on site.	The design targets 100% of the annual heat to come from the GSHP and ASHP units. The use of PV has been prioritized on site in order to supply maximum renewable energy to the development.
Include information on how the building's actual energy performance will be monitored post-construction and report the energy and carbon performance on the GLA's online platform.	The proposed Energy Strategy has incorporated a specific metering strategy that demonstrates compliance with the GLA's Be Seen requirement. Telereal Trillium adopts smart metering solutions that provide as a minimum hourly data capture of heat consumption/ generation partnered with a web/ cloud based platform providing access to live data delivering analytics and performance monitoring. Telereal Trillium intend to use established technologies providing the described functionality to form its strategy for demonstrating compliance with Be Seen for its heating and hot water energy related services.

Table 5.1 Heat Network Strategy

6 ASSESSMENT OF BASELINE ENERGY DEMAND

The primary energy demands of the development will be:

- *Heating;*
- *Lighting;*
- *Hot Water;*
- *General Power;*
- *Cooling;*
- *Ventilation.*

To assess the preliminary energy consumption of the proposed development, calculations have been completed using approved SBEM software (Hevacomp V8i SS1 SP10) and Elmhurst SAP software. The calculations generate annualised energy consumption for the buildings, from which the “carbon footprint” can be assessed.

The assessment of the energy demand for the site has been based on the notional development according to the building’s uses, through the construction of a building model in compliance with therequirements of Part L 2021 of the Building Regulations.

The total baseline energy and carbon emissions for the entire development, taking into account regulated energy demands are:

- *17,929,373.63kWh/annum*
- *87.4 Tonnes CO_2/annum*

7 PASSIVE DESIGN AND ENERGY EFFICIENT MEASURES

To provide carbon savings beyond a base Part L 2021 build and achieve compliance with local policies, the following passive design and energy efficiency measures are recommended.

Passive Design

Landscape – The surrounding landscape can have a positive and negative impact on the energy performance of a building. Shading from surrounding buildings and or trees can reduce solar gains but it can also increase the need for artificial lighting if daylight is blocked. The development has a landscape strategy developed to integrate the Ravenscourt Park Hospital development within the surrounding settings whilst creating a new residential quarter for Hammersmith that will have an attractive public realm to interface with both the heritage of the site and new green infrastructure. The scale and massing of the development means that internal shading of facades is inherent whilst also being mindful to maintain sufficient daylight/ sunlight factors to both public landscaped spaces and internal residential spaces.

Layout & Design – The proposed layout of a building can have an impact on its energy consumption.The position and size of windows for example will determine the amount of daylight, solar gain and natural ventilation the building will receive. By using these principles, as set out in table 7.1 below, the design of the scheme reduces energy consumption and limits overheating to ensure compliance with TM59. The proposed development itself will provide shading to neighboring blocks and therefore reduce the associated solar gains.

Orientation – Orientation plays a critical role in passive design, with the south side of a building receiving the most sunshine hours per day. The east and west orientations however receive the most intensive sunshine hours in the morning and evening respectively. The majority of the proposed development is east and west facing and therefore would benefit from the morning and afternoon sun.

Design Measures Proposed	Design Strategy/ Outcome	Design Output
Reduce the amount of heat entering a building in summer through orientation, shading, and green roofs and walls.	Effective double glazing to be provided with low G values and shading co-efficient to limit the effects of areas with large proportions of glazing.	Included within the development.
	Shading: Window reveals to reduce solar gain within rooms. Also, adjacent blocks also aid in providing shading to reduce solar gain even more.	Included within the development.
	Insulation: Highly insulated buildings to reduce heat gain through the fabric	Included within the development.
	Green Roofs: A total of 1,608 sqm green roof has been proposed for the development.	Included within the development.
Passive ventilation.	Openable windows as means of overcoming overheating during summer hot days.	All windows will be openable.
Mechanical ventilation.	Energy efficient mechanical ventilation with heat recovery to be provided to the commercial and residential units.	Included within the development.

Table 7.1 Summary of Design measures explored/ taken for the development

The 'U' values shown in Table 7.2 shall be targeted within the new-built residential element of the development, in accordance with Part L 1 (2021), these 'U' values go beyond the minimum requirements of Part L 2021.

Feature	U – Value (W/m².K)		
	Block E	Block B ,C and D – Top Floor Block D – Floor 3	Block B + C – Floor 1-4, Block D – Floor 1 & 2
Ground Floor	0.15	N/A	0.25
External Wall	0.18	0.18	0.55
Roof	0.12	0.15	n/a
Windows (Double Glazed)	1.2	1.2 (For top floors only of Blocks B,C & D a 0.8 W/m².K U value (Triple Glazed window) has been proposed)	1.2
External Doors	1.3	n/a	1.4

Table 7.2 U – Values targeted in the new-built residential elements of the development

The following 'U' values shall be targeted within the existing residential element of the development, in accordance with Part L1 (2021).

Feature	U – Value (W/m².K)
Ground Floor	0.25
External Wall	0.30
Roof	0.16
Windows (Double Glazed)	1.2

Table 7.2.1 U – Values targeted in the existing residential elements of the development

The following ‘U’ values shall be targeted within the Commercial Part of the development, in accordance with Part L2 (2021).

Feature	U – Value ($W/m^2.K$)			
	Refurb Block A & C		New Built (Block F Care Home)	
External Walls	0.30		0.16	
Exposed Floors	0.25		0.15	
Exposed Roof	0.16		0.15	
Glazing	U=1.2	G’=0.36	U=1.2	G’=0.36
Air Permeability	n/a		5 $m^3/hr/m^2$@ 50 Pa	

Table 7.3 U – Values targeted in the Non-Residential part of the development

In conjunction with the GLAs Energy Assessment Guidance, the domestic element of the development has achieved a 10% carbon emission improvement beyond Part L from passive and energy efficiency measures. Similarly, the non-domestic development has achieved at least a 15% carbon emission improvement beyond Part L from energy efficiency measures. The total energy and carbon emissions taking into account the following energy efficiency and passive measures will be calculated:

- High performance double glazing with low G values and shading co-efficient to limit the effects of solar gain;
- Mechanical Whole House Ventilation with Heat Recovery;
- The provision of energy efficient lighting;
- The provision of time and temperature zone control on HVAC systems;
- Improved specific fan powers.

The commercial space and each residential unit will be able to monitor their energy usage via electrical, heat and water meters. The landlord energy usage will also be monitored to help the landlord reduce their energy usage as well. All major items of plant equipment will be monitored, and the systems will be monitored to enable a minimum of 90% of the energy used in the building to be easily attributed to an end use. Electrical supplies will be metered by smart meters. Heat will be billed and metered as required by the Metering and Billing Regulations 2014.

From the utilisation of the above measures the total carbon improvement of 18% for the non-domestic and 24% for the residential blocks over Part L 2021 has been achieved. The overall energy and carbon emissions for the development are reduced to:

- *13,675,266.65 kWh/annum*
- *68.8 Tonnes CO_2/annum*

(A full set of calculations supporting these figures included in Appendix A of this document)

7.1 OVERHEATING ASSESSMENT

An overheating assessment has been undertaken for a sample floor on each Block within the residential element and the Care Home in Block F, in order to assess the overheating risk to occupants. This assessment followed CIBSE guidance TM59 and Part O of building regulations.

7.2 COOLING

In order to prevent and mitigate any potential overheating risks and minimise excessive heat generation contributing to the urban heat island effect, in accordance with the London Plan 2021, the following design strategies have been considered for inclusion within the development following the GLA cooling hierarchy displayed in Table 7.4.

Cooling Hierarchy	Design Strategy
Minimise internal heat generation through energy efficient design.	Energy efficient measures as per the list above in Section 7.0.
Reduce the amount of heat entering a building in summer through orientation, shading, fenestration, insulation and green roofs and walls.	Double glazing to be provided with low G values and shading co-efficient to limit the effects of areas of glazing contributing to solar gain.
	Orientation: Benefit from shading by adjacent blocks which further reduces solar gain.
	Shading: Window reveals have been optimized within the construction methodologies to provide shading and reduce solar gain within rooms. Adjacent blocks also aid in providing shading to reduce solar gain.
	Insulation: Highly insulated buildings to reduce heat gain through the fabric.
	Green Roofs: Biodiverse roofs to provide reduced heat island effects through evaporative cooling.
Manage the heat within the building through exposed internal thermal mass and high ceilings.	The residential nature of this development limits the feasibility of these measures due to the domestic floor to floor heights and finishes.
Passive ventilation.	Openable windows as means of overcoming overheating during summer hot days.
Mechanical ventilation.	Energy efficient mechanical ventilation with heat recovery to be provided to the commercial and new-built residential units.
Active cooling systems (ensuring they are the lowest carbon options).	For new-built residential element of the development natural ventilation with MVHR will be adopted and has been demonstrated as complying with TM59 criteria. For existing residential element of the development natural ventilation will be utilised together with the MEV for Part F compliance. Cooling is only proposed within the new-built superior apartments.

Table 7.4 Part L Building Regulations Applicable

SBEM & SAP calculations have been used to check compliance with Building Regulations; summertime temperature. Current SBEM models confirm that the risk of overheating in non-residential spaces is considered to be within acceptable limits, these can be found in Appendix D.

The GLA's overheating checklist has been completed and can be found within the Overheating Report (ref: 6391-CBC-IC-RP-S-005-P01). Dynamic thermal modelling has been carried out for a typical residential floor layout to demonstrate compliance with CIBSE TM59 and Part O.

7.3 COOLING DEMAND

According to the GLA guidance on preparing energy assessments as part of planning applications (April 2020), for non-domestic buildings the actual cooling demand should be lower than the notional cooling demand. This has been demonstrated in table 7.6 below.

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	81.39	151,812
Notional	82.23	153,366

Table 7.6 Cooling Demand Comparison

7.4 BE SEEN

In March 2021, the new London Plan was introduced, in which a new element was added to the energy hierarchy: Be Seen. The document states "A requirement for all major development to 'be seen' i.e. to monitor and report its energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target. The process to be followed as part of the 'be seen' post construction monitoring requirement is another critical element of the energy hierarchy that will play an important role in keeping running costs low."

Appropriate quality assurance mechanisms and commitments that should be considered as part of the energy strategy include:

- Gaining quality assurance accreditation (e.g. Heat Trust)
- Following quality standards (e.g. CIBSE Code of Practice)
- Transparent billing, including separation of the ongoing maintenance and capital replacement aspects of the standing charge.
- Aftercare support (e.g. BREEAM Man 05 Aftercare)
- Heat tariffs options given to occupants
- Consumer choice for metering arrangements at no extra cost (e.g. Prepayment Meters (PPM))
- Thermal storage linked to pricing signals and renewable generation

Therefore, it is anticipated that post communication monitoring will be undertaken.

8 RENEWABLE ENERGY

The use of renewable and low or zero carbon (LZC) technologies within the development has been addressed and the following, Table 8.1, reviews the primary options for generation of on-site renewable / LZC energy and considers their suitability for use on the development.

<table>
<tr><th colspan="2">Renewable Technology Feasibility Assessment</th><th>Feasible?</th></tr>
<tr><td>Bio Fuel Boilers
</td><td>Bio-fuel boilers are specifically designed to burn solid biomass or liquid bio-fuel in order to heat water, or raise steam. This can then be used for space heating or Domestic Hot Water (DHW) supply. Bio-fuel boilers could potentially provide the annual space heating and DHW demand for the Units, however they are not recommended for this development for the following reasons:-
1. Biomass boilers generate increased Oxides of Nitrogen (NOx) and particulates (PM10) which would affect air quality.
2. The storage requirements for the biofuel would require a large plant space, with an auxiliary storage facility to allow for a two week period where delivery of fuel might not be available.</td><td rowspan="2">No</td></tr>
<tr><td colspan="2"><u>Land Use</u>
Large volumes of storage is required for fuel at ground level or basement level with sufficient vehicular access for fuel delivered.
<u>Noise</u>
Noise levels are generated by the operation of the bio-fuel boiler and associated deliveries of the bio-fuel. The plant room enclosure will have to be attenuated to acceptable levels imposed by planning and Acoustician recommendations.</td></tr>
</table>

Renewable Technology Feasibility Assessment		Feasible?
Wind Turbines 	Wind turbines convert the kinetic energy in the wind into mechanical energy which is then converted into electricity. Wind turbines can provide electrical power either directly to a load or via a battery system. The use of wind turbines is not recommended for this development for the following reasons:- 1. Wind turbines, of a size necessary to make a contribution to the Units' renewable energy requirements are considered inappropriate on spatial, planning, aesthetic and noise grounds. Noise pollution from commercial wind turbines can be quiet significant within a few hundred metres. 2. The site is not ideal; an ideal site is a hill with a flat, clear exposure. It should be free from strong turbulence and obstructions like large trees, houses or other buildings. As the development is surrounded by industrial buildings, turbulent wind flow will be experienced across the site which is not ideal for wind turbine installations. 3. The financial viability of a small scale installation on the site would be compromised by the operational efficiency of the units (circa 30%). 4. Wind turbines, can cause electrical interference within a 2km radius. 5. Finally, the main disadvantage is down to the winds unreliability factor. The wind strength is often too low in many areas, where this site is located the wind speed is 4.5 m/s at 10m, as can be seen in the wind map presented in Appendix C, in order for the wind turbines to be feasible, wind speeds of greater than 5.5m/s are required.	No
<u>Land Use</u> There would be an adverse visual impact on the site which will be dependent on the height at which the wind turbines are located. <u>Noise</u> Noise levels are generated by the rotating blades; these noise levels will vary dependent on wind velocity and will need to be in acceptable levels imposed by planning and Acoustician recommendations.		
Ground Source Heat Pumps 	Space cooling and heating can be provided by circulating water cooled or heated directly by the ground or via subterranean water. Ground water cooling and heating through the use of aquifers makes use of the relatively stable ground/ water temperature which is available at a temperature range of 10 – 14°C. The use of Ground Source Heat Pumps is recommended for this development for the following reasons:- 1. Favourable ground conditions for the GSHP. 2. The site area meet requirements due to ground conditions for the installation of GSHP. 3. This GSHP does not affect water quality and the amount that can be extracted.	Yes
<u>Land Use</u> This installation would require Environmental Agency approval. Ground and Hydrology analysis would be required to investigate if favourable conditions exist. <u>Noise</u>		

Renewable Technology Feasibility Assessment		Feasible?
There are no noise issues generated by this technology.		
Solar Water Heating 	Solar Water Heating systems use radiant energy from the sun to heat water. Systems comprise of a roof mounted heat collector piped to a coil located within a hot water storage cylinder. The use of Solar Panels are not recommended for this development for the following reasons: 1. The roof area is better utilised for the provision of PV Panels.	No
<u>Land Use</u> Roof space is better served for the installation of Photovoltaic panels. <u>Noise</u> Noise levels are generated by pumps at roof level, these are insignificant so should pose no issues.		
Air Source Heat Pumps 	An Air Source Heat Pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C and typically draws approximately a quarter to a third of the electricity of a standard resistance heater for the same amount of heating, reducing utility bills. This typical efficiency compares to 70-95% for a fossil-fuel powered boiler. Air Source Heat Pump has been incorporated in the development to provide heating as well as cooling to the commercial spaces within Block E and F.	Yes
<u>Land Use</u> Air Source Heat Pumps can be installed on ground mounted, roof mounted or wall mounted frames. When installing Air Source Heat Pumps there are various factors to consider; Heat Pumps should be positioned to provide shelter from high winds which can reduce efficiency by causing defrost problems. <u>Noise</u> Noise levels are generated by fans, and compressors causing vibrations. The noise levels are dependent on manufacturer and vary accordingly, these will need to be in acceptable levels imposed by planning and Acousticians recommendations.		
Photovoltaics 	Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases silicon. A 39 kWp photovoltaic array is proposed for the Block F of development. They have the following advantages for use on this development; 1. Photovoltaic panels can be situated at roof level, east facing, to provide a source of renewable energy. 2. Panels can be grid connected to sell surplus electricity produced. 3. Low maintenance issues. 4. Visual use of renewable energy can be seen by general public.	Yes

Renewable Technology Feasibility Assessment	Feasible?
Land Use There are no land issues or adverse visual impacts as the photovoltaic panels are roof mounted. Noise There are no noise issues generated by this technology.	

Table 8.1 Renewable Technology Feasibility Assessment

8.2 ENERGY COST

Within the energy strategy, one of the key consideration was to keep the estimated cost of energy to occupants as low as possible. Energy efficiency and passive measures were taken to reduce the energy demand of all apartments. To maintain the quality assurance mechanism for the occupants, many measures were incorporated within the development such as:

- Following CIBSE Code of Practice
- Transparent billing so occupants are not over billed
- Occupant will also be able to have metering arrangements like prepayment meters at no extra cost

9 DECENTRALISED ENERGY

Decentralised energy refers to energy that is generated off the main grid, which may include microrenewables, heating and cooling. It can refer to energy from waste plants, combined heat and power, district heating and cooling, as well as geothermal, biomass or solar energy. Decentralised Energy schemes can serve a single building or a whole community, even being built out across entire cities.

In line with the Draft London Plan, Policy SI3 Energy infrastructure, major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system that adheres to the following:

The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

1. Connect to local or existing planned heat networks
    a. Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
    b. 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)
    c. Use ultra-low NOx gas boilers
2. CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy Sl 1. Where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

9.1 EXISTING DISTRICT HEATING NETWORK

Existing District Heating Networks have been investigated through the UK CHP Development Map which confirms there is no district heating network to which a connection is technically feasible (as shown in Appendix C). Contact has been made with the local council to enquire about connection to an existing district heating network and it has been confirmed that no connection is available for the development.

9.2 SITE WIDE HEAT NETWORK

The use of Air Source Heat Pumps (ASHP) and GSHP is proposed in a communal heat network which will provide heating and hot water for the residential units, and heating for the commercial element. A future connection to an external district heating network shall be provided from the plant rooms of each building (shown in appendix F).

10 SUMMARY OF PROPOSED SCHEME

Consideration has been given in Sections 8.0 of this document to the options that are available for the development in relation to Low Zero Carbon technologies and renewable energy. Not all options were feasible for inclusion. The technologies proposed are as follows:

1. Passive Design and Energy Efficient Measures
2. Air Source Heat Pumps and Ground Source Heat Pump
3. Photovoltaics

This review has resulted in the formulation of an Energy Strategy to be adopted for the development involving the installation of GSHP, ASHP and PV. The following Tables 10.1 and 10.2 highlight the carbon emissions and savings that are currently anticipated for the development. Based on the analysis within this report, it is confirmed that the development targets compliance with Part L 2021, The London Plan 2021 and the GLA's energy assessment guidance (2020). The following Tables 10.1 and 10.2 highlight the carbon and savings that are currently anticipated for the overall development from a base Part L 2013 compliant build.

	Carbon Dioxide Emissions (Tonnes CO_2 per annum)	
	Regulated	Unreguled
Baseline: Part L 2021 of the Building Regulations Compliant Development	87.4	43.7
After Energy Demand Reduction	68.8	It is anticipated that a circa 3% saving can be achieved through the use of energy efficient equipment, for example A or A+ appliances. This would reduce theunregulated carbon emissions to: 42.4
After Renewable Energy	38.2	

Table 10.1 Carbon Dioxide Emissions

	Regulated Carbon Dioxide Savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	18.6	21
Savings from Renewable Energy	30.6	35
Total Cumulative Savings	49.2	56
Total Target Savings	30.59	35.00%
Policy Exceedance	18.61	21%

Table 10.2 Regulated Carbon Savings

10.1 SAP 10 CARBON FACTOR CONSIDERATION

As of January 2019, the GLAs energy assessment guidance encourages planning applications to utilise the updated (SAP 10) carbon emission factor in order to assess the expected carbon performance of new developments. The updated carbon factor reflects the decarbonisation of grid electricity through an increase in electricity generation from renewable and low carbon technologies. The updated SAP 10 carbon emission factor from the previous SAP 2012 factors are highlighted in Table 10.3 below.

Fuel Type	Fuel Carbon Factor (KgCO_2/kWh)	
	SAP 2012	SAP 10
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

Table 10.3 Carbon Factors

10.2 CARBON CASH-IN-LIEU CONTRIBUTION

As a result of the zero-carbon target having not been achieved in line with The London Plan Policy SI 2, the cash in lieu contribution requirement has been calculated and displayed below in Table 10.4. Assuming a carbon off-set price of £95 per tonne of carbon dioxide for a period of 30 years,the contribution for offsite renewable solutions is displayed below in Table 10.4.

Development	Annual Shortfall Tonnes CO_2 per Annum	Carbon Off-set Contribution (£)
Baseline: Part L 2021 of the Building Regulations Compliant Development	38.2	£108,945

Table 10.4 Calculated Carbon Shortfall and Cash in Lieu Contribution

The London Plan requires all major developments to achieve a minimum on-site carbon reduction of 35% beyond Part L 2021 with a target of net-zero carbon. The overall development has an anticipated on-site CO_2 improvement of 56% beyond Part L 2021. The net-zero carbon shortfall will be met via cash-in-lieu contribution.

11 APPENDICES

APPENDIX A ENERGY AND CARBON CALCULATIONS

Residential Carbon Calculations:

RESIDENTIAL CO_2 ANALYSIS (PART L1)

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²) (Row 4)	Number of units	Total area represented by model (m²)	Baseline: TER ($kgCO_2/m^2$) (Row 273)	Baseline: Energy saving/generation technologies (-) ($kgCO_2$ p.a.) (Row 269)	'Be Lean': DER ($kgCO_2/m^2$) (Row 273 or 384)	'Be Clean': DER ($kgCO_2/m^2$) (Row 273 or 384)	'Be Green': DER ($kgCO_2/m^2$) (Row 273 or 384)	Fabric Energy Efficiency (FEE): Target Fabric Energy Efficiency (kWh/m²)	Fabric Energy Efficiency (FEE): Dwelling Fabric Energy Efficiency (kWh/m²)
NEW BUILD APARTMENTS										
Block B: TF-A1-S	126	2	252	10.92	-161.53	10.49	10.49	3.33	35.64	35.32
Block B: TF-A2-N	87	4	348	12.07	-111.60	11.38	11.38	4.60	32.15	27.92
Block C: 5F.A1.V	152	1	152	9.69	-243.32	9.33	9.33	3.10	35.34	33.95
Block D: 3F.A2.S	94	4	376	11.98	-120.67	10.17	10.17	1.74	34.20	32.07
Block D: 3F.A3.N	65	3	195	14.31	-83.41	12.15	12.15	1.82	37.29	34.56
Block D: 4F.A1.N	134	2	268	12.16	-171.77	11.47	11.47	3.22	41.81	34.44
Block E: GF.1A.N	75	2	150	15.38	-120.19	13.08	13.08	3.81	45.56	43.63
Block E: GF.3A.S	50	1	50	14.36	-128.19	12.20	12.20	3.48	42.43	37.80
Block E: 1F.1A.N	75	3	225	13.21	-120.19	11.22	11.22	3.21	35.79	32.85
Block E: 1F.3A.S	81	4	324	11.33	-129.79	9.60	9.60	2.91	29.12	25.68
Block E: 1F.4A.N	116	2	232	12.40	-185.76	10.52	10.52	3.06	41.41	38.43
Block E: 2F.3A.S	54	2	108	13.30	-86.56	11.31	11.31	3.40	28.39	26.45
Block E: 2F.4A.S	78	1	78	11.84	-123.39	10.07	10.07	3.00	30.35	27.00
Block E: 2F.5A.N	77	1	77	13.89	-124.99	11.83	11.83	3.50	39.65	38.68
Block E: 4F.1A.N	75	1	75	14.84	-120.19	12.61	12.61	3.74	43.12	41.52
Block E: 4F.3A.S	54	2	108	16.13	-86.56	13.71	13.71	3.90	40.73	38.31
Block E: 4F.4A.S	78	1	78	13.15	-128.19	11.18	11.18	3.38	37.22	36.09
Block E: 4F.5A.N	77	1	77	15.09	-124.99	12.82	12.82	3.95	45.01	46.80
EXISTING APARTMENTS										
Block B: GF.A1.S	54	2	108	0.16	0.00	0.15	0.15	0.06	0.00	0.00
Block B: GF.A2.S	131	2	262	0.36	0.00	0.31	0.31	0.12	0.00	0.00
Block B: GF.A3.E	84	4	336	0.26	0.00	0.23	0.23	0.09	0.00	0.00
Block B: GF.A7.N	95	1	95	0.33	0.00	0.27	0.27	0.10	0.00	0.00
Block B: GF.A11.	113	4	452	0.33	0.00	0.27	0.27	0.11	0.00	0.00
Block B: GF.A5.W	126	2	252	0.40	0.00	0.30	0.30	0.12	0.00	0.00
Block B: GF.A8.E	59	2	118	0.23	0.00	0.18	0.18	0.07	0.00	0.00
Block B: 1F.A1.E	147	5	735	0.33	0.00	0.27	0.27	0.11	0.00	0.00
Block B: 1F.A2.W	158	3	474	3.90	0.00	2.64	2.64	0.75	0.00	0.00
Block B: 1F.A4.N	91	18	1638	0.27	0.00	0.22	0.22	0.09	0.00	0.00
Block B: 1F.A5.S	98	6	588	0.23	0.00	0.18	0.18	0.08	0.00	0.00
Block B: 2F.A3.E	82	8	656	0.22	0.00	0.17	0.17	0.07	0.00	0.00
Block B: 3F.A2.S	133	6	798	3.92	0.00	2.87	2.87	0.81	0.00	0.00
			0							
Block C: FF.A1.W	94	2	188	0.25	0.00	0.22	0.22	0.09	0.00	0.00
Block C: 3F.A1.W	94	5	470	0.21	0.00	0.16	0.16	0.08	0.00	0.00
Block C: 4F.A2.E	82	2	164	0.20	0.00	0.15	0.15	0.06	0.00	0.00
Block D: GF.A1.S	48	2	96	0.14	0.00	0.12	0.12	0.05	0.00	0.00
Block D: GF.A3.W	86	2	172	0.26	0.00	0.22	0.22	0.09	0.00	0.00
Block D: GF.A5.N	44	4	176	0.17	0.00	0.15	0.15	0.05	0.00	0.00
Block D: GF.A9.S	61	2	122	0.18	0.00	0.16	0.16	0.06	0.00	0.00
Block D: 1F.A1.S	99	6	594	0.23	0.00	0.18	0.18	0.08	0.00	0.00
Block D: 1F.A2.S	65	2	130	0.17	0.00	0.14	0.14	0.06	0.00	0.00
Block D: 1F.A4.N	63	12	756	0.16	0.00	0.14	0.14	0.06	0.00	0.00
Sum		139	12,583	3.8	-34.3	3.2	3.2	0.9	9.3	8.6

Unit identifier	Baseline: Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	Baseline: Energy saving/generation technologies ($kgCO_2$ p.a.)	'Be Lean': Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	'Be Lean': Part L 2021 CO_2 emissions with Notional PV savings included ($kgCO_2$ p.a.)	'Be Lean' savings ($kgCO_2$ p.a.)	'Be Clean': Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	'Be Clean': Part L 2021 CO_2 emissions with Notional PV savings included ($kgCO_2$ p.a.)	'Be Clean' savings ($kgCO_2$ p.a.)	'Be Green': Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	'Be Green' savings ($kgCO_2$ p.a.)
NEW BUILD APARTMENTS										
Block B: TF-A1-S	2,752	-323	2,843	2,320	431	2,843	2,320	0	839	1,481
Block B: TF-A2-N	4,200	-446	3,960	3,514	687	3,960	3,514	0	1,601	1,913
Block C: 5F.A1.V	1,473	-243	1,418	1,175	298	1,418	1,175	0	471	704
Block D: 3F.A2.S	4,504	-482	3,824	3,342	1,163	3,824	3,342	0	654	2,687
Block D: 3F.A3.N	2,790	-250	2,369	2,119	671	2,369	2,119	0	355	1,764
Block D: 4F.A1.N	3,259	-344	3,074	2,730	528	3,074	2,730	0	863	1,867
Block E: GF.1A.N	2,307	-240	1,962	1,722	585	1,962	1,722	0	572	1,150
Block E: GF.3A.S	1,149	-128	976	848	301	976	848	0	278	569
Block E: 1F.1A.N	2,972	-361	2,525	2,164	808	2,525	2,164	0	722	1,442
Block E: 1F.3A.S	3,671	-519	3,110	2,591	1,080	3,110	2,591	0	943	1,648
Block E: 1F.4A.N	2,877	-372	2,441	2,069	808	2,441	2,069	0	710	1,359
Block E: 2F.3A.S	1,436	-173	1,221	1,048	388	1,221	1,048	0	367	681
Block E: 2F.4A.S	924	-123	785	662	261	785	662	0	234	428
Block E: 2F.5A.N	1,070	-125	911	786	284	911	786	0	270	516
Block E: 4F.1A.N	1,113	-120	946	826	287	946	826	0	281	545
Block E: 4F.3A.S	1,742	-173	1,481	1,308	434	1,481	1,308	0	421	886
Block E: 4F.4A.S	1,026	-128	872	744	282	872	744	0	264	480
Block E: 4F.5A.N	1,162	-125	987	862	300	987	862	0	304	558
EXISTING APARTMENTS										
Block B: GF.A1.S	17	0	16	16	1	16	16	0	6	10
Block B: GF.A2.S	94	0	81	81	13	81	81	0	31	50
Block B: GF.A3.E	87	0	77	77	10	77	77	0	30	47
Block B: GF.A7.N	31	0	26	26	6	26	26	0	10	16
Block B: GF.A11.	149	0	122	122	27	122	122	0	50	72
Block B: GF.A5.W	101	0	76	76	25	76	76	0	30	45
Block B: GF.A8.E	27	0	21	21	6	21	21	0	8	13
Block B: 1F.A1.E	243	0	198	198	44	198	198	0	81	118
Block B: 1F.A2.W	1,849	0	1,251	1,251	597	1,251	1,251	0	356	896
Block B: 1F.A4.N	442	0	360	360	82	360	360	0	147	213
Block B: 1F.A5.S	135	0	106	106	29	106	106	0	47	59
Block B: 2F.A3.E	144	0	112	112	33	112	112	0	46	66
Block B: 3F.A2.S	3,128	0	2,290	2,290	838	2,290	2,290	0	646	1,644
Block C: FF.A1.W	47	0	41	41	6	41	41	0	17	24
Block C: 3F.A1.W	99	0	75	75	24	75	75	0	38	38
Block C: 4F.A2.E	33	0	25	25	8	25	25	0	10	15
Block D: GF.A1.S	13	0	12	12	2	12	12	0	5	7
Block D: GF.A3.W	45	0	38	38	7	38	38	0	15	22
Block D: GF.A5.N	30	0	26	26	4	26	26	0	9	18
Block D: GF.A9.S	22	0	20	20	2	20	20	0	7	12
Block D: 1F.A1.S	137	0	107	107	30	107	107	0	48	59
Block D: 1F.A2.S	22	0	18	18	4	18	18	0	8	10
Block D: 1F.A4.N	121	0	106	106	15	106	106	0	45	60
Sum	47,444	-4,677	40,710	36,034	11,410	40,710	36,034	0	11,839	24,195

Non-Residential Carbon Calculations:

NON-RESIDENTIAL CO_2 ANALYSIS (PART L2)

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	Baseline: BRUKL TER ($kgCO_2/m^2$)	Baseline: BRUKL Displaced electricity (-) (kWh / m²)	'Be Lean': BRUKL BER ($kgCO_2/m^2$)	'Be Clean': BRUKL BER ($kgCO_2/m^2$)	'Be Green': BRUKL BER ($kgCO_2/m^2$)
Block A	1155	1	1155	11.43		9.88	9.88	7.33
Block C	555	1	555	12.08		6.81	6.81	4.60
Block F	3242	1	3242	5.97		5.28	5.28	4.63
Sum		3	5,012	8.0	0.0	6.5	6.5	5.3
SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS								
Total Sum			17,595	-	-	-	-	-

Building Use	Baseline: Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	Baseline: Energy saving/generation technologies ($kgCO_2$ p.a.)	'Be Lean': Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	'Be Lean': Part L 2021 CO_2 emissions with Notional PV savings included ($kgCO_2$ p.a.)	'Be Lean' savings ($kgCO_2$ p.a.)	'Be Clean': Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	'Be Clean': Part L 2021 CO_2 emissions with Notional PV savings included ($kgCO_2$ p.a.)	'Be Clean' savings ($kgCO_2$ p.a.)	'Be Green': Part L 2021 CO_2 emissions ($kgCO_2$ p.a.)	'Be Green' savings ($kgCO_2$ p.a.)
Block A	13,545	0.00	11,707.80	11,708	1,837	11,708	11,708	0	8,686	3,022
Block C	7,067	0.00	3,983.85	3,984	3,083	3,984	3,984	0	2,691	1,293
Block F	19,355	0.00	17,117.76	17,118	2,237	17,118	17,118	0	15,010	2,107
Sum	39,966	0	32,809	32,809	7,157	32,809	32,809	0	26,388	6,422
SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS										
Total Sum	87,410	-4,677	73,520	68,843	18,566	73,520	68,843	0	38,226	30,617

Carbon Savings:

Part L 2021 Performance

Residential

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

	Carbon Dioxide Emissions for residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	47.4	
After energy demand reduction (be lean)	36.0	
After heat network connection (be clean)	36.0	
After renewable energy (be green)	11.8	

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for residential buildings

	Regulated residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	11.4	24%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	24.2	51%
Cumulative on site savings	**35.6**	**75%**
Annual savings from off-set payment	11.8	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**355**	-
Cash in-lieu contribution (£)	**33,741**	

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

Non-residential

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

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	40.0	
After energy demand reduction (be lean)	32.8	
After heat network connection (be clean)	32.8	
After renewable energy (be green)	26.4	

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-residential buildings

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	7.2	18%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	6.4	16%
Total Cumulative Savings	**13.6**	**34%**
Annual savings from off-set payment	26.4	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**792**	-
Cash in-lieu contribution (£)	**75,204**	

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

Overall Site Carbon Results:

SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	87.4		
Be lean	68.8	18.6	21%
Be clean	68.8	0.0	0%
Be green	38.2	30.6	35%
Total Savings	-	49.2	56%
	-	CO_2 savings off-set (Tonnes CO_2)	-
Off-set	-	**1,146.8**	-

Residential Blocks Baseline Energy Results:

kWh/annum Baseline														
Typical Unit	Area m²	Quantity	Total Area m²	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
					TER Worksheet	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	DER Sheet Row 315	DER Sheet (Row 313 + 331)	DER Sheet Row 332	DER Sheet [(Row 310a) ÷ (Row 367a x 0.01)]			
Block B: GF.A1.S	54	2	108	0.16	0.16	71303.065	0	71.3031	188.7311	34925.633	212977.4644	160	0.16
Block B: GF.A2.SE	131	2	262	0.36	0.36	197381.969	0	197.382	400.788	43117.269	482194.816	360	0.36
Block B: GF.A3.E	84	4	336	0.26	0.26	135756.117	0	135.7561	296.9264	40386.965	706303.058	260	0.26
Block B: GF.A7.N	95	1	95	0.33	0.33	187058.093	0	187.0581	314.0695	41543.147	229102.3676	330	0.33
Block B: GF.A11.S	113	4	452	0.33	0.33	178442.291	0	178.4423	351.3307	42281.392	885013.824	330	0.33
Block B: GF.A5.W	126	2	252	0.40	0.40	233846.154	0	233.8462	359.7543	42673.301	554226.111	400	0.40
Block B: GF.A8.E	59	2	118	0.23	0.23	116837.916	0	116.8379	255.2824	36017.468	306455.0086	230	0.23
Block B: 1F.A1.E	147	5	735	0.33	0.33	168111.913	0	168.1119	419.4315	43356.808	1060281.322	330	0.33
Block B: 1F.A2.W	158	3	474	3.90	3.90	206332.857	35.4576	206.3329	423.3859	43482.218	751440.7542	3900	3.90
Block B: 1F.A4.N	91	18	1638	0.27	0.27	142703.788	0	142.7038	295.2045	41174.689	3317694.935	270	0.27
Block B: 1F.A5.S	98	6	588	0.23	0.23	107129.345	0	107.1293	332.4536	41784.15	896118.4674	230	0.23
Block B: 2F.A3.E	82	8	656	0.22	0.22	101129.83	0	101.1298	275.7719	40126.254	1133063.886	220	0.22
Block B: 3F.A2.S	133	6	798	3.92	3.92	208728.908	4.5273	208.7289	493.9806	43153.609	1515538.523	3920	3.92
Block B: TF-A1-S	126	2	252	10.92	10.92	62733.029	223.6214	125.4661	331.9929	21507.0355	169842.2898	2751.84	2.75
Block B: TF-A2-N	87	4	348	12.07	12.07	43435.47351	82.1487	80.3556	262.446	22025.86757	263545.1655	4200.36	4.20
			0										
Block C: 5F.A1.W	152	1	152	9.69	9.69	7103.339065	84.8683	152.0115	367.0158	2012.859813	9720.094479	1472.88	1.47
Block C: FF.A1.W	94	2	188	0.25	0.25	11944.7235	0	119.4472	345.4011	4111.5475	33042.2386	250	0.25
Block C: SF.A1.W	94	5	470	0.21	0.21	8593.5126	0	85.9351	345.4011	4111.5475	65681.9815	210	0.21
Block C: 4F.A2.E	82	2	164	0.20	0.20	9088.3017	0	90.883	270.2658	3978.5483	26855.9976	200	0.20
			0										
Block D: GF.A1.S	48	2	96	0.14	0.14	55065.685	0	55.0657	198.1547	33597.949	177833.7088	140	0.14
Block D: GF.A3.W	86	2	172	0.26	0.26	133863.303	0	133.8633	294.0927	40631.529	349845.576	260	0.26
Block D: GF.A5.N	44	4	176	0.17	0.17	84371.092	0	84.3711	162.9324	32732.007	469401.61	170	0.17
Block D: GF.A9.S	61	2	122	0.18	0.18	80047.942	0	80.0479	231.4514	36442.56	233604.0026	180	0.18
Block D: 1F.A1.SW	99	6	594	0.23	0.23	104039.661	0	104.0397	316.8392	41858.207	877912.4814	230	0.23
Block D: 1F.A2.S	65	2	130	0.17	0.17	70401.746	0	70.4017	239.3465	37263.23	215949.4484	170	0.17
Block D: 1F.A4.N	63	12	756	0.16	0.16	63355.15	0	63.3551	251.2715	36858.324	1206337.207	160	0.16
Block D: 3F.A2.S	94	4	376	11.98	11.98	67326.69039	0	94.59	277.4	29506.19217	388819.4902	4504.48	4.50
Block D: 3F.A3.N	65	3	195	14.31	14.31	49942.62295	0	60.93	207.99	30543.60656	242265.4485	2790.45	2.79
Block D: 4F.A1.N	134	2	268	12.16	12.16	7797.948686	23.2994	136.4641	343.3145	2466.907771	21535.86891	3258.88	3.26
			0										
Block E: GF.1A.N	75	2	150	15.38	15.38	4393.846154	0	327.33	231.71	2759.230769	15424.23385	2307	2.31
Block E: GF.3A.S	80	1	80	14.36	14.36	4481.43666	0	351.55	244.27	2587.402689	7664.659349	1148.8	1.15
Block E: 1F.1A.N	75	3	225	13.21	13.21	3315.433071	0	312.32	275.7305	40386.965	132871.3457	2972.25	2.97
Block E: 1F.3A.S	81	4	324	11.33	11.33	3544.464567	0	336.84	291.9399	41543.147	182865.5659	3670.92	3.67
Block E: 1F.4A.N	116	2	232	12.40	12.40	6225.070064	0	515.67	326.9684	42281.392	98698.20093	2876.8	2.88
Block E: 2F.3A.S	54	2	108	13.30	13.30	2209.427586	0	226.59	335.0259	42673.301	90888.68897	1436.4	1.44
Block E: 2F.4A.S	78	1	78	11.84	11.84	3193.890323	0	326.93	236.1871	36017.468	39774.47542	923.52	0.92
Block E: 2F.5A.N	77	1	77	13.89	13.89	4294.851613	0	347.59	390.9158	43356.808	48390.16541	1069.53	1.07
Block E:4F.1A.N	75	1	75	14.84	14.84	4198.56391	0	326.05	394.7336	43482.218	48401.56551	1113	1.11
Block E: 4F.3A.S	54	2	108	16.13	16.13	3161.333333	0	239.6	274.3128	41174.689	89699.87027	1742.04	1.74
Block E: 4F.4A.S	78	1	78	13.15	13.15	3998.824701	0	348.45	309.1003	41784.15	46440.525	1025.7	1.03
Block E: 4F.5A.N	77	1	77	15.09	15.09	4871.783148	0	355.61	256.0323	40126.254	45609.67945	1161.93	1.16
Total	**3685**	**139**	**12583**								**17,649,332.12**	**53,336.78**	**53.34**

Residential Blocks Passive Energy Results

kWh/annum Baseline + Passive/Energy Efficiency Measures													
Typical Unit	Area m²	Quantity	Total Area m²	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
					TER Worksheet	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	DER Sheet Row 315	DER Sheet (Row 313 + 331)	DER Sheet Row 332	DER Sheet [(Row 310a) ÷ (Row 367a x 0.01)]			
Block B: GF.A1.S	54	2	108	0.15	0.16	62538.844	0	62.5388	183.8822	34925.633	195421.796	150.00	0.15
Block B: GF.A2.SE	131	2	262	0.31	0.36	162926.458	0	162.9265	373.3196	43117.269	413159.9462	310.00	0.31
Block B: GF.A3.E	84	4	336	0.23	0.26	111222.694	0	111.2227	275.7305	40386.965	607986.4488	230.00	0.23
Block B: GF.A7.N	95	1	95	0.27	0.33	142882.651	0	142.8827	291.9399	41543.147	184860.6206	270.00	0.27
Block B: GF.A11.S	113	4	452	0.27	0.33	139061.366	0	139.0614	326.9684	42281.392	727235.1512	270.00	0.27
Block B: GF.A5.W	126	2	252	0.30	0.40	159924.996	0	159.925	335.0259	42673.301	406186.4958	300.00	0.30
Block B: GF.A8.E	59	2	118	0.18	0.23	84236.169	0	84.2362	236.1871	36017.468	241148.1206	180.00	0.18
Block B: 1F.A1.E	147	5	735	0.27	0.33	126047.631	0	126.0476	390.9158	43356.808	849607.012	270.00	0.27
Block B: 1F.A2.W	158	3	474	2.64	3.90	125542.458	36.0372	125.5425	394.7336	43482.218	508742.9679	2640.00	2.64
Block B: 1F.A4.N	91	18	1638	0.22	0.27	102390.577	0	102.3906	274.3128	41174.689	2590955.449	220.00	0.22
Block B: 1F.A5.S	98	6	588	0.18	0.23	70291.667	0	70.2917	309.1003	41784.15	674731.254	180.00	0.18
Block B: 2F.A3.E	82	8	656	0.17	0.22	69049.888	0	69.0499	256.0323	40126.254	876009.7936	170.00	0.17
Block B: 3F.A2.S	133	6	798	2.87	3.92	140597.816	4.7605	140.5978	460.1626	43153.609	1106141.675	2870.00	2.87
Block B: TF-A1-S	126	2	252	10.49	10.92	59330.596	226.9383	118.6612	331.9929	21507.0355	163030.4478	2643.48	2.64
Block B: TF-A2-N	87	4	348	11.38	12.07	39610.43946	84.8912	73.2793	262.446	22025.86757	248227.6941	3960.24	3.96
	0	0											
Block C: 5F.A1.W	152	1	152	9.33	9.69	6754.879673	86.6859	144.55	367.02	2012.859813	9365.995386	1418.16	1.42
Block C: FF.A1.W	94	2	188	0.22	0.25	10166.0733	0	101.6607	321.0381	4111.5475	29400.6392	220.00	0.22
Block C: SF.A1.W	94	5	470	0.16	0.21	5002.7867	0	50.0279	321.0381	4111.5475	47427.001	160.00	0.16
Block C: 4F.A2.E	82	2	164	0.15	0.20	4741.2381	0	47.4124	250.9203	3978.5483	18036.2382	150.00	0.15
	0	0											
Block D: GF.A1.S	48	2	96	0.12	0.14	44921.541	0	44.9215	182.8035	33597.949	157494.43	120.00	0.12
Block D: GF.A3.W	86	2	172	0.22	0.26	101408.347	0	101.4083	273.1537	40631.529	284828.876	220.00	0.22
Block D: GF.A5.N	44	4	176	0.15	0.17	67753.678	0	67.7537	150.0957	32732.007	402814.1376	150.00	0.15
Block D: GF.A9.S	61	2	122	0.16	0.18	62860.388	0	62.8604	214.2265	36442.56	199160.0698	160.00	0.16
Block D: 1F.A1.SW	99	6	594	0.18	0.23	65443.53	0	65.4435	294.6065	41858.207	645970.722	180.00	0.18
Block D: 1F.A2.S	65	2	130	0.14	0.17	48661.504	0	48.6615	221.6983	37263.23	172390.1876	140.00	0.14
Block D: 1F.A4.N	63	12	756	0.14	0.16	47098.974	0	47.099	232.6606	36858.324	1010844.691	140.00	0.14
Block D: 3F.A2.S	94	4	376	10.17	11.98	52185.2669	0	73.32	277.4	29506.04982	328168.1469	3823.92	3.82
Block D: 3F.A3.N	65	3	195	12.15	14.31	37431.55738	0	45.67	207.99	30543.60656	204686.4718	2369.25	2.37
Block D: 4F.A1.N	134	2	268	11.47	12.16	7203.217771	24.5597	126.06	343.31	2466.907771	20328.11049	3073.96	3.07
	0	0	0								0	0.00	0.00
Block E: GF.1A.N	75	2	150	13.08	15.38	3283.846154		312.9	231.71	2759.230769	13175.37385	1962.00	1.96
Block E: GF.3A.S	80	1	80	12.20	14.36	3368.011323		335.81	244.27	2587.402689	6535.494013	976.00	0.98
Block E: 1F.1A.N	75	3	225	11.22	13.21	2353.543307		300.09	231.71	2798.425197	17051.30551	2524.50	2.52
Block E: 1F.3A.S	81	4	324	9.60	11.33	2167.346939		323.7	246.7	2495.918367	20934.66122	3110.40	3.11
Block E: 1F.4A.N	116	2	232	10.52	12.40	4822.292994		493.61	315.2	2494.904459	16252.0149	2440.64	2.44
Block E: 2F.3A.S	54	2	108	11.31	13.30	1525.517241		216.67	172.27	2213.793103	8256.50069	1221.48	1.22
Block E: 2F.4A.S	78	1	78	10.07	11.84	2321.290323		313.4	236.82	2332.258065	5203.768387	785.46	0.79
Block E: 2F.5A.N	77	1	77	11.83	13.89	3261.290323		331.57	239.33	2341.935484	6174.125806	910.91	0.91
Block E:4F.1A.N	75	1	75	12.61	14.84	3118.045113		311.68	231.71	2696.766917	6358.20203	945.75	0.95
Block E: 4F.3A.S	54	2	108	13.71	16.13	2320		227.61	172.27	2252.631579	9945.023158	1480.68	1.48
Block E: 4F.4A.S	78	1	78	11.18	13.15	2984.727756		333.18	244.27	2426.958831	5989.136587	872.04	0.87
Block E: 4F.5A.N	77	1	77	12.82	15.09	3735.467015		338.21	239.33	2370.346179	6683.353194	987.14	0.99
Total	**284**	**5**	**12583**								**13,446,919.55**	**45,206.01**	**45.21**

Residential Blocks Be Green Energy Results:

kWh/annum Baseline + Passive/Energy Efficiency Measures + ASHP													
Typical Unit	Area m²	Quantity	Total Area m²	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
					TER Worksheet	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	DER Sheet Row 315	DER Sheet (Row 313 + 331)	DER Sheet Row 332	DER Sheet [(Row 310a) ÷ (Row 367a x 0.01)]			
Block B: GF.A1.S	54	2	108	0.06	0.16	10086.91032	0	62.5388	183.8822	5633.166613	31,933.00	60.00	0.06
Block B: GF.A2.SE	131	2	262	0.12	0.36	26278.46097	0	162.9265	373.3196	6954.398226	67,538.21	120.00	0.12
Block B: GF.A3.E	84	4	336	0.09	0.26	17939.14419	0	111.2227	275.7305	6514.026613	99,360.50	90.00	0.09
Block B: GF.A7.N	95	1	95	0.10	0.33	23045.58887	0	142.8827	291.9399	6700.507581	30,180.92	100.00	0.10
Block B: GF.A11.S	113	4	452	0.11	0.33	22429.25258	0	139.0614	326.9684	6819.579355	118,859.45	110.00	0.11
Block B: GF.A5.W	126	2	252	0.12	0.40	25794.35419	0	159.925	335.0259	6882.790484	66,344.19	120.00	0.12
Block B: GF.A8.E	59	2	118	0.07	0.23	13586.47887	0	84.2362	236.1871	5809.269032	39,432.34	70.00	0.07
Block B: 1F.A1.E	147	5	735	0.11	0.33	20330.26306	0	126.0476	390.9158	6993.033548	139,201.30	110.00	0.11
Block B: 1F.A2.W	158	3	474	0.75	3.90	32608.43065	36.0372	125.5425	394.7336	11294.0826	133,376.48	750.00	0.75
Block B: 1F.A4.N	91	18	1638	0.09	0.27	16514.60919	0	102.3906	274.3128	6641.078871	423,583.05	90.00	0.09
Block B: 1F.A5.S	98	6	588	0.08	0.23	11337.36565	0	70.2917	309.1003	6739.379032	110,736.82	80.00	0.08
Block B: 2F.A3.E	82	8	656	0.07	0.22	11137.07871	0	69.0499	256.0323	6471.976452	143,473.10	70.00	0.07
Block B: 3F.A2.S	133	6	798	0.81	3.92	36518.91325	4.7605	140.5978	460.1626	11208.72961	289,998.98	810.00	0.81
Block B: TF-A1-S	126	2	252	3.33	10.92	6119.462338	377.1089	488.4092	331.9929	11172.48597	36,978.92	839.16	0.84
Block B: TF-A2-N	87	4	348	4.60	12.07	6266.064935	144.3504	661.6686	262.446	10583.85844	71,673.55	1600.80	1.60
	0	0											
Block C: 5F.A1.W	152	1	152	3.10	9.60	893.6011948	307.9148	560.126	367.0158	1118.836364	3,247.49	471.20	0.47
Block C: FF.A1.W	94	2	188	0.09	0.25	1578.54379	0	97.8697	321.0381	663.1528226	5,321.21	90.00	0.09
Block C: SF.A1.W	94	5	470	0.08	0.21	1019.675694	0	63.2199	321.0381	663.1528226	10,335.43	80.00	0.08
Block C: 4F.A2.E	82	2	164	0.06	0.20	764.7158226	0	47.4124	250.9203	641.7013387	3,409.50	60.00	0.06
	0	0											
Block D: GF.A1.S	48	2	96	0.05	0.14	7245.409839	0	44.9215	182.8035	5419.024032	25,784.32	50.00	0.05
Block D: GF.A3.W	86	2	172	0.09	0.26	16356.185	0	101.4083	273.1537	6553.472419	46,568.44	90.00	0.09
Block D: GF.A5.N	44	4	176	0.05	0.17	10928.01258	0	67.7537	150.0957	5279.355968	65,700.87	50.00	0.05
Block D: GF.A9.S	61	2	122	0.06	0.18	10138.77226	0	62.8604	214.2265	5877.832258	32,587.38	60.00	0.06
Block D: 1F.A1.SW	99	6	594	0.08	0.23	10555.40806	0	65.4435	294.6065	6751.32371	106,000.69	80.00	0.08
Block D: 1F.A2.S	65	2	130	0.06	0.17	7848.629677	0	48.6615	221.6983	6010.198387	28,258.38	60.00	0.06
Block D: 1F.A4.N	63	12	756	0.06	0.16	7596.60871	0	47.099	232.6606	5944.890968	165,855.11	60.00	0.06
Block D: 3F.A2.S	94	4	376	1.74	11.98	580.4971129	0	744.7132	277.3982	668.6483871	9,085.03	654.24	0.65
Block D: 3F.A3.N	65	3	195	1.82	14.31	414.9675484	0	515.802	207.99	601.016129	5,219.33	354.90	0.35
Block D: 4F.A1.N	134	2	268	3.22	12.16	794.0783117	142.5801	545.534	343.31	1121.322078	5,893.65	862.96	0.86
	0	0											
Block E: GF.1A.N	75	2	150	3.81	15.38	532.748034	0	292.1601	231.7066	870.5471845	3,854.32	571.50	0.57
Block E: GF.3A.S	80	1	80	3.48	14.36	440.2617476	0	306.3638	244.272	887.3390777	1,878.24	278.40	0.28
Block E: 1F.1A.N	75	3	225	3.21	13.21	262.9337621	0	281.0438	231.7066	862.6699029	4,915.06	722.25	0.72
Block E: 1F.3A.S	81	4	324	2.91	11.33	173.3566748	0	298.9701	246.6987	890.4266019	6,437.81	942.84	0.94
Block E: 1F.4A.N	116	2	232	3.06	12.40	680.6818932	0	445.9703	315.2165	950.6707282	4,785.08	709.92	0.71
Block E: 2F.3A.S	54	2	108	3.40	13.30	103.6225	0	198.8211	172.2663	779.2169903	2,507.85	367.20	0.37
Block E: 2F.4A.S	78	1	78	3.00	11.84	179.5092476	0	284.8124	236.8185	877.533835	1,578.67	234.00	0.23
Block E: 2F.5A.N	77	1	77	3.50	13.89	424.6889563	0	17.4972	239.3318	880.8925971	1,562.41	269.50	0.27
Block E:4F.1A.N	75	1	75	3.74	14.84	501.4691262	0	290.8714	231.7066	870.5471845	1,894.59	280.50	0.28
Block E: 4F.3A.S	54	2	108	3.90	16.13	270.6410922	0	205.7023	172.2663	779.2169903	2,855.65	421.20	0.42
Block E: 4F.4A.S	78	1	78	3.38	13.15	391.1783738	0	304.3415	244.272	887.3390777	1,827.13	263.64	0.26
Block E: 4F.5A.N	77	1	77	3.95	15.09	640.9874757	0	307.4281	239.3318	880.8925971	2,068.64	304.15	0.30
Total	3685	139	12583								2,352,103.10	13,408.36	13.41

Non-Residential Baseline Results:

	Baseline					
Block Name	Area (m2)	Energy consumption [kWh/m2]	Energy consumption (kWh)	CO2 Emission (KgCO2/m2.annum)	CO2 Emission (KgCO2.annum)	CO2 Emission (Tonns CO2.annum)
Block A	1,185.00	80.13	94,954.05	11.43	13,544.55	13.54
Block C	585.00	87.62	51,257.70	12.08	7,066.80	7.07
Block F	3,242.00	41.28	133,829.76	5.97	19,354.74	19.35
Total			280,041.51			39.97

Non-Residential Passive Results:

	Passive					
Block Name	Area (m2)	Energy consumption [kWh/m2]	Energy consumption (kWh)	CO2 Emission (KgCO2/m2.annum)	CO2 Emission (KgCO2.annum)	CO2 Emission (Tonns CO2.annum)
Block A	1,185.00	68.90	81,646.50	9.88	11,707.80	11.71
Block C	585.00	49.60	29,016.00	6.81	3,983.85	3.98
Block F	3,242.00	36.30	117,684.60	5.28	17,117.76	17.12
Total			228,347.10			32.81

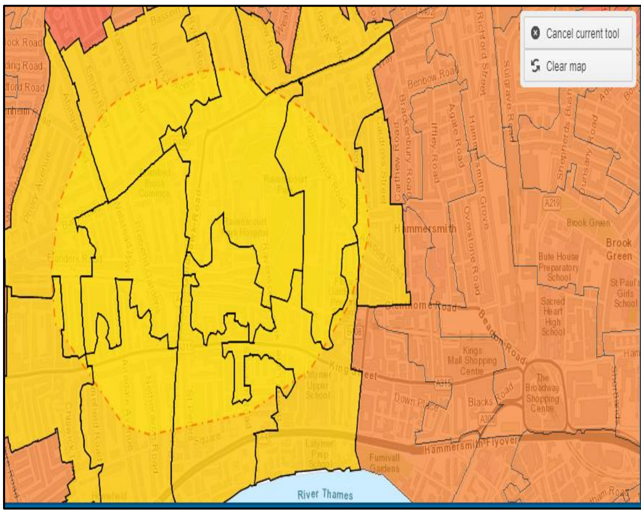
Non-Residential Be Green Results:

	Be Green					
Block Name	Area (m2)	Energy consumption [kWh/m2]	Energy consumption (kWh)	CO2 Emission (KgCO2/m2.annum)	CO2 Emission (KgCO2.annum)	CO2 Emission (Tonns CO2.annum)
Block A	1,185.00	51.87	61,465.95	7.33	8,686.05	8.69
Block C	585.00	33.57	19,638.45	4.60	2,691.00	2.69
Block F	3,242.00	31.69	102,738.98	4.63	15,010.46	15.01
Total			183,843.38			26.39

APPENDIX B WIND DATA

Wind Velocity Chart for the Development

APPENDIX C CHP AVAILABILITY



Sector Totals | Large Heat Load Sites (0)

The table below shows the sector totals within your search area.

Sector Name	Share	Total MWh
Communications and Transport	0.88%	933 MWh
Commercial Offices	4.71%	4,976 MWh
Domestic	90.97%	96,183 MWh
Education	1.12%	1,182 MWh
Government Buildings	0.02%	21 MWh
Hotels	0.77%	818 MWh
Large Industrial	0%	0 MWh
Health	0.14%	146 MWh
Other	0.13%	134 MWh
Small Industrial	0.35%	371 MWh
Prisons	0%	0 MWh
Retail	0.86%	907 MWh
Sport and Leisure	0.04%	39 MWh
Warehouses	0.02%	18 MWh
District Heating	0%	0 MWh
Total heat load in Area		105,728 MWh

CHP Availability Search

APPENDIX D SAMPLE BRUKL REPORTS

BRUKL Output Document

Compliance with England Building Regulations Part L 2021

Project name

Block F-Be Green

As designed

Date: Fri Oct 13 10:13:47 2023

Administrative information

Building Details

Address:

Certifier details

Name:

Telephone number: 01344 628821

Address: Cudd Bentley, Ashurst Manor, Sunninghill, SL5 7DD

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.d.0

Interface to calculation engine: Energy Simulator

Interface to calculation engine version: 10.10.0.199

BRUKL compliance module version: v6.1.d.0

Foundation area [m²]: 532

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	5.98	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	4.63	
Target primary energy rate (TPER), $kWh/m^2.annum$	64.1	
Building primary energy rate (BPER), $kWh/m^2.annum$	48.86	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.16	0.16	Wall 1
Floors	0.18	0.15	0.15	Internal Floor 1
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	0.15	0.15	Exposed Roof 1
Windows** and roof windows	1.6	1.4	1.4	Window 1
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	-	-	No external personnel doors
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

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

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

Building services

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

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

1- Bed

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.3	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

2- Circulation

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

3- Lounge

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.3	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

4- Office/recption

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.3	6.2	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- Default DHW

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

Zone-level mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
1F.BED1	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED10	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED11	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED12	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED13	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED14	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED15	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED16	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED17	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED18	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED2	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED3	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED4	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED5	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED6	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED7	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED8	-	-	-	-	0.9	-	-	-	-	0.8	N/A
1F.BED9	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED1	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED10	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED11	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED12	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED13	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED14	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED15	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED16	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED17	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED18	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED2	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED3	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED4	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED5	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED6	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED7	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED8	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED9	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED1	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED2	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED3	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED4	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED5	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED6	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED7	-	-	-	-	0.9	-	-	-	-	0.8	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
3F.BED8	-	-	-	-	0.9	-	-	-	-	0.8	N/A
3F.BED9	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED1	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED2	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED3	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED4	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED5	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED6	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED7	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED8	-	-	-	-	0.9	-	-	-	-	0.8	N/A
4F.BED9	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED1	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED10	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED11	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED2	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED3	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED4	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED5	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED6	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED7	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED8	-	-	-	-	0.9	-	-	-	-	0.8	N/A
GF.BED9	-	-	-	-	0.9	-	-	-	-	0.8	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
1F.BED1	130	-	-
1F.BED10	130	-	-
1F.BED11	130	-	-
1F.BED12	130	-	-
1F.BED13	130	-	-
1F.BED14	130	-	-
1F.BED15	130	-	-
1F.BED16	130	-	-
1F.BED17	130	-	-
1F.BED18	130	-	-
1F.BED2	130	-	-
1F.BED3	130	-	-
1F.BED4	130	-	-
1F.BED5	130	-	-
1F.BED6	130	-	-
1F.BED7	130	-	-
1F.BED8	130	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
1F.BED9	130	-	-
2F.BED1	130	-	-
2F.BED10	130	-	-
2F.BED11	130	-	-
2F.BED12	130	-	-
2F.BED13	130	-	-
2F.BED14	130	-	-
2F.BED15	130	-	-
2F.BED16	130	-	-
2F.BED17	130	-	-
2F.BED18	130	-	-
2F.BED2	130	-	-
2F.BED3	130	-	-
2F.BED4	130	-	-
2F.BED5	130	-	-
2F.BED6	130	-	-
2F.BED7	130	-	-
2F.BED8	130	-	-
2F.BED9	130	-	-
3F.BED1	130	-	-
3F.BED2	130	-	-
3F.BED3	130	-	-
3F.BED4	130	-	-
3F.BED5	130	-	-
3F.BED6	130	-	-
3F.BED7	130	-	-
3F.BED8	130	-	-
3F.BED9	130	-	-
4F.BED1	130	-	-
4F.BED2	130	-	-
4F.BED3	130	-	-
4F.BED4	130	-	-
4F.BED5	130	-	-
4F.BED6	130	-	-
4F.BED7	130	-	-
4F.BED8	130	-	-
4F.BED9	130	-	-
GF.BED1	130	-	-
GF.BED10	130	-	-
GF.BED11	130	-	-
GF.BED2	130	-	-
GF.BED3	130	-	-
GF.BED4	130	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
GF.BED5	130	-	-
GF.BED6	130	-	-
GF.BED7	130	-	-
GF.BED8	130	-	-
GF.BED9	130	-	-
1F.CIR1	120	-	-
1F.CIR2	120	-	-
1F.CIR3	120	-	-
2F.CIR1	120	-	-
2F.CIR2	120	-	-
2F.CIR3	120	-	-
3F.CIR1	120	-	-
3F.CIR2	120	-	-
3F.CIR3	120	-	-
4F.CIR1	120	-	-
4F.CIR2	120	-	-
4F.CIR3	120	-	-
GF.CIR1	120	-	-
GF.CIR2	120	-	-
GF.CIR3	120	-	-
1F.WC1	120	-	-
1F.WC10	120	-	-
1F.WC11	120	-	-
1F.WC2	120	-	-
1F.WC3	120	-	-
1F.WC4	120	-	-
1F.WC5	120	-	-
1F.WC6	120	-	-
1F.WC7	120	-	-
1F.WC8	120	-	-
1F.WC9	120	-	-
2F.WC1	120	-	-
2F.WC10	120	-	-
2F.WC11	120	-	-
2F.WC2	120	-	-
2F.WC3	120	-	-
2F.WC4	120	-	-
2F.WC5	120	-	-
2F.WC6	120	-	-
2F.WC7	120	-	-
2F.WC8	120	-	-
2F.WC9	120	-	-
3F.WC1	120	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
3F.WC2	120	-	-
3F.WC3	120	-	-
3F.WC4	120	-	-
3F.WC5	120	-	-
3F.WC6	120	-	-
3F.WC7	120	-	-
3F.WC8	120	-	-
4F.WC1	120	-	-
4F.WC2	120	-	-
4F.WC3	120	-	-
4F.WC4	120	-	-
4F.WC5	120	-	-
4F.WC6	120	-	-
4F.WC7	120	-	-
4F.WC8	120	-	-
GF.WC1	120	-	-
GF.WC2	120	-	-
GF.WC3	120	-	-
GF.WC4	120	-	-
GF.WC5	120	-	-
GF.WC6	120	-	-
GF.WC7	120	-	-
1F.DINING	130	-	-
1F.LOUNGE	130	-	-
1F.NURSES	130	-	-
1F.QROOM	130	-	-
2F.DINING	130	-	-
2F.LOUNGE	130	-	-
2F.NURSES	130	-	-
2F.QROOM	130	-	-
3F.DINING	130	-	-
3F.LOUNGE	130	-	-
3F.NURSES	130	-	-
4F.DINING	130	-	-
4F.LOUNGE	130	-	-
4F.NURSES	130	-	-
GF.DINING	130	-	-
GF.LOUNG1	130	-	-
GF.NURSES	130	-	-
GF.QROOM	130	-	-
GF.OFF1	130	-	-
GF.RECEP	130	95	1.421
1F.STOE2	120	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
1F.STOR1	120	-	-
1F.STOR4	120	-	-
2F.STOR1	120	-	-
2F.STOR2	120	-	-
2F.STOR4	120	-	-
3F.STOR1	120	-	-
3F.STOR2	120	-	-
4F.STOR1	120	-	-
4F.STOR2	120	-	-
GF.STOR1	120	-	-
GF.STOR2	120	-	-
GF.VOID	120	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1F.BED1	NO (-79.5%)	NO
1F.BED10	YES (+7.4%)	NO
1F.BED11	NO (-31.2%)	NO
1F.BED12	NO (-69.4%)	NO
1F.BED13	NO (-4.5%)	NO
1F.BED14	NO (-6.3%)	NO
1F.BED15	NO (-2.1%)	NO
1F.BED16	NO (-4.5%)	NO
1F.BED17	NO (-6.3%)	NO
1F.BED18	NO (-2.1%)	NO
1F.BED2	NO (-37.3%)	NO
1F.BED3	NO (-38.2%)	NO
1F.BED4	NO (-37.4%)	NO
1F.BED5	NO (-37.4%)	NO
1F.BED6	NO (-38.6%)	NO
1F.BED7	NO (-38.6%)	NO
1F.BED8	NO (-37.4%)	NO
1F.BED9	NO (-45.1%)	NO
2F.BED1	NO (-79.5%)	NO
2F.BED10	YES (+7.4%)	NO
2F.BED11	NO (-31.2%)	NO
2F.BED12	NO (-69.4%)	NO
2F.BED13	NO (-4.5%)	NO
2F.BED14	NO (-6.3%)	NO
2F.BED15	NO (-2.1%)	NO
2F.BED16	NO (-4.5%)	NO
2F.BED17	NO (-6.3%)	NO
2F.BED18	NO (-2.1%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2F.BED2	NO (-37.3%)	NO
2F.BED3	NO (-38.2%)	NO
2F.BED4	NO (-37.4%)	NO
2F.BED5	NO (-37.4%)	NO
2F.BED6	NO (-38.6%)	NO
2F.BED7	NO (-38.6%)	NO
2F.BED8	NO (-37.4%)	NO
2F.BED9	NO (-45.1%)	NO
3F.BED1	NO (-34.9%)	NO
3F.BED2	NO (-34.9%)	NO
3F.BED3	NO (-50.8%)	NO
3F.BED4	YES (+3.7%)	NO
3F.BED5	NO (-32.4%)	NO
3F.BED6	YES (+41.8%)	NO
3F.BED7	NO (-7%)	NO
3F.BED8	NO (-8.8%)	NO
3F.BED9	NO (-5.7%)	NO
4F.BED1	NO (-34.9%)	NO
4F.BED2	NO (-34.9%)	NO
4F.BED3	NO (-50.8%)	NO
4F.BED4	YES (+3.7%)	NO
4F.BED5	NO (-32.4%)	NO
4F.BED6	YES (+41.8%)	NO
4F.BED7	NO (-7%)	NO
4F.BED8	NO (-8.8%)	NO
4F.BED9	NO (-5.7%)	NO
GF.BED1	NO (-79.1%)	NO
GF.BED10	NO (-7.6%)	NO
GF.BED11	NO (-4.7%)	NO
GF.BED2	NO (-32.7%)	NO
GF.BED3	NO (-30.3%)	NO
GF.BED4	NO (-34.5%)	NO
GF.BED5	NO (-69.4%)	NO
GF.BED6	NO (-3.4%)	NO
GF.BED8	NO (-3.4%)	NO
GF.BED9	N/A	N/A
1F.LOUNGE	NO (-37.3%)	NO
1F.NURSES	N/A	N/A
1F.QROOM	N/A	N/A
2F.LOUNGE	NO (-37.3%)	NO
2F.NURSES	N/A	N/A
2F.QROOM	N/A	N/A
3F.LOUNGE	NO (-35.1%)	NO
3F.NURSES	NO (-36%)	NO
4F.LOUNGE	NO (-35.1%)	NO
4F.NURSES	NO (-36%)	NO
GF.LOUNG1	NO (-34.2%)	NO
GF.NURSES	N/A	N/A
GF.QROOM	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF.OFF1	N/A	N/A
GF.RECEP	NO (-44.2%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	3241.7	3241.7
External area [m^2]	5975.1	5975.1
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	1534.54	1857.2
Average U-value [W/m^{2}K]	0.26	0.31
Alpha value* [%]	21	18.16

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

Building Use

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	7.36	6.61
Cooling	0.57	0.57
Auxiliary	2.21	1.86
Lighting	15.62	14.02
Hot water	15.28	23.38
Equipment*	75.95	75.95
TOTAL**	**41.05**	**46.45**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	9.36	3.32
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*9.36*	*3.32*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	350.38	338.71
Primary energy [kWh/m^2]	48.86	64.1
Total emissions [kg/m^2]	4.63	5.98

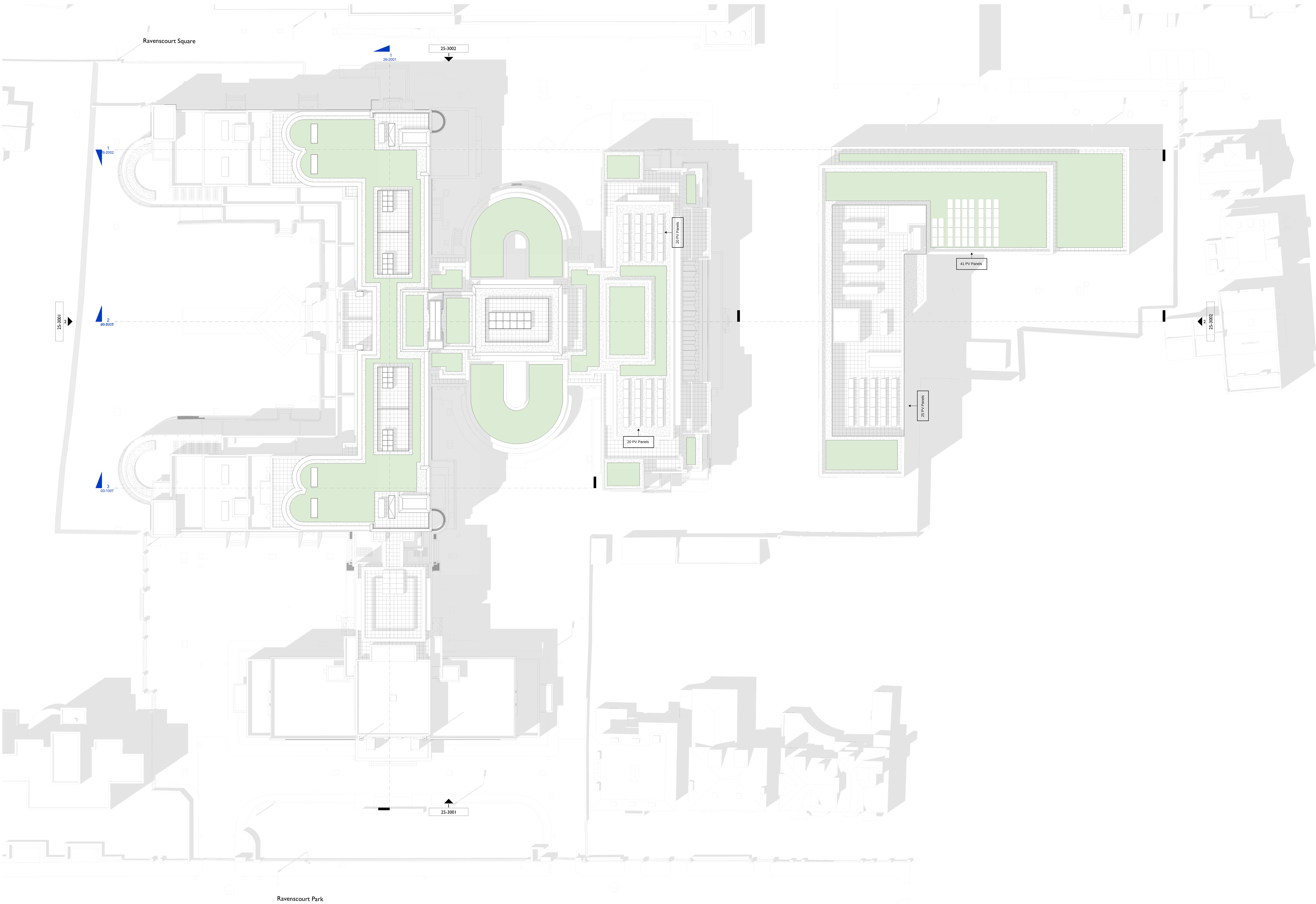
HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Other local room heater - unfanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	42.2	109	3.4	0	6.1	3.44	0	4.3	0
	Notional	46.9	78.8	4.9	0	4	2.64	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	48	121.2	16.7	0	0	0.8	0	1	0
	Notional	52.9	114.6	11	0	0	1.34	0	----	----
[ST] No Heating or Cooling										
	Actual	294.4	49.1	0	0	0	0	0	0	0
	Notional	325.2	52.3	0	0	0	0	0	----	----
[ST] Other local room heater - unfanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	105.2	1131.7	8.5	0	0	3.44	0	4.3	0
	Notional	85.6	1115.5	9	0	0	2.64	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	113.5	308.2	7.9	19.4	0	4.01	4.4	4.3	6.2
	Notional	135.9	307.4	14.3	19.4	0	2.64	4.4	----	----
[ST] No Heating or Cooling										
	Actual	54.5	51.2	0	0	0	0	0	0	0
	Notional	50.9	29	0	0	0	0	0	----	----

Key to terms

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

APPENDIX E PV ROOF PLANS



GENERAL NOTES

CONTRACTOR TO IMMEDIATELY ADVISE THE CONTRACT ADMINISTRATOR & ARCHITECT OF ANY DISCREPANCIES BETWEEN THE EXISTING SURVEY DRAWINGS AND THE SITE SITUATION IF FOUND TO DIFFER. SHOULD A DISCREPANCY BE IDENTIFIED, THE CONTRACTOR IS TO REQUEST VERIFICATION FROM THE CONTRACT ADMINISTRATOR BY WAY OF INSTRUCTION PRIOR TO PROCEEDING WITH THE ASSOCIATED WORK OR ORDERING OF MATERIALS.

WHERE THERE IS A PERCEIVED DISCREPANCY BETWEEN THE ARCHITECTS / M & E / STRUCTURAL ENG. DRAWINGS, SPECIFICATIONS AND SCHEDULES, THOSE OF THE ARCHITECT ARE TO TAKE PRECEDENCE. THE CONTRACTOR IS TO SEEK CLARIFICATION FROM THE CONTRACT ADMINISTRATOR PRIOR TO UNDERTAKING THE WORKS OR ASSOCIATED WORKS

THE CONTRACTOR IS RESPONSIBLE FOR CHECKING DIMENSIONS. ANY DISCREPANCY TO BE VERIFIED WITH THE ARCHITECTS BEFORE PROCEEDING WITH ANY WORKS.

DO NOT SCALE DRAWINGS.

FIGURED DIMENSIONS TO BE WORKED IN ALL CASES. ALL DIMS ARE IN mm UNLESS OTHERWISE STATED.

ALL SUPPLIED TIMBER AND TIMBER BASED PRODUCTS SHALL CARRY THE FOREST STEWARDSHIP COUNCIL'S (FSC) TRADEMARK OR OTHER LABEL FROM AN EQUIVALENT INTERNATIONALLY RECOGNISED, GLOBALLY APPLICABLE, INDEPENDENT CERTIFICATION SYSTEM FOR GOOD FOREST MANAGEMENT, ACCEPTABLE TO THE ARCHITECT. CHAIN OF CUSTODY DOCUMENTATION IS TO BE PROVIDED PRIOR TO ANY WORKS PROCEEDING AND IS TO BE AVAILABLE FOR INSPECTION ON REQUEST BY THE ARCHITECT (WHERE INDEPENDENTLY CERTIFIED TIMBER STOCKS ARE NOT AVAILABLE, TIMBER AND WOOD PRODUCTS MAY BE SOURCED FROM SUPPLIERS THAT HAVE ADOPTED A FORMAL ENVIRONMENTAL PURCHASING POLICY, AND CAN PROVIDE CREDIBLE EVIDENCE OF A COMMITMENT TO THAT POLICY).

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECT'S, STRUCTURAL ENGINEER'S, M&E ENGINEER'S AND OTHER CONTRACT DOCUMENTS.

PART L PV REQUIREMENTS

40% of dwelling floor area / 6.5 x no. of storeys

Dwelling Floor Area = 11,898 sqm (approx.) - 4759 sqm (40%)
No. of storeys = 6

4759 / 39 = 122 sqm

GREEN ROOF - 1480 sqm

0m 4m 8m 12m 16m 20m

VISUAL SCALE 1:200 @ A1

Notes, legends or Key plans to be added above here

23.09.15	WIP_8	DM	Issued for Information
23.08.04	WIP_7	DM	Issued for Information
23.07.10	WIP_6	DM	Issued for Information
23.06.23	WIP_5	DM	Issued for Information
23.06.02	WIP_4	DM	Issued for Information
23.05.12	WIP_3	DM	WIP for Information
23.03.10	WIP_2	DM	Issued for Information
23.01.31	WIP_1	EG	Issued for Information
DATE	REV	BY	DESCRIPTION

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Client
TT Group (Telereal Trillium)

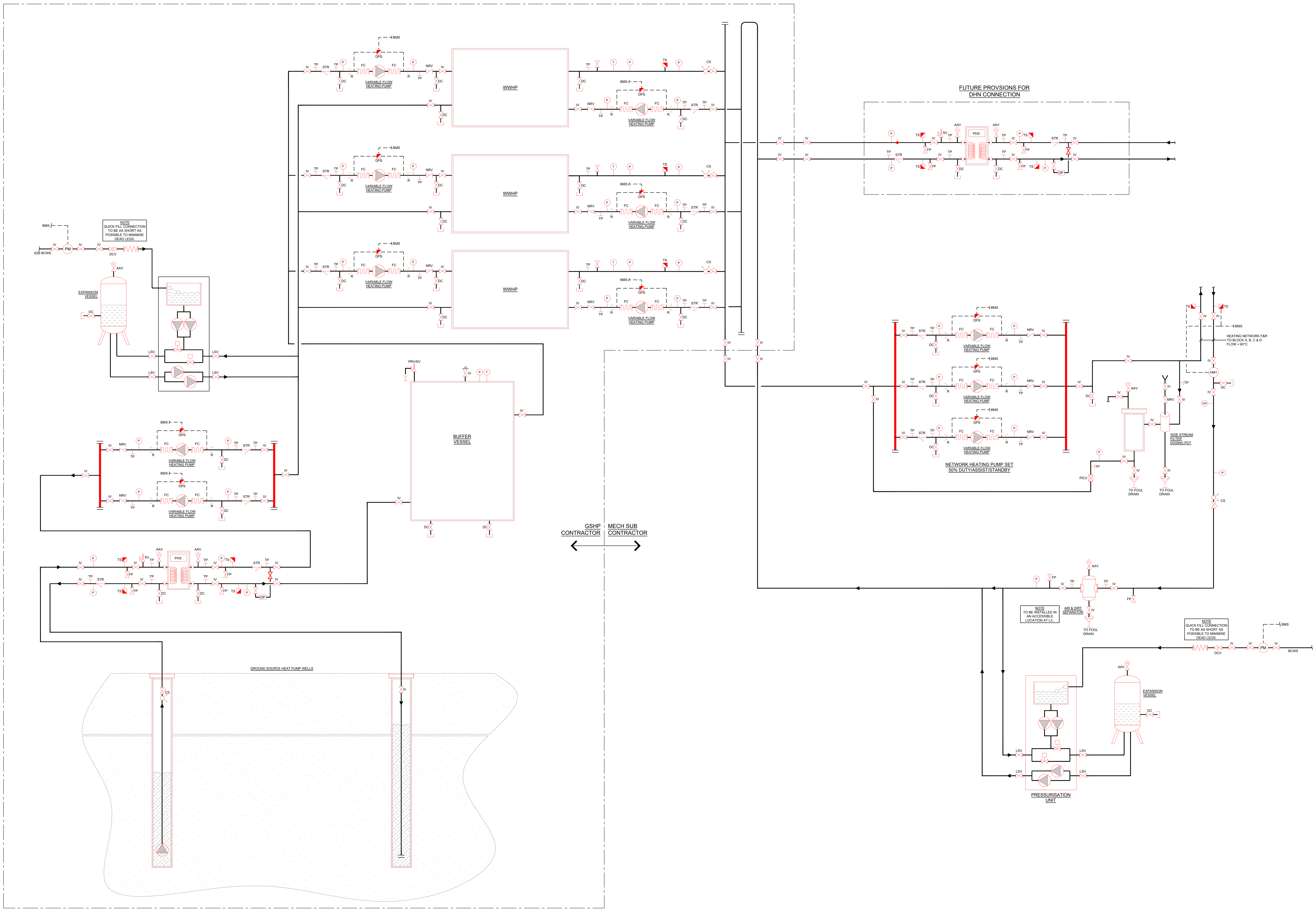
Job Title
2210 - Ravenscourt Park

Drawing Title
Masterplan - Proposed Roof Plan

Drawing Number & Revision
2210-SPP-RCZ-0R-DR-A-20-1009

Scale	Date Amended	Amended By	Revision
1 : 200	23.09.15	DM	WIP_8
Checked	Date Created	Drawn By	SUITABILITY
BR	23.01.15	DM	S2

APPENDIX F DHN FUTURE PROVISION



NOTES

1. THE HEATING SYSTEM DESIGN AND SPECIFICATION SHALL TAKE INTO CONSIDERATION THE FOLLOWING TO INCREASE SYSTEM EFFICIENCIES, REDUCE SYSTEM CAPACITY AND MINIMISE SYSTEM LOSSES BY:
   - CAREFUL DESIGN OF PIPEWORK DISTRIBUTION SYSTEM TO KEEP CIRCUIT LENGTHS TO AN ABSOLUTE MINIMUM.
   - MINIMISE PIPEWORK DIAMETERS WHILST STAYING WITHIN RECOGNISED GUIDELINES FOR VELOCITIES AND PRESSURE DROPS.
   - UTILISE THE CORRECT DIVERSITY CURSE FOR DOMESTIC HOT WATER TO AVOID OVERSIZING AND NEEDLESSLY INCREASED PLANT, PIPEWORK AND EQUIPMENT SIZES.
   - MAXIMISE INSULATION BY ENSURING ALL SYSTEM ELEMENTS ARE INSULATED AND THAT THE MAXIMUM THICKNESS OF INSULATION IS USED.
   - AVOID USE OF BYPASS AND MINIMISE THE NUMBER OF HEAT EXCHANGERS.
   - SET DOMESTIC HOT WATER OUTLET TEMPERATURES AS LOW AS POSSIBLE WHILST STILL MEETING THE REQUIRED RESPONSE TIMES.
2. LOW LEVEL RISER PIPEWORK TO BE PN16 RATED. HIGH LEVEL RISER PIPEWORK TO BE PN25 RATED.
3. ALL HEATING PIPEWORK TO BE RUN IN MEDIUM WEIGHT BLACK STEEL.
4. PIPEWORK IN PLANTROOMS SHALL BE PROVIDED WITH A 'ISOGENOPAC' FINISH.
5. AIR BOTTLE DISCHARGE PIPES TO RUN TO CONNECT TO NEAREST FOUL DRAINAGE RISER VIA HEPVo VALVE & TUNDISH.
6. AIR VENTS TO BE PROVIDED AT ALL SYSTEM HIGH POINTS AS PER THE CUDD BENTLEY MECHANICAL SERVICES SPECIFICATION.

Revision	Description	Drawn By	Engineer	Approved	Date
P01	STAGE 2 ISSUE	AS	RH	RH	31-10-23

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STAGE 2

Client

TELEREAL TRILLIUM

Project/Site Location

RAVENSCOURT PARK HOSPITAL
HAMMERSMITH

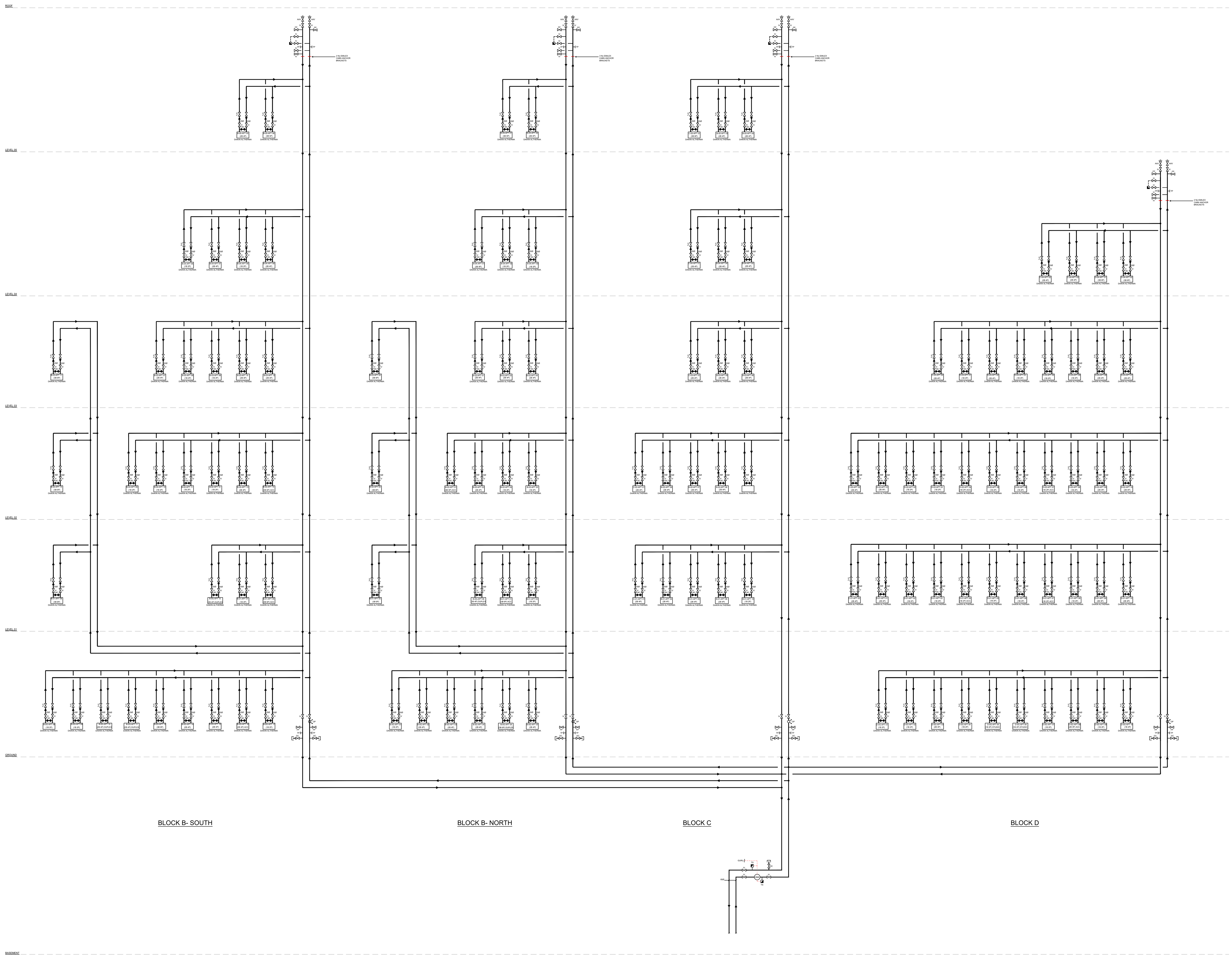
Drawing Title

PLANTROOM HEATING SCHEMATIC

Scale	Size	Drawn By	Engineer	Approved	Date
NTS	A1	AS	RH	RH	OCT'23

Drawing Reference	Revision
6391-CBC-ZZ-XX-DR-M-50001	P01

File Location:



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2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL CUDD BENTLEY DRAWINGS, SCHEDULES AND SPECIFICATIONS.
3. DO NOT SCALE FROM THIS DRAWING.
4. ALL DIMENSIONS AND LEVELS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
5. ALL PLANT, MATERIALS AND EQUIPMENT TO BE INSTALLED STRICTLY IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.
6. ANY DISCREPANCY IS TO BE REFERRED TO CUDD BENTLEY CONSULTING.
7. ALL DIMENSIONS TO BE CHECKED AND VERIFIED ON SITE PRIOR TO THE COMMENCEMENT OF WORKS.
8. ALL PART NUMBERS SHALL BE VERIFIED BY THE CONTRACTOR.
9. THIS DRAWING IS TO BE READ IN CONJUNCTION AND COORDINATED WITH ALL OTHER DESIGN TEAM PROJECT DRAWINGS, SCHEDULES AND SPECIFICATIONS.

Revision	Description	Drawn By	Engineer	Approved	Date
P01	STAGE 2	DK	DK	RH	05-10-23

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STAGE 2

Client

TELEREAL TRILLIUM

Project/Site Location

RAVENSCOURT PARK HOSPITAL, HAMMERSMITH

Drawing Title

BLOCKS A-D
AMBIENT LOOP
SCHEMATIC

Scale	Size	Drawn By	Engineer	Approved	Date
NTS	A1	DK	DK	RH	OCT' 23

Drawing Reference	Revision
6391-CBC-ZZ-XX-DR-M-53002	P01

File Location:

APPENDIX G SAP WORKSHEETS

Full SAP Calculation Printout

elmhurst energy

Property Reference	1F - 4A - N					Issued on Date	13/10/2023
Assessment Reference	Be Green			Prop Type Ref			
Property							
SAP Rating	82 B	DER	3.06			TER	12.40
Environmental	97 A	% DER < TER					75.32
CO_2 Emissions (t/year)	0.31	DFEE	38.43			TFEE	41.41
Compliance Check	See BREL	% DFEE < TFEE					7.19
% DPER < TPER	50.63	DPER	32.29			TPER	65.40
Assessor Details	Mr. Sushil Pathak					Assessor ID	Z621-0001
Client	001, 002						

```
--------------------------------------------------------------------------------------------



--------------------------------------------------------------------------------------------
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        Storey height             Volume
                                                                          (m2)             (m)                   (m3)
Ground floor                                                          116.0000 (1b)    x     3.1500 (2b)    =    365.4000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            116.0000                                              (4)
Dwelling volume                                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    365.4000 (5)



--------------------------------------------------------------------------------------------
2. Ventilation rate
--------------------------------------------------------------------------------------------
                                                                                                       m3 per hour

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

                                                                                               Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =       0.0000 / (5) =    0.0000 (8)
Pressure test                                                                                                   Yes
Pressure Test Method                                                                                   Blower Door
Measured/design AP50                                                                                        2.5000 (17)
Infiltration rate                                                                                           0.1250 (18)
Number of sides sheltered                                                                                        1 (19)

Shelter factor                                                            (20) = 1  -  [0.075 x (19)]  =    0.9250 (20)
Infiltration rate adjusted to include shelter factor                             (21) = (18) x (20)  =    0.1156 (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
                0.1474    0.1445    0.1416    0.1272    0.1243    0.1098    0.1098    0.1070    0.1156    0.1243    0.1301    0.1359 (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) =              76.5000 (23c)

Effective ac    0.2649    0.2620    0.2591    0.2447    0.2418    0.2273    0.2273    0.2245    0.2331    0.2418    0.2476    0.2534 (25)



--------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
--------------------------------------------------------------------------------------------
Element                                     Gross      Openings       NetArea      U-value        A x U      K-value          A x K
                                               m2            m2            m2         W/m2K          W/K       kJ/m2K           kJ/K
Opening Type 1 (Uw = 1.20)                                              38.0800       1.1450      43.6031                            (27)
Door                                                                     2.2000       1.3000       2.8600                            (26)
External Wall 1                          117.5900       40.2800        77.3100       0.1800      13.9158     190.0000     14688.9000 (29a)
```

```
sheltered wall                               9.3400                         9.3400        0.1700        1.5878       190.0000      1774.6000 (29a)
Total net area of external elements Aum(A, m2)                             126.9300                                                           (31)
Fabric heat loss, W/K = Sum (A x U)                                    (26)...(30) + (32) =        61.9667                                     (33)
Party Wall 1                                                                46.4000        0.0000        0.0000       180.0000      8352.0000 (32)
Party Floor 1                                                              116.0000                                    40.0000      4640.0000 (32d)
Party Ceiling 1                                                            116.0000                                    30.0000      3480.0000 (32b)
Internal Wall 1                                                            102.9100                                     9.0000       926.1900 (32c)

Heat capacity Cm = Sum(A x k)                                                    (28)...(30) + (32) + (32a)...(32e) =  33861.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                         291.9111 (35)
List of Thermal Bridges
        K1 Element                                                                     Length      Psi-value         Total
        E16 Corner (normal)                                                           25.2000        0.0320          0.8064
        E17 Corner (inverted - internal area greater than external area)              22.0500       -0.1170         -2.5799
        E2 Other lintels (including other steel lintels)                              14.1800        0.0020          0.0284
        E3 Sill                                                                       14.1800        0.0130          0.1843
        E4 Jamb                                                                       37.8000        0.0080          0.3024
        E7 Party floor between dwellings (in blocks of flats)                         74.6600        0.0000          0.0000
        E18 Party wall between dwellings                                               6.3000       -0.0010         -0.0063
        P3 Party wall - Intermediate floor between dwellings (in blocks of flats)     29.4600        0.0000          0.0000
        E6 Intermediate floor within a dwelling                                        2.9600        0.0000          0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                 -1.2647 (36)
Point Thermal bridges                                                                                         (36a) =      0.0000
Total fabric heat loss                                                                              (33) + (36) + (36a) =    60.7020 (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         31.9448    31.5963    31.2477    29.5049    29.1564    27.4136    27.4136    27.0650    28.1107    29.1564    29.8535    30.5506 (38)
Heat transfer coeff
              92.6468    92.2983    91.9497    90.2069    89.8584    88.1156    88.1156    87.7670    88.8127    89.8584    90.5555    91.2526 (39)
Average = Sum(39)m / 12 =                                                                                                     90.1198

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP            0.7987     0.7957     0.7927     0.7776     0.7746     0.7596     0.7596     0.7566     0.7656     0.7746     0.7807     0.7867 (40)
HLP (average)                                                                                                                  0.7769
Days in mont       31         28         31         30         31         30         31         31         30         31         30         31




-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                             2.8464 (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
              82.9886    81.7561    80.0205    76.8203    74.4241    71.7670    70.3318    72.0553    73.9318    76.7750    80.0410    82.7080 (42b)
Hot water usage for other uses
              43.7804    42.1884    40.5964    39.0043    37.4123    35.8203    35.8203    37.4123    39.0043    40.5964    42.1884    43.7804 (42c)
Average daily hot water use (litres/day)                                                                                    116.7438 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
             126.7689   123.9444   120.6168   115.8246   111.8364   107.5873   106.1521   109.4676   112.9362   117.3713   122.2294   126.4884 (44)
Energy conte  200.7710   176.4952   185.3835   158.5581   150.5533   132.2912   128.3818   135.5438   139.2616   159.2718   174.1382   198.0503 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =    1938.6996
Distribution loss  (46)m = 0.15 x (45)m
              30.1157    26.4743    27.8075    23.7837    22.5830    19.8437    19.2573    20.3316    20.8892    23.8908    26.1207    29.7075 (46)
Water storage loss:
Store volume                                                                                                                180.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                 1.4000 (48)
  Temperature factor from Table 2b                                                                                            0.7800 (49)
Enter (49) or (54) in (55)                                                                                                    1.0920 (55)
Total storage loss
              33.8520    30.5760    33.8520    32.7600    33.8520    32.7600    33.8520    33.8520    32.7600    33.8520    32.7600    33.8520 (56)
If cylinder contains dedicated solar storage
              33.8520    30.5760    33.8520    32.7600    33.8520    32.7600    33.8520    33.8520    32.7600    33.8520    32.7600    33.8520 (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
             257.8854   228.0824   242.4979   213.8301   207.6677   187.5632   185.4962   192.6582   194.5336   216.3862   229.4102   255.1647 (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
             257.8854   228.0824   242.4979   213.8301   207.6677   187.5632   185.4962   192.6582   194.5336   216.3862   229.4102   255.1647 (64)
                                                                                 Total per year (kWh/year) = Sum(64)m =    2611.1756 (64)
12Total per year (kWh/year)                                                                                                       2611 (64)
Electric shower(s)
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (64a)
                                                 Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =      0.0000 (64a)
Heat gains from water heating, kWh/month
             112.4479    99.9544   107.3315    96.9382    95.7505    88.2044    88.3785    90.7598    90.5221    98.6494   102.1185   111.5432 (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        142.3219   142.3219   142.3219   142.3219   142.3219   142.3219   142.3219   142.3219   142.3219   142.3219   142.3219   142.3219 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
```

	141.1826	156.3093	141.1826	145.8887	141.1826	145.8887	141.1826	141.1826	145.8887	141.1826	145.8887	141.1826	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	279.9103	282.8149	275.4954	259.9131	240.2432	221.7563	209.4059	206.5014	213.8208	229.4031	249.0730	267.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating gains (Table 5)													
	151.1396	148.7417	144.2628	134.6364	128.6969	122.5061	118.7883	121.9890	125.7251	132.5933	141.8313	149.9237	(72)
Total internal gains													
	637.9291	653.5625	626.6374	606.1347	575.8193	555.8477	535.0734	535.3695	551.1312	568.8756	602.4896	624.3628	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	22.1800	10.6334	0.3600	0.0000	0.7700	65.3772	(74)
East	15.9000	19.6403	0.3600	0.0000	0.7700	86.5641	(76)

Solar gains	151.9413	294.2769	491.1774	747.7346	957.8282	1002.0301	944.9185	781.5459	579.5994	349.6573	188.5865	125.6878	(83)
Total gains	789.8704	947.8394	1117.8148	1353.8693	1533.6475	1557.8778	1479.9919	1316.9155	1130.7306	918.5329	791.0760	750.0506	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	101.5256	101.9090	102.2953	104.2717	104.6761	106.7465	106.7465	107.1704	105.9086	104.6761	103.8703	103.0768	
alpha	7.7684	7.7939	7.8197	7.9514	7.9784	8.1164	8.1164	8.1447	8.0606	7.9784	7.9247	7.8718	
util living area													
	0.9974	0.9889	0.9484	0.7732	0.5429	0.3619	0.2620	0.3066	0.5402	0.8961	0.9905	0.9982	(86)
MIT	20.3432	20.5252	20.7635	20.9613	20.9974	20.9999	21.0000	21.0000	20.9982	20.9033	20.5878	20.3203	(87)
Th 2	20.2545	20.2571	20.2597	20.2727	20.2754	20.2885	20.2885	20.2911	20.2832	20.2754	20.2701	20.2649	(88)
util rest of house													
	0.9964	0.9852	0.9335	0.7357	0.5014	0.3217	0.2196	0.2593	0.4849	0.8627	0.9866	0.9975	(89)
MIT 2	19.4875	19.7201	20.0133	20.2395	20.2736	20.2884	20.2885	20.2911	20.2823	20.1896	19.8114	19.4667	(90)
Living area fraction									fLA = Living area / (4) =			0.4810	(91)
MIT	19.8991	20.1074	20.3742	20.5867	20.6218	20.6307	20.6307	20.6321	20.6267	20.5329	20.1849	19.8773	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8991	20.1074	20.3742	20.5867	20.6218	20.6307	20.6307	20.6321	20.6267	20.5329	20.1849	19.8773	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9958	0.9843	0.9360	0.7523	0.5213	0.3411	0.2400	0.2820	0.5115	0.8755	0.9861	0.9970	(94)
Useful gains	786.5740	932.9376	1046.2750	1018.4921	799.5256	531.3402	355.1681	371.4291	578.3555	804.1346	780.0785	747.8304	(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													
	1445.2115	1403.6158	1275.7275	1054.2190	801.6953	531.3968	355.1706	371.4380	579.6525	892.5523	1184.9055	1430.5933	(97)
Space heating kWh													
	490.0263	316.2958	170.7127	25.7234	1.6143	0.0000	0.0000	0.0000	0.0000	65.7828	291.4754	507.9756	(98a)
Space heating requirement - total per year (kWh/year)												1869.6063	
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													
	490.0263	316.2958	170.7127	25.7234	1.6143	0.0000	0.0000	0.0000	0.0000	65.7828	291.4754	507.9756	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1869.6063	
Space heating per m2										(98c) / (4) =		16.1173	(99)

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 Heat pump-Space and Water	1.0000	(303a)
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													
	490.0263	316.2958	170.7127	25.7234	1.6143	0.0000	0.0000	0.0000	0.0000	65.7828	291.4754	507.9756	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307a	735.0394	474.4437	256.0691	38.5851	2.4214	0.0000	0.0000	0.0000	0.0000	98.6742	437.2131	761.9634	
Space heating requirement													
	735.0394	474.4437	256.0691	38.5851	2.4214	0.0000	0.0000	0.0000	0.0000	98.6742	437.2131	761.9634	(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	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310a	386.8281	342.1236	363.7469	320.7452	311.5015	281.3447	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470	
Water heating fuel	386.8281	342.1236	363.7469	320.7452	311.5015	281.3447	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	35.4951	32.0601	35.4951	34.3501	35.4951	34.3501	35.4951	35.4951	34.3501	35.4951	34.3501	35.4951	(331)
Lighting	39.0575	31.3334	28.2122	20.6695	15.9657	13.0441	14.5645	18.9314	24.5901	32.2635	36.4415	40.1430	(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	2804.4094	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	3916.7634	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	28.0441	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)		
mechanical ventilation fans (SFP = 0.9375)	417.9262	(330a)
Total electricity for the above, kWh/year	417.9262	(331)
Electricity for lighting (calculated in Appendix L)	315.2165	(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	7454.3156	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			412.0000	(367)
Space and Water heating from Heat pump	1631.3526	0.1585	107.8585	(367)
Electrical energy for heat distribution (space & water)	28.0441	0.0000	9.9591	(372)
Overall CO2 factor for heat network			0.0374	(386)
Total CO2 associated with community systems			251.6855	(373)
Space and water heating			251.6855	(376)
Pumps, fans and electric keep-hot	417.9262	0.1387	57.9715	(378)
Energy for lighting	315.2165	0.1443	45.4955	(379)
Total CO2, kg/year			355.1525	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0600	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			412.0000	(467a)
Space and Water heating from Heat pump	1631.3526	1.5865	1079.9144	(467)
Electrical energy for heat distribution (space & water)	28.0441	0.0000	104.0537	(472)
Overall CO2 factor for heat network			0.3912	(486)
Total CO2 associated with community systems			2629.6294	(473)
Space and water heating			2629.6294	(476)
Pumps, fans and electric keep-hot	417.9262	1.5128	632.2388	(478)
Energy for lighting	315.2165	1.5338	483.4895	(479)
Total Primary energy kWh/year			3745.3578	(483)
Dwelling Primary energy Rate (DPER)			32.2900	(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	116.0000 (1b)	x	3.1500 (2b)	=	365.4000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.0000				(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4000 (5)

2. Ventilation rate

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1095 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3595 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3325 (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	0.4239	0.4156	0.4073	0.3658	0.3574	0.3159	0.3159	0.3076	0.3325	0.3574	0.3741	0.3907	(22b)
Effective ac	0.5899	0.5864	0.5830	0.5669	0.5639	0.5499	0.5499	0.5473	0.5553	0.5639	0.5700	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.2000	1.0000	2.2000			(26)
TER Opening Type (Uw = 1.20)			26.8000	1.1450	30.6870			(27)
External Wall 1	117.5900	40.2800	77.3100	0.1800	13.9158			(29a)
sheltered wall	9.3400		9.3400	0.1800	1.6812			(29a)
Total net area of external elements Aum(A, m2)			115.6500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.4840			(33)
Party Wall 1			46.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 301.9111 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	25.2000	0.0900	2.2680
E17 Corner (inverted – internal area greater than external area)	22.0500	-0.0900	-1.9845
E2 Other lintels (including other steel lintels)	14.1800	0.0500	0.7090
E3 Sill	14.1800	0.0500	0.7090
E4 Jamb	37.8000	0.0500	1.8900
E7 Party floor between dwellings (in blocks of flats)	74.6600	0.0700	5.2262
E18 Party wall between dwellings	6.3000	0.0600	0.3780
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	29.4600	0.0000	0.0000
E6 Intermediate floor within a dwelling	2.9600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.1957 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	57.6797 (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	71.1273	70.7065	70.2940	68.3567	67.9943	66.3070	66.3070	65.9945	66.9569	67.9943	68.7275	69.4941	(38)
Heat transfer coeff	128.8070	128.3862	127.9737	126.0365	125.6740	123.9867	123.9867	123.6742	124.6366	125.6740	126.4073	127.1738	(39)
Average = Sum(39)m / 12 =												126.0347	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1104	1.1068	1.1032	1.0865	1.0834	1.0689	1.0689	1.0662	1.0745	1.0834	1.0897	1.0963	(40)
HLP (average)												1.0865	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8464	(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	82.9886	81.7561	80.0205	76.8203	74.4241	71.7670	70.3318	72.0553	73.9318	76.7750	80.0410	82.7080	(42b)
Hot water usage for other uses	43.7804	42.1884	40.5964	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804	(42c)
Average daily hot water use (litres/day)												116.7438	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.7689	123.9444	120.6168	115.8246	111.8364	107.5873	106.1521	109.4676	112.9362	117.3713	122.2294	126.4884	(44)
Energy conte	200.7710	176.4952	185.3835	158.5581	150.5533	132.2912	128.3818	135.5438	139.2616	159.2718	174.1382	198.0503	(45)
Energy content (annual)											Total = Sum(45)m =	1938.6996	
Distribution loss (46)m = 0.15 x (45)m	30.1157	26.4743	27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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	250.0137	220.9725	234.6262	206.2123	199.7959	179.9454	177.6244	184.7864	186.9158	208.5144	221.7924	247.2929	(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	250.0137	220.9725	234.6262	206.2123	199.7959	179.9454	177.6244	184.7864	186.9158	208.5144	221.7924	247.2929	(64)
									Total per year (kWh/year) = Sum(64)m =			2518.4924	(64)
12Total per year (kWh/year)												2518	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month	106.1505	94.2665	101.0342	90.8439	89.4531	82.1102	82.0811	84.4624	84.4278	92.3520	96.0243	105.2458	(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	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	141.1826	156.3093	141.1826	145.8887	141.1826	145.8887	141.1826	141.1826	145.8887	141.1826	145.8887	141.1826	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	279.9103	282.8149	275.4954	259.9131	240.2432	221.7563	209.4059	206.5014	213.8208	229.4031	249.0730	267.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating gains (Table 5)	142.6754	140.2775	135.7986	126.1721	120.2327	114.0419	110.3240	113.5248	117.2609	124.1290	133.3671	141.4595	(72)
Total internal gains	632.4649	648.0982	621.1732	600.6705	570.3551	547.3835	526.6092	526.9053	542.6670	563.4113	597.0254	618.8986	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.6100	10.6334	0.6300	0.7000	0.7700	50.7279	(74)
East	11.1900	19.6403	0.6300	0.7000	0.7700	67.1660	(76)

Solar gains	117.8938	228.3344	381.1128	580.1802	743.1957	777.4929	733.1789	606.4151	449.7210	271.3050	146.3274	97.5233	(83)
Total gains	750.3587	876.4327	1002.2860	1180.8507	1313.5508	1324.8764	1259.7881	1133.3204	992.3880	834.7163	743.3528	716.4218	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	75.5258	75.7733	76.0175	77.1860	77.4086	78.4620	78.4620	78.6603	78.0529	77.4086	76.9596	76.4957	
alpha	6.0351	6.0516	6.0678	6.1457	6.1606	6.2308	6.2308	6.2440	6.2035	6.1606	6.1306	6.0997	
util living area	0.9989	0.9968	0.9889	0.9442	0.8055	0.5888	0.4317	0.4986	0.7927	0.9762	0.9970	0.9992	(86)
MIT	19.8805	20.0462	20.3087	20.6712	20.9112	20.9892	20.9986	20.9969	20.9411	20.6052	20.1859	19.8627	(87)
Th 2	19.9923	19.9953	19.9982	20.0119	20.0144	20.0264	20.0264	20.0286	20.0218	20.0144	20.0092	20.0038	(88)
util rest of house	0.9984	0.9955	0.9842	0.9220	0.7462	0.5041	0.3370	0.3952	0.7093	0.9626	0.9956	0.9988	(89)
MIT 2	18.6885	18.9025	19.2379	19.6911	19.9477	20.0213	20.0260	20.0277	19.9865	19.6236	19.0923	18.6743	(90)
Living area fraction									fLA = Living area / (4) =			0.4810	(91)
MIT	19.2619	19.4527	19.7530	20.1625	20.4112	20.4869	20.4939	20.4939	20.4457	20.0958	19.6183	19.2460	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2619	19.4527	19.7530	20.1625	20.4112	20.4869	20.4939	20.4939	20.4457	20.0958	19.6183	19.2460	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9945	0.9828	0.9259	0.7714	0.5448	0.3826	0.4451	0.7478	0.9640	0.9948	0.9984	(94)
Useful gains	748.8123	871.6417	985.0165	1093.3001	1013.3221	721.8041	482.0334	504.4776	742.0982	804.6524	739.4975	715.3013	(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	1927.1945	1868.3643	1696.0379	1419.4906	1094.7698	729.8993	482.7901	506.3125	790.9057	1193.3758	1582.4076	1913.4532	(97)
Space heating kWh	876.7164	669.7976	528.9999	234.8572	60.5970	0.0000	0.0000	0.0000	0.0000	289.2102	606.8953	891.4250	(98a)
Space heating requirement - total per year (kWh/year)												4158.4987	
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	876.7164	669.7976	528.9999	234.8572	60.5970	0.0000	0.0000	0.0000	0.0000	289.2102	606.8953	891.4250	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4158.4987	
Space heating per m2											(98c) / (4) =	35.8491	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	876.7164	669.7976	528.9999	234.8572	60.5970	0.0000	0.0000	0.0000	0.0000	289.2102	606.8953	891.4250	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	949.8552	725.6746	573.1310	254.4498	65.6523	0.0000	0.0000	0.0000	0.0000	313.3372	657.5247	965.7909	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	250.0137	220.9725	234.6262	206.2123	199.7959	179.9454	177.6244	184.7864	186.9158	208.5144	221.7924	247.2929	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6320	86.3832	85.8259	84.3522	81.7276	79.8000	79.8000	79.8000	79.8000	84.7936	86.1981	86.6771	(217)
Fuel for water heating, kWh/month	288.5928	255.8049	273.3746	244.4658	244.4656	225.4954	222.5870	231.5619	234.2303	245.9081	257.3054	285.3038	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	29.3350	23.5336	21.1894	15.5243	11.9914	9.7971	10.9389	14.2188	18.4689	24.2322	27.3702	30.1503	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-30.1717	-44.2206	-66.0386	-77.2158	-85.8054	-80.9710	-79.9337	-74.1797	-64.5034	-51.8289	-33.7473	-25.8890	(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	-12.2900	-26.2798	-53.0467	-80.8931	-108.1856	-109.1916	-107.9541	-90.8820	-65.8976	-38.0327	-16.5490	-9.6906	(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	4505.4157	(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		3009.0958 (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)		236.7499 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-1433.3977 (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		6403.8637 (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	4505.4157	0.2100	946.1373 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3009.0958	0.2100	631.9101 (264)
Space and water heating			1578.0474 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	236.7499	0.1443	34.1703 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-714.5049	0.1338	-95.5965
PV Unit electricity exported	-718.8927	0.1254	-90.1789
Total			-185.7755 (269)
Total CO2, kg/year			1438.3715 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.4000 (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	4505.4157	1.1300	5091.1197 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3009.0958	1.1300	3400.2782 (278)
Space and water heating			8491.3979 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	236.7499	1.5338	363.1349 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-714.5049	1.4944	-1067.7816
PV Unit electricity exported	-718.8927	0.4604	-331.0025
Total			-1398.7840 (283)
Total Primary energy kWh/year			7585.8496 (286)
Target Primary Energy Rate (TPER)			65.4000 (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		116.0000 (1b)	x	3.1500 (2b)	=	365.4000 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.0000					
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4000 (5)

2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)

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

			Air changes per hour
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1095 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			2.5000 (17)
Infiltration rate			0.2345 (18)
Number of sides sheltered			1 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.2169 (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	0.2765	0.2711	0.2657	0.2386	0.2332	0.2060	0.2060	0.2006	0.2169	0.2332	0.2440	0.2548	(22b)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5382	0.5367	0.5353	0.5285	0.5272	0.5212	0.5212	0.5201	0.5235	0.5272	0.5298	0.5325	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.20)			38.0800	1.1450	43.6031			(27)
Door			2.2000	1.3000	2.8600			(26)
External Wall 1	117.5900	40.2800	77.3100	0.1800	13.9158	190.0000	14688.9000	(29a)
sheltered wall	9.3400		9.3400	0.1700	1.5878	190.0000	1774.6000	(29a)
Total net area of external elements Aum(A, m2)			126.9300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.9667			(33)
Party Wall 1			46.4000	0.0000	0.0000	180.0000	8352.0000	(32)
Party Floor 1			116.0000			40.0000	4640.0000	(32d)
Party Ceiling 1			116.0000			40.0000	4640.0000	(32b)
Internal Wall 1			102.9100			9.0000	926.1900	(32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 35021.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 301.9111 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	25.2000	0.0320	0.8064
E17 Corner (inverted – internal area greater than external area)	22.0500	-0.1170	-2.5799
E2 Other lintels (including other steel lintels)	14.1800	0.0020	0.0284
E3 Sill	14.1800	0.0130	0.1843
E4 Jamb	37.8000	0.0080	0.3024
E7 Party floor between dwellings (in blocks of flats)	74.6600	0.0000	0.0000
E18 Party wall between dwellings	6.3000	-0.0010	-0.0063
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	29.4600	0.0000	0.0000
E6 Intermediate floor within a dwelling	2.9600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) -1.2647 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 60.7020 (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	64.9013	64.7223	64.5468	63.7226	63.5684	62.8505	62.8505	62.7176	63.1270	63.5684	63.8803	64.2065	(38)
Heat transfer coeff	125.6033	125.4243	125.2488	124.4246	124.2704	123.5525	123.5525	123.4196	123.8290	124.2704	124.5823	124.9085	(39)
Average = Sum(39)m / 12 =												124.4238	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0828	1.0812	1.0797	1.0726	1.0713	1.0651	1.0651	1.0640	1.0675	1.0713	1.0740	1.0768	(40)
HLP (average)												1.0726	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8464 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	31.0620	30.6007	29.9511	28.7533	27.8564	26.8619	26.3247	26.9698	27.6722	28.7363	29.9588	30.9570	(42b)
Hot water usage for other uses	43.7804	42.1884	40.5964	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804	(42c)

Average daily hot water use (litres/day) 68.5997 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	74.8424	72.7891	70.5474	67.7576	65.2687	62.6822	62.1450	64.3821	66.6765	69.3327	72.1471	74.7374	(44)
Energy conte	118.5321	103.6507	108.4288	92.7568	87.8642	77.0751	75.1590	79.7185	82.2188	94.0838	102.7868	117.0207	(45)

Energy content (annual) Total = Sum(45)m = 1139.2952

Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	100.7523	88.1031	92.1645	78.8433	74.6846	65.5138	63.8851	67.7607	69.8860	79.9712	87.3688	99.4676	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	100.7523	88.1031	92.1645	78.8433	74.6846	65.5138	63.8851	67.7607	69.8860	79.9712	87.3688	99.4676	(64)

Total per year (kWh/year) = Sum(64)m = 968.4010 (64)

12Total per year (kWh/year) 968 (64)

Electric shower(s)													
	57.6161	51.3365	56.0574	53.4949	54.4988	51.9865	53.7194	54.4988	53.4949	56.0574	55.0034	57.6161	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 655.3803 (64a)

Heat gains from water heating, kWh/month													
	39.5921	34.8599	37.0555	33.0846	32.2958	29.3751	29.4011	30.5649	30.8452	34.0072	35.5930	39.2709	(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	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	141.1826	156.3093	141.1826	145.8887	141.1826	145.8887	141.1826	141.1826	145.8887	141.1826	145.8887	141.1826	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	279.9103	282.8149	275.4954	259.9131	240.2432	221.7563	209.4059	206.5014	213.8208	229.4031	249.0730	267.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating gains (Table 5)													
	53.2152	51.8748	49.8058	45.9508	43.4084	40.7987	39.5177	41.0818	42.8406	45.7086	49.4348	52.7835	(72)
Total internal gains													
	540.0047	556.6956	532.1803	517.4491	490.5308	474.1403	455.8028	454.4623	468.2467	481.9909	510.0931	527.2226	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	22.1800	10.6334	0.3600	0.0000	0.7700	65.3772	(74)
East	15.9000	19.6403	0.3600	0.0000	0.7700	86.5641	(76)

Solar gains	151.9413	294.2769	491.1774	747.7346	957.8282	1002.0301	944.9185	781.5459	579.5994	349.6573	188.5865	125.6878	(83)
Total gains	691.9460	850.9725	1023.3577	1265.1838	1448.3590	1476.1704	1400.7213	1236.0083	1047.8461	831.6482	698.6795	652.9104	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.4522	77.5627	77.6714	78.1859	78.2829	78.7378	78.7378	78.8226	78.5619	78.2829	78.0869	77.8830	
alpha	6.1635	6.1708	6.1781	6.2124	6.2189	6.2492	6.2492	6.2548	6.2375	6.2189	6.2058	6.1922	
util living area													
	0.9993	0.9972	0.9872	0.9242	0.7487	0.5306	0.3875	0.4574	0.7608	0.9760	0.9979	0.9995	(86)
MIT	19.8719	20.0605	20.3532	20.7298	20.9426	20.9940	20.9993	20.9981	20.9540	20.6137	20.1689	19.8390	(87)
Th 2	20.0149	20.0162	20.0174	20.0233	20.0243	20.0294	20.0294	20.0304	20.0275	20.0243	20.0221	20.0198	(88)
util rest of house													
	0.9990	0.9961	0.9819	0.8969	0.6866	0.4526	0.3024	0.3621	0.6758	0.9623	0.9968	0.9993	(89)
MIT 2	18.9860	19.1750	19.4650	19.8229	19.9922	20.0273	20.0293	20.0300	20.0067	19.7263	19.2883	18.9570	(90)

Living area fraction fLA = Living area / (4) = 0.4810 (91)

MIT	19.4121	19.6010	19.8923	20.2592	20.4494	20.4923	20.4959	20.4957	20.4624	20.1531	19.7119	19.3812	(92)

Temperature adjustment 0.0000

adjusted MIT	19.4121	19.6010	19.8923	20.2592	20.4494	20.4923	20.4959	20.4957	20.4624	20.1531	19.7119	19.3812	(93)

8. Space heating requirement

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

```
Utilisation      0.9987     0.9954     0.9810     0.9042     0.7147     0.4901     0.3434     0.4081     0.7158     0.9645     0.9964     0.9991 (94)
Useful gains   691.0704   847.0772  1003.9550  1144.0106  1035.1473   723.5296   480.9480   504.3710   750.0431   802.1617   696.1333   652.3290 (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
              1898.1351  1843.8574  1677.3639  1413.3587  1087.2915   728.0076   481.3469   505.4857   787.8459  1187.1729  1571.2223  1896.2656 (97)
Space heating kWh
               898.0561   669.8363   501.0162   193.9307    38.7953     0.0000     0.0000     0.0000     0.0000   286.4483   630.0641   925.4889 (98a)
Space heating requirement - total per year (kWh/year)                                                                                4143.6359
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
               898.0561   669.8363   501.0162   193.9307    38.7953     0.0000     0.0000     0.0000     0.0000   286.4483   630.0641   925.4889 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                       4143.6359
Space heating per m2                                                                                                (98c) / (4) =      35.7210 (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  1161.3935   914.2885   937.9887     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation      0.0000     0.0000     0.0000     0.0000     0.0000     0.9658     0.9860     0.9707     0.0000     0.0000     0.0000     0.0000 (101)
Useful loss      0.0000     0.0000     0.0000     0.0000     0.0000  1121.7093   901.4942   910.5220     0.0000     0.0000     0.0000     0.0000 (102)
Total gains      0.0000     0.0000     0.0000     0.0000     0.0000  1667.1891  1581.7156  1391.9918     0.0000     0.0000     0.0000     0.0000 (103)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000   392.7454   506.0848   358.2136     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    98.1864   126.5212    89.5534     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling requirement                                                                                                             314.2609 (107)
Energy for space heating                                                                                                               35.7210 (99)
Energy for space cooling                                                                                                                2.7091 (108)
Total                                                                                                                                  38.4301 (109)
Fabric Energy Efficiency (DFEE)                                                                                                           38.4 (109)


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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY
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1. Overall dwelling characteristics
----------------------------------------------------------------------------------------------------
                                                                                            Area         Storey height             Volume
                                                                                            (m2)               (m)                  (m3)
Ground floor                                                                            116.0000 (1b)    x      3.1500 (2b)    =     365.4000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              116.0000                                                              (4)
Dwelling volume                                                                                 (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     365.4000 (5)


----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                                                                              m3 per hour

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

                                                                                                                 Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =              40.0000 / (5) =      0.1095 (8)
Pressure test                                                                                                                          Yes
Pressure Test Method                                                                                                            Blower Door
Measured/design AP50                                                                                                                5.0000 (17)
Infiltration rate                                                                                                                   0.3595 (18)
Number of sides sheltered                                                                                                                1 (19)

Shelter factor                                                                                   (20) = 1  -  [0.075 x (19)]  =      0.9250 (20)
Infiltration rate adjusted to include shelter factor                                                       (21) = (18) x (20)  =      0.3325 (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
                0.4239     0.4156     0.4073     0.3658     0.3574     0.3159     0.3159     0.3076     0.3325     0.3574     0.3741     0.3907 (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    0.5899     0.5864     0.5830     0.5669     0.5639     0.5499     0.5499     0.5473     0.5553     0.5639     0.5700     0.5763 (25)



-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                         Gross       Openings        NetArea        U-value          A x U        K-value          A x K
                                                   m2             m2             m2          W/m2K            W/K         kJ/m2K           kJ/K
TER Opaque door                                                              2.2000         1.0000         2.2000                                (26)
TER Opening Type (Uw = 1.20)                                                26.8000         1.1450        30.6870                                (27)
External Wall 1                              117.5900        40.2800        77.3100         0.1800        13.9158                               (29a)
sheltered wall                                 9.3400                        9.3400         0.1800         1.6812                               (29a)
Total net area of external elements Aum(A, m2)                             115.6500                                                           (31)
Fabric heat loss, W/K = Sum (A x U)                                               (26)...(30) + (32) =    48.4840                            (33)
Party Wall 1                                                                46.4000         0.0000         0.0000                                (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                 301.9111 (35)
List of Thermal Bridges
        K1 Element                                                                              Length      Psi-value          Total
        E16 Corner (normal)                                                                    25.2000         0.0900         2.2680
        E17 Corner (inverted – internal area greater than external area)                       22.0500        -0.0900        -1.9845
        E2 Other lintels (including other steel lintels)                                       14.1800         0.0500         0.7090
        E3 Sill                                                                                14.1800         0.0500         0.7090
        E4 Jamb                                                                                37.8000         0.0500         1.8900
        E7 Party floor between dwellings (in blocks of flats)                                  74.6600         0.0700         5.2262
        E18 Party wall between dwellings                                                        6.3000         0.0600         0.3780
        P3 Party wall - Intermediate floor between dwellings (in blocks of flats)              29.4600         0.0000         0.0000
        E6 Intermediate floor within a dwelling                                                 2.9600         0.0000         0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                          9.1957 (36)
Point Thermal bridges                                                                                          (36a) =              0.0000
Total fabric heat loss                                                                           (33) + (36) + (36a) =             57.6797 (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          71.1273    70.7065    70.2940    68.3567    67.9943    66.3070    66.3070    65.9945    66.9569    67.9943    68.7275    69.4941 (38)
Heat transfer coeff
              128.8070   128.3862   127.9737   126.0365   125.6740   123.9867   123.9867   123.6742   124.6366   125.6740   126.4073   127.1738 (39)
Average = Sum(39)m / 12 =                                                                                                          126.0347

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             1.1104     1.1068     1.1032     1.0865     1.0834     1.0689     1.0689     1.0662     1.0745     1.0834     1.0897     1.0963 (40)
HLP (average)                                                                                                                        1.0865
Days in mont        31         28         31         30         31         30         31         31         30         31         30         31



-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                    2.8464 (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
               31.0620    30.6007    29.9511    28.7533    27.8564    26.8619    26.3247    26.9698    27.6722    28.7363    29.9588    30.9570 (42b)
Hot water usage for other uses
               43.7804    42.1884    40.5964    39.0043    37.4123    35.8203    35.8203    37.4123    39.0043    40.5964    42.1884    43.7804 (42c)
Average daily hot water use (litres/day)                                                                                            68.5997 (43)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               74.8424    72.7891    70.5474    67.7576    65.2687    62.6822    62.1450    64.3821    66.6765    69.3327    72.1471    74.7374 (44)
Energy conte  118.5321   103.6507   108.4288    92.7568    87.8642    77.0751    75.1590    79.7185    82.2188    94.0838   102.7868   117.0207 (45)
Energy content (annual)                                                                                      Total = Sum(45)m =   1139.2952
Distribution loss  (46)m = 0.15 x (45)m
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Primary loss    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Combi loss      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (61)
Total heat required for water heating calculated for each month
              100.7523    88.1031    92.1645    78.8433    74.6846    65.5138    63.8851    67.7607    69.8860    79.9712    87.3688    99.4676 (62)
WWHRS           0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63a)
PV diverter     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63b)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63c)
FGHRS           0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63d)
Output from w/h
              100.7523    88.1031    92.1645    78.8433    74.6846    65.5138    63.8851    67.7607    69.8860    79.9712    87.3688    99.4676 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =       968.4010 (64)
12Total per year (kWh/year)                                                                                                            968 (64)
Electric shower(s)
               57.6161    51.3365    56.0574    53.4949    54.4988    51.9865    53.7194    54.4988    53.4949    56.0574    55.0034    57.6161 (64a)
                                                  Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =   655.3803 (64a)
```

Heat gains from water heating, kWh/month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	39.5921	34.8599	37.0555	33.0846	32.2958	29.3751	29.4011	30.5649	30.8452	34.0072	35.5930	39.2709	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	141.1826	156.3093	141.1826	145.8887	141.1826	145.8887	141.1826	141.1826	145.8887	141.1826	145.8887	141.1826	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	279.9103	282.8149	275.4954	259.9131	240.2432	221.7563	209.4059	206.5014	213.8208	229.4031	249.0730	267.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating gains (Table 5)													
	53.2152	51.8748	49.8058	45.9508	43.4084	40.7987	39.5177	41.0818	42.8406	45.7086	49.4348	52.7835	(72)
Total internal gains													
	540.0047	556.6956	532.1803	517.4491	490.5308	474.1403	455.8028	454.4623	468.2467	481.9909	510.0931	527.2226	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.6100	10.6334	0.6300	0.7000	0.7700	50.7279	(74)
East	11.1900	19.6403	0.6300	0.7000	0.7700	67.1660	(76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	117.8938	228.3344	381.1128	580.1802	743.1957	777.4929	733.1789	606.4151	449.7210	271.3050	146.3274	97.5233	(83)
Total gains	657.8985	785.0300	913.2931	1097.6293	1233.7265	1251.6332	1188.9817	1060.8774	917.9677	753.2958	656.4205	624.7459	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	75.5258	75.7733	76.0175	77.1860	77.4086	78.4620	78.4620	78.6603	78.0529	77.4086	76.9596	76.4957	
alpha	6.0351	6.0516	6.0678	6.1457	6.1606	6.2308	6.2308	6.2440	6.2035	6.1606	6.1306	6.0997	
util living area													
	0.9995	0.9982	0.9931	0.9589	0.8360	0.6199	0.4569	0.5311	0.8316	0.9855	0.9985	0.9996	(86)
MIT	19.8070	19.9743	20.2414	20.6212	20.8898	20.9858	20.9981	20.9956	20.9224	20.5471	20.1172	19.7896	(87)
Th 2	19.9923	19.9953	19.9982	20.0119	20.0144	20.0264	20.0264	20.0286	20.0218	20.0144	20.0092	20.0038	(88)
util rest of house													
	0.9992	0.9975	0.9900	0.9413	0.7800	0.5323	0.3569	0.4219	0.7526	0.9766	0.9977	0.9994	(89)
MIT 2	18.9029	19.0722	19.3399	19.7174	19.9481	20.0211	20.0260	20.0276	19.9838	19.6554	19.2264	18.8948	(90)
Living area fraction									fLA = Living area / (4) =			0.4810	(91)
MIT	19.3378	19.5062	19.7736	20.1522	20.4011	20.4851	20.4936	20.4932	20.4353	20.0843	19.6549	19.3252	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3378	19.5062	19.7736	20.1522	20.4011	20.4851	20.4936	20.4932	20.4353	20.0843	19.6549	19.3252	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9970	0.9892	0.9443	0.8035	0.5744	0.4051	0.4747	0.7888	0.9774	0.9974	0.9993	(94)
Useful gains	657.2559	782.6762	903.3905	1036.4494	991.3380	718.9154	481.7134	503.6086	724.1053	736.2485	654.6999	624.3031	(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													
	1936.9776	1875.2296	1698.6663	1418.1819	1093.5057	729.6800	482.7584	506.2294	789.6116	1191.9359	1587.0310	1923.5292	(97)
Space heating kWh													
	952.1129	734.1959	591.6852	274.8474	76.0127	0.0000	0.0000	0.0000	0.0000	339.0314	671.2783	966.6243	(98a)
Space heating requirement - total per year (kWh/year)												4605.7882	
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													
	952.1129	734.1959	591.6852	274.8474	76.0127	0.0000	0.0000	0.0000	0.0000	339.0314	671.2783	966.6243	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4605.7882	
Space heating per m2										(98c) / (4) =		39.7051	(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	1165.4750	917.5016	939.9242	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9282	0.9675	0.9406	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1081.7594	887.7211	884.1187	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1404.7431	1334.2279	1187.2934	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	232.5482	332.2010	225.5620	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	58.1371	83.0503	56.3905	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement	197.5778	(107)
Energy for space heating	39.7051	(99)
Energy for space cooling	1.7033	(108)
Total	41.4083	(109)
Fabric Energy Efficiency (TFEE)	41.4	(109)

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

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1. Overall dwelling characteristics

	Area (m2)			Storey height (m)		Volume (m3)	
Ground floor	116.0000	(1b)	x	3.1500	(2b) =	365.4000	(1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		365.4000	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		2.5000	(17)
Infiltration rate		0.1250	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1156	(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	0.1474	0.1445	0.1416	0.1272	0.1243	0.1098	0.1098	0.1070	0.1156	0.1243	0.1301	0.1359	(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) =	76.5000	(23c)

Effective ac	0.2649	0.2620	0.2591	0.2447	0.2418	0.2273	0.2273	0.2245	0.2331	0.2418	0.2476	0.2534	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.20)			38.0800	1.1450	43.6031			(27)
Door			2.2000	1.3000	2.8600			(26)
External Wall 1	117.5900	40.2800	77.3100	0.1800	13.9158	190.0000	14688.9000	(29a)

sheltered wall	9.3400	9.3400	0.1700	1.5878	190.0000	1774.6000	(29a)
Total net area of external elements Aum(A, m2)		126.9300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	61.9667			(33)
Party Wall 1		46.4000	0.0000	0.0000	180.0000	8352.0000	(32)
Party Floor 1		116.0000			40.0000	4640.0000	(32d)
Party Ceiling 1		116.0000			40.0000	4640.0000	(32b)
Internal Wall 1		102.9100			9.0000	926.1900	(32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 35021.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 301.9111 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	25.2000	0.0320	0.8064
E17 Corner (inverted - internal area greater than external area)	22.0500	-0.1170	-2.5799
E2 Other lintels (including other steel lintels)	14.1800	0.0020	0.0284
E3 Sill	14.1800	0.0130	0.1843
E4 Jamb	37.8000	0.0080	0.3024
E7 Party floor between dwellings (in blocks of flats)	74.6600	0.0000	0.0000
E18 Party wall between dwellings	6.3000	-0.0010	-0.0063
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	29.4600	0.0000	0.0000
E6 Intermediate floor within a dwelling	2.9600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) -1.2647 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 60.7020 (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	31.9448	31.5963	31.2477	29.5049	29.1564	27.4136	27.4136	27.0650	28.1107	29.1564	29.8535	30.5506	(38)
Heat transfer coeff	92.6468	92.2983	91.9497	90.2069	89.8584	88.1156	88.1156	87.7670	88.8127	89.8584	90.5555	91.2526	(39)
Average = Sum(39)m / 12 =												90.1198	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7987	0.7957	0.7927	0.7776	0.7746	0.7596	0.7596	0.7566	0.7656	0.7746	0.7807	0.7867	(40)
HLP (average)												0.7769	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8464 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	82.9886	81.7561	80.0205	76.8203	74.4241	71.7670	70.3318	72.0553	73.9318	76.7750	80.0410	82.7080	(42b)
Hot water usage for other uses	43.7804	42.1884	40.5964	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804	(42c)

Average daily hot water use (litres/day) 116.7438 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.7689	123.9444	120.6168	115.8246	111.8364	107.5873	106.1521	109.4676	112.9362	117.3713	122.2294	126.4884	(44)
Energy conte	200.7710	176.4952	185.3835	158.5581	150.5533	132.2912	128.3818	135.5438	139.2616	159.2718	174.1382	198.0503	(45)
Energy content (annual)											Total = Sum(45)m =	1938.6996	
Distribution loss (46)m = 0.15 x (45)m	30.1157	26.4743	27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46)

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.4000 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.0920 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	33.8520	30.5760	33.8520	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	33.8520	(56)
If cylinder contains dedicated solar storage	33.8520	30.5760	33.8520	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	33.8520	(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	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(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	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(64)

Total per year (kWh/year) = Sum(64)m = 2611.1756 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	112.4479	99.9544	107.3315	96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	(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	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.6222	39.6330	32.2317	24.4015	18.2404	15.3993	16.6395	21.6287	29.0299	36.8602	43.0213	45.8623	(67)

```
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               417.7766    422.1118    411.1872    387.9300    358.5720    330.9796    312.5462    308.2110    319.1356    342.3928    371.7508    399.3431 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                54.9251     54.9251     54.9251     54.9251     54.9251     54.9251     54.9251     54.9251     54.9251     54.9251     54.9251     54.9251 (69)
Pumps, fans      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -113.8576   -113.8576   -113.8576   -113.8576   -113.8576   -113.8576   -113.8576   -113.8576   -113.8576   -113.8576   -113.8576   -113.8576 (71)
Water heating gains (Table 5)
               151.1396    148.7417    144.2628    134.6364    128.6969    122.5061    118.7883    121.9890    125.7251    132.5933    141.8313    149.9237 (72)
Total internal gains
               725.3922    722.3403    699.5356    658.8217    617.3631    580.7389    559.8278    563.6825    585.7445    623.7000    668.4572    706.9830 (73)



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6. Solar gains
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[Jan]                                        Area          Solar flux                g                FF            Access               Gains
                                               m2            Table 6a    Specific data    Specific data            factor                   W
                                                                 W/m2      or Table 6b      or Table 6c          Table 6d
----------------------------------------------------------------------------------------------------
North                                     22.1800             10.6334           0.3600           0.0000            0.7700             65.3772 (74)
East                                      15.9000             19.6403           0.3600           0.0000            0.7700             86.5641 (76)
----------------------------------------------------------------------------------------------------

Solar gains    151.9413    294.2769    491.1774    747.7346    957.8282   1002.0301    944.9185    781.5459    579.5994    349.6573    188.5865    125.6878 (83)
Total gains    877.3335   1016.6173   1190.7130   1406.5563   1575.1913   1582.7690   1504.7463   1345.2284   1165.3439    973.3573    857.0436    832.6708 (84)



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7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                    21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                    Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau            105.0036    105.4001    105.7997    107.8437    108.2620    110.4033    110.4033    110.8417    109.5367    108.2620    107.4286    106.6079
alpha            8.0002      8.0267      8.0533      8.1896      8.2175      8.3602      8.3602      8.3894      8.3024      8.2175      8.1619      8.1072
util living area
                 0.9953      0.9845      0.9329      0.7519      0.5292      0.3563      0.2577      0.3001      0.5247      0.8725      0.9857      0.9967 (86)

MIT             20.4339     20.5923     20.8129     20.9714     20.9982     20.9999     21.0000     21.0000     20.9988     20.9281     20.6513     20.4082 (87)
Th 2            20.2545     20.2571     20.2597     20.2727     20.2754     20.2885     20.2885     20.2911     20.2832     20.2754     20.2701     20.2649 (88)
util rest of house
                 0.9937      0.9793      0.9146      0.7136      0.4885      0.3167      0.2160      0.2539      0.4708      0.8349      0.9801      0.9956 (89)
MIT 2           19.6009     19.8022     20.0696     20.2488     20.2742     20.2884     20.2885     20.2911     20.2826     20.2140     19.8889     19.5770 (90)
Living area fraction                                                                                        fLA = Living area / (4) =           0.4810 (91)
MIT             20.0016     20.1823     20.4271     20.5964     20.6224     20.6307     20.6307     20.6321     20.6271     20.5575     20.2556     19.9768 (92)
Temperature adjustment                                                                                                                           0.0000
adjusted MIT    20.0016     20.1823     20.4271     20.5964     20.6224     20.6307     20.6307     20.6321     20.6271     20.5575     20.2556     19.9768 (93)



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8. Space heating requirement
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                    Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation      0.9930      0.9787      0.9191      0.7310      0.5080      0.3357      0.2360      0.2761      0.4967      0.8504      0.9799      0.9950 (94)
Useful gains   871.1744    995.0005   1094.3289   1028.1480    800.2220    531.3601    355.1692    371.4329    578.8063    827.7516    839.8438    828.4968 (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
              1454.7047   1410.5259   1280.5967   1055.0941    801.7562    531.3986    355.1707    371.4384    579.6920    894.7628   1191.3131   1439.6777 (97)
Space heating kWh
               434.1466    279.2331    138.5833     19.4012      1.1415      0.0000      0.0000      0.0000      0.0000     49.8563    253.0579    454.7186 (98a)
Space heating requirement - total per year (kWh/year)                                                                                        1630.1384
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
               434.1466    279.2331    138.5833     19.4012      1.1415      0.0000      0.0000      0.0000      0.0000     49.8563    253.0579    454.7186 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                               1630.1384
Space heating per m2                                                                                                  (98c) / (4) =         14.0529 (99)



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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 Heat pump-Space and Water                                                                                       1.0000 (303a)
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
               434.1466    279.2331    138.5833     19.4012      1.1415      0.0000      0.0000      0.0000      0.0000     49.8563    253.0579    454.7186 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50
307a           651.2199    418.8497    207.8749     29.1017      1.7122      0.0000      0.0000      0.0000      0.0000     74.7845    379.5869    682.0779
Space heating requirement
               651.2199    418.8497    207.8749     29.1017      1.7122      0.0000      0.0000      0.0000      0.0000     74.7845    379.5869    682.0779 (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
               257.8854   228.0824   242.4979   213.8301   207.6677   187.5632   185.4962   192.6582   194.5336   216.3862   229.4102   255.1647 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50
310a           386.8281   342.1236   363.7469   320.7452   311.5015   281.3447   278.2443   288.9872   291.8004   324.5792   344.1152   382.7470
Water heating fuel
               386.8281   342.1236   363.7469   320.7452   311.5015   281.3447   278.2443   288.9872   291.8004   324.5792   344.1152   382.7470 (310)
Cooling System Energy Efficiency Ratio                                                                                                0.0000 (314)
Space coolin     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (315)
Pumps and Fa    35.4951    32.0601    35.4951    34.3501    35.4951    34.3501    35.4951    35.4951    34.3501    35.4951    34.3501    35.4951 (331)
Lighting        39.0575    31.3334    28.2122    20.6695    15.9657    13.0441    14.5645    18.9314    24.5901    32.2635    36.4415    40.1430 (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                                                                                             2445.2076 (307)
Space heating fuel - secondary                                                                                                        0.0000 (309)
Water heating fuel - community heating                                                                                             3916.7634 (310)
Efficiency of water heater                                                                                                            0.0000 (311)
Electricity used for heat distribution                                                                                               24.4521 (313)
Space cooling fuel                                                                                                                    0.0000 (321)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)
   mechanical ventilation fans (SFP =       0.9375)                                                                                 417.9262 (330a)
Total electricity for the above, kWh/year                                                                                           417.9262 (331)
Electricity for lighting (calculated in Appendix L)                                                                                 315.2165 (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                                                                                                7095.1137 (338)


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10b. Fuel costs - using Table 12 prices
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                                                                                           Fuel          Fuel price             Fuel cost
                                                                                       kWh/year               p/kWh                £/year
Space heating from Heat pump                                                          2445.2076              4.4400              108.5672 (340a)
Space heating total                                                                                                              108.5672 (340)
Total CO2 associated with community systems                                                                                        0.0000 (473)
Space heating - secondary                                                                0.0000              0.0000                0.0000 (341)
Water heating from Heat pump                                                          3916.7634              4.4400              173.9043 (342a)
Water heating total                                                                                                              173.9043 (342)
Energy for instantaneous electric shower(s)                                              0.0000             16.4900                0.0000 (347a)
Pumps, fans and electric keep-hot                                                      417.9262             16.4900               68.9160 (349)
Energy for lighting                                                                    315.2165             16.4900               51.9792 (350)
Additional standing charges                                                                                                       92.0000 (351)
Total energy cost                                                                                                                495.3667 (355)



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11b. SAP rating - Community heating scheme
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Energy cost deflator (Table 12):                                                                                                   0.3600 (356)
Energy cost factor (ECF)                                                        [(255) x (256)] / [(4) + 45.0] =                   1.1077 (357)
SAP value                                                                                                                         82.0450
SAP rating (Section 12)                                                                                                                82 (358)
SAP band                                                                                                                                B


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                                                         Energy     Emission factor             Emissions
                                                                                       kWh/year         kg CO2/kWh           kg CO2/year
Efficiency of heat source Heat pump                                                                                              412.0000 (367)
Space and Water heating from Heat pump                                                1544.1677              0.1587               94.1806 (367)
Electrical energy for heat distribution (space & water)                                 24.4521              0.0000                9.3956 (372)
Overall CO2 factor for heat network                                                                                                0.0373 (386)
Total CO2 associated with community systems                                                                                      237.4441 (373)
Space and water heating                                                                                                          237.4441 (376)
Pumps, fans and electric keep-hot                                                      417.9262              0.1387               57.9715 (378)
```

Energy for lighting	315.2165	0.1443	45.4955 (379)
Total CO2, kg/year			340.9111 (383)
CO2 emissions per m2			2.9400 (384)
EI value			97.1626 (384a)
EI rating			97 (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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)
Ground floor	116.0000 (1b)	x	3.1500 (2b)	=	365.4000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.0000				(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4000 (5)

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2. Ventilation rate

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

			Air changes per hour
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			2.5000 (17)
Infiltration rate			0.1250 (18)
Number of sides sheltered			1 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1156 (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	0.1214	0.1156	0.1156	0.1070	0.1070	0.0954	0.0983	0.0925	0.0954	0.1012	0.1012	0.1098 (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) =	76.5000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Effective ac	0.2389	0.2331	0.2331	0.2245	0.2245	0.2129	0.2158	0.2100	0.2129	0.2187	0.2187	0.2273 (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
Opening Type 1 (Uw = 1.20)			38.0800	1.1450	43.6031		(27)
Door			2.2000	1.3000	2.8600		(26)
External Wall 1	117.5900	40.2800	77.3100	0.1800	13.9158	190.0000	14688.9000 (29a)
sheltered wall	9.3400		9.3400	0.1700	1.5878	190.0000	1774.6000 (29a)
Total net area of external elements Aum(A, m2)			126.9300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.9667		(33)
Party Wall 1			46.4000	0.0000	0.0000	180.0000	8352.0000 (32)
Party Floor 1			116.0000			40.0000	4640.0000 (32d)
Party Ceiling 1			116.0000			40.0000	4640.0000 (32b)
Internal Wall 1			102.9100			9.0000	926.1900 (32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	35021.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		301.9111 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E16 Corner (normal)	25.2000	0.0320	0.8064
E17 Corner (inverted – internal area greater than external area)	22.0500	-0.1170	-2.5799
E2 Other lintels (including other steel lintels)	14.1800	0.0020	0.0284
E3 Sill	14.1800	0.0130	0.1843
E4 Jamb	37.8000	0.0080	0.3024
E7 Party floor between dwellings (in blocks of flats)	74.6600	0.0000	0.0000
E18 Party wall between dwellings	6.3000	-0.0010	-0.0063
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	29.4600	0.0000	0.0000
E6 Intermediate floor within a dwelling	2.9600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) -1.2647 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 60.7020 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.8078	28.1107	28.1107	27.0650	27.0650	25.6708	26.0193	25.3222	25.6708	26.3679	26.3679	27.4136	(38)
Heat transfer coeff	89.5098	88.8127	88.8127	87.7670	87.7670	86.3728	86.7213	86.0242	86.3728	87.0699	87.0699	88.1156	(39)
Average = Sum(39)m / 12 =												87.5346	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7716	0.7656	0.7656	0.7566	0.7566	0.7446	0.7476	0.7416	0.7446	0.7506	0.7506	0.7596	(40)
HLP (average)												0.7546	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8464 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	82.9886	81.7561	80.0205	76.8203	74.4241	71.7670	70.3318	72.0553	73.9318	76.7750	80.0410	82.7080	(42b)
Hot water usage for other uses	43.7804	42.1884	40.5964	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804	(42c)

Average daily hot water use (litres/day) 116.7438 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.7689	123.9444	120.6168	115.8246	111.8364	107.5873	106.1521	109.4676	112.9362	117.3713	122.2294	126.4884	(44)
Energy conte	200.7710	176.4952	185.3835	158.5581	150.5533	132.2912	128.3818	135.5438	139.2616	159.2718	174.1382	198.0503	(45)

Energy content (annual) Total = Sum(45)m = 1938.6996

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	30.1157	26.4743	27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46)

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.4000 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.0920 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	33.8520	30.5760	33.8520	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	33.8520	(56)
If cylinder contains dedicated solar storage	33.8520	30.5760	33.8520	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	33.8520	(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	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(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	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(64)

Total per year (kWh/year) = Sum(64)m = 2611.1756 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	112.4479	99.9544	107.3315	96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	(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	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.6222	39.6330	32.2317	24.4015	18.2404	15.3993	16.6395	21.6287	29.0299	36.8602	43.0213	45.8623	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.7766	422.1118	411.1872	387.9300	358.5720	330.9796	312.5462	308.2110	319.1356	342.3928	371.7508	399.3431	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating gains (Table 5)	151.1396	148.7417	144.2628	134.6364	128.6969	122.5061	118.7883	121.9890	125.7251	132.5933	141.8313	149.9237	(72)
Total internal gains	725.3922	722.3403	699.5356	658.8217	617.3631	580.7389	559.8278	563.6825	585.7445	623.7000	668.4572	706.9830	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	22.1800	11.9814	0.3600	0.0000	0.7700	73.6654	(74)
East	15.9000	22.3313	0.3600	0.0000	0.7700	98.4248	(76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	172.0903	300.9973	497.9669	781.8060	974.4253	1089.7924	1017.0605	861.4874	637.3608	382.4465	219.0645	140.8221	(83)
Total gains	897.4825	1023.3376	1197.5025	1440.6277	1591.7885	1670.5313	1576.8883	1425.1699	1223.1052	1006.1466	887.5216	847.8051	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	108.6836	109.5367	109.5367	110.8417	110.8417	112.6309	112.1782	113.0873	112.6309	111.7292	111.7292	110.4033	
alpha	8.2456	8.3024	8.3024	8.3894	8.3894	8.5087	8.4785	8.5392	8.5087	8.4486	8.4486	8.3602	
util living area	0.9916	0.9757	0.8963	0.6678	0.4408	0.2585	0.1705	0.1932	0.4095	0.7825	0.9693	0.9940	(86)
MIT	20.5501	20.6881	20.8864	20.9897	20.9997	21.0000	21.0000	21.0000	20.9999	20.9737	20.7700	20.5280	(87)
Th 2	20.2780	20.2832	20.2832	20.2911	20.2911	20.3016	20.2990	20.3042	20.3016	20.2963	20.2963	20.2885	(88)
util rest of house	0.9886	0.9679	0.8711	0.6280	0.4019	0.2224	0.1319	0.1512	0.3602	0.7345	0.9578	0.9918	(89)
MIT 2	19.7677	19.9433	20.1737	20.2831	20.2909	20.3016	20.2990	20.3042	20.3016	20.2766	20.0567	19.7488	(90)
Living area fraction									fLA = Living area / (4) =			0.4810	(91)
MIT	20.1441	20.3016	20.5165	20.6230	20.6318	20.6376	20.6362	20.6389	20.6375	20.6119	20.3998	20.1236	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1441	20.3016	20.5165	20.6230	20.6318	20.6376	20.6362	20.6389	20.6375	20.6119	20.3998	20.1236	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9880	0.9681	0.8798	0.6468	0.4206	0.2398	0.1505	0.1714	0.3839	0.7566	0.9597	0.9912	(94)
Useful gains	886.6802	990.6847	1053.5413	931.7862	669.5507	400.5571	237.2863	244.2163	469.5655	761.2939	851.7408	840.3427	(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	1346.5907	1305.6901	1164.9130	941.1284	669.8231	400.5587	237.2864	244.2163	469.6495	784.6645	1079.6480	1323.8136	(97)
Space heating kWh	342.1734	211.6836	82.8606	6.7263	0.2026	0.0000	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023	(98a)
Space heating requirement - total per year (kWh/year)												1184.8298	
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	342.1734	211.6836	82.8606	6.7263	0.2026	0.0000	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1184.8298	
Space heating per m2										(98c) / (4) =		10.2141	(99)

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 Heat pump-Space and Water	1.0000	(303a)
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:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	342.1734	211.6836	82.8606	6.7263	0.2026	0.0000	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307a	513.2601	317.5255	124.2908	10.0895	0.3039	0.0000	0.0000	0.0000	0.0000	26.0816	246.1398	539.5535	
Space heating requirement	513.2601	317.5255	124.2908	10.0895	0.3039	0.0000	0.0000	0.0000	0.0000	26.0816	246.1398	539.5535	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Annual water heating requirement	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310a	386.8281	342.1236	363.7469	320.7452	311.5015	281.3447	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470	
Water heating fuel	386.8281	342.1236	363.7469	320.7452	311.5015	281.3447	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)

```
Pumps and Fa    35.4951    32.0601    35.4951    34.3501    35.4951    34.3501    35.4951    35.4951    34.3501    35.4951    34.3501    35.4951 (331)
Lighting        39.0575    31.3334    28.2122    20.6695    15.9657    13.0441    14.5645    18.9314    24.5901    32.2635    36.4415    40.1430 (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                                                                                                 1777.2447 (307)
Space heating fuel - secondary                                                                                                            0.0000 (309)
Water heating fuel - community heating                                                                                                 3916.7634 (310)
Efficiency of water heater                                                                                                                0.0000 (311)
Electricity used for heat distribution                                                                                                   17.7724 (313)
Space cooling fuel                                                                                                                        0.0000 (321)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)
   mechanical ventilation fans (SFP =       0.9375)                                                                                     417.9262 (330a)
Total electricity for the above, kWh/year                                                                                               417.9262 (331)
Electricity for lighting (calculated in Appendix L)                                                                                     315.2165 (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                                                                                                    6427.1509 (338)



----------------------------------------------------------------------------------------------------
10b. Fuel costs - using BEDF prices (528)
----------------------------------------------------------------------------------------------------
                                                                                      Fuel           Fuel price           Fuel cost
                                                                                  kWh/year                p/kWh              £/year
Space heating from Heat pump                                                     1777.2447               4.8000             85.3077 (340a)
Space heating total                                                                                                         85.3077 (340)
Total CO2 associated with community systems                                                                                  0.0000 (473)
Space heating - secondary                                                           0.0000               0.0000              0.0000 (341)
Water heating from Heat pump                                                     3916.7634               4.8000            188.0046 (342a)
Water heating total                                                                                                        188.0046 (342)
Energy for instantaneous electric shower(s)                                         0.0000              21.5100              0.0000 (347a)
Pumps, fans and electric keep-hot                                                 417.9262              21.5100             89.8959 (349)
Energy for lighting                                                               315.2165              21.5100             67.8031 (350)
Additional standing charges                                                                                                 98.0000 (351)
Total energy cost                                                                                                          529.0114 (355)



----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                                                    Energy      Emission factor           Emissions
                                                                                  kWh/year           kg CO2/kWh         kg CO2/year
Efficiency of heat source Heat pump                                                                                        412.0000 (367)
Space and Water heating from Heat pump                                           1382.0408               0.1596             68.8413 (367)
Electrical energy for heat distribution (space & water)                            17.7724               0.0000              8.3516 (372)
Overall CO2 factor for heat network                                                                                          0.0371 (386)
Total CO2 associated with community systems                                                                                211.0608 (373)
Space and water heating                                                                                                    211.0608 (376)
Pumps, fans and electric keep-hot                                                 417.9262               0.1387             57.9715 (378)
Energy for lighting                                                               315.2165               0.1443             45.4955 (379)
Total CO2, kg/year                                                                                                         314.5278 (383)



----------------------------------------------------------------------------------------------------
13b. Primary energy - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                                                    Energy Primary energy factor     Primary energy
                                                                                  kWh/year           kg CO2/kWh            kWh/year
Efficiency of heat source Heat pump                                                                                        412.0000 (467a)
Space and Water heating from Heat pump                                           1382.0408               1.5907            686.1636 (467)
Electrical energy for heat distribution (space & water)                            17.7724               0.0000             87.8312 (472)
Overall CO2 factor for heat network                                                                                          0.3898 (486)
Total CO2 associated with community systems                                                                               2219.6560 (473)
Space and water heating                                                                                                   2219.6560 (476)
Pumps, fans and electric keep-hot                                                 417.9262               1.5128            632.2388 (478)
Energy for lighting                                                               315.2165               1.5338            483.4895 (479)
Total Primary energy kWh/year                                                                                             3335.3844 (483)


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SAP 10 EPC IMPROVEMENTS
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Be Green

Current energy efficiency rating:                                        B 82
Current environmental impact rating:                                     A 97

__________________________________________________________________________________________

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

Recommended measures:                     SAP change   Cost change     CO2 change
(none)
__________________________________________________________________________________________

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

Potential energy efficiency rating:                                     B 82
Potential environmental impact rating:                                           A 97

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 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                            £158          £158         £0
  Community scheme                       £371          £371         £0

  Space heating                          £273          £273         £0
  Water heating                          £188          £188         £0
  Lighting                               £68           £68          £0

  Total cost of fuels                   £529           £529           £0
  Total cost of uses                    £529           £529           £0
  Delivered energy                      55 kWh/m²      55 kWh/m²      0 kWh/m²
  Carbon dioxide emissions              0.3 tonnes     0.3 tonnes     0.0 tonnes
  CO2 emissions per m²                  3 kg/m²        3 kg/m²        0 kg/m²
  Primary energy                        29 kWh/m²      29 kWh/m²      0 kWh/m²



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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING
-----------------------------------------------------------------------------------------------------
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling characteristics
-----------------------------------------------------------------------------------------------------
                                                                                                  Area          Storey height                Volume
                                                                                                  (m2)                (m)                     (m3)
Ground floor                                                                                  116.0000 (1b)     x       3.1500 (2b)     =     365.4000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              116.0000                                                                      (4)
Dwelling volume                                                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     365.4000 (5)




-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                                                                                                     m3 per hour

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

                                                                                                                           Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =            0.0000 / (5) =        0.0000 (8)
Pressure test                                                                                                                           Yes
Pressure Test Method                                                                                                             Blower Door
Measured/design AP50                                                                                                                 2.5000 (17)
Infiltration rate                                                                                                                    0.1250 (18)
```

Number of sides sheltered 1 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.1156 (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	0.1474	0.1445	0.1416	0.1272	0.1243	0.1098	0.1098	0.1070	0.1156	0.1243	0.1301	0.1359	(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) = 76.5000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2649	0.2620	0.2591	0.2447	0.2418	0.2273	0.2273	0.2245	0.2331	0.2418	0.2476	0.2534	(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	
Opening Type 1 (Uw = 1.20)			38.0800	1.1450	43.6031			(27)
Door			2.2000	1.3000	2.8600			(26)
External Wall 1	117.5900	40.2800	77.3100	0.1800	13.9158	190.0000	14688.9000	(29a)
sheltered wall	9.3400		9.3400	0.1700	1.5878	190.0000	1774.6000	(29a)
Total net area of external elements Aum(A, m2)			126.9300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.9667			(33)
Party Wall 1			46.4000	0.0000	0.0000	180.0000	8352.0000	(32)
Party Floor 1			116.0000			40.0000	4640.0000	(32d)
Party Ceiling 1			116.0000			40.0000	4640.0000	(32b)
Internal Wall 1			102.9100			9.0000	926.1900	(32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 35021.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 301.9111 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	25.2000	0.0320	0.8064
E17 Corner (inverted – internal area greater than external area)	22.0500	-0.1170	-2.5799
E2 Other lintels (including other steel lintels)	14.1800	0.0020	0.0284
E3 Sill	14.1800	0.0130	0.1843
E4 Jamb	37.8000	0.0080	0.3024
E7 Party floor between dwellings (in blocks of flats)	74.6600	0.0000	0.0000
E18 Party wall between dwellings	6.3000	-0.0010	-0.0063
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	29.4600	0.0000	0.0000
E6 Intermediate floor within a dwelling	2.9600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) -1.2647 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 60.7020 (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	31.9448	31.5963	31.2477	29.5049	29.1564	27.4136	27.4136	27.0650	28.1107	29.1564	29.8535	30.5506	(38)
Heat transfer coeff	92.6468	92.2983	91.9497	90.2069	89.8584	88.1156	88.1156	87.7670	88.8127	89.8584	90.5555	91.2526	(39)

Average = Sum(39)m / 12 = 90.1198

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7987	0.7957	0.7927	0.7776	0.7746	0.7596	0.7596	0.7566	0.7656	0.7746	0.7807	0.7867	(40)
HLP (average)												0.7769	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy 2.8464 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	82.9886	81.7561	80.0205	76.8203	74.4241	71.7670	70.3318	72.0553	73.9318	76.7750	80.0410	82.7080	(42b)
Hot water usage for other uses	43.7804	42.1884	40.5964	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804	(42c)

Average daily hot water use (litres/day) 116.7438 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.7689	123.9444	120.6168	115.8246	111.8364	107.5873	106.1521	109.4676	112.9362	117.3713	122.2294	126.4884	(44)
Energy conte	200.7710	176.4952	185.3835	158.5581	150.5533	132.2912	128.3818	135.5438	139.2616	159.2718	174.1382	198.0503	(45)

Energy content (annual) Total = Sum(45)m = 1938.6996
Distribution loss (46)m = 0.15 x (45)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	30.1157	26.4743	27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46)

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.4000 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.0920 (55)
Total storage loss

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	33.8520	30.5760	33.8520	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	33.8520	(56)

If cylinder contains dedicated solar storage	33.8520	30.5760	33.8520	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	33.8520	(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	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(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	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(64)

Total per year (kWh/year) = Sum(64)m = 2611.1756 (64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month	112.4479	99.9544	107.3315	96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	(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	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.6222	39.6330	32.2317	24.4015	18.2404	15.3993	16.6395	21.6287	29.0299	36.8602	43.0213	45.8623	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.7766	422.1118	411.1872	387.9300	358.5720	330.9796	312.5462	308.2110	319.1356	342.3928	371.7508	399.3431	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating gains (Table 5)	151.1396	148.7417	144.2628	134.6364	128.6969	122.5061	118.7883	121.9890	125.7251	132.5933	141.8313	149.9237	(72)
Total internal gains	725.3922	722.3403	699.5356	658.8217	617.3631	580.7389	559.8278	563.6825	585.7445	623.7000	668.4572	706.9830	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	22.1800	10.6334	0.3600	0.0000	0.7700	65.3772	(74)
East	15.9000	19.6403	0.3600	0.0000	0.7700	86.5641	(76)

Solar gains	151.9413	294.2769	491.1774	747.7346	957.8282	1002.0301	944.9185	781.5459	579.5994	349.6573	188.5865	125.6878	(83)
Total gains	877.3335	1016.6173	1190.7130	1406.5563	1575.1913	1582.7690	1504.7463	1345.2284	1165.3439	973.3573	857.0436	832.6708	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	105.0036	105.4001	105.7997	107.8437	108.2620	110.4033	110.4033	110.8417	109.5367	108.2620	107.4286	106.6079	
alpha	8.0002	8.0267	8.0533	8.1896	8.2175	8.3602	8.3602	8.3894	8.3024	8.2175	8.1619	8.1072	
util living area	0.9953	0.9845	0.9329	0.7519	0.5292	0.3563	0.2577	0.3001	0.5247	0.8725	0.9857	0.9967	(86)
MIT	20.4339	20.5923	20.8129	20.9714	20.9982	20.9999	21.0000	21.0000	20.9988	20.9281	20.6513	20.4082	(87)
Th 2	20.2545	20.2571	20.2597	20.2727	20.2754	20.2885	20.2885	20.2911	20.2832	20.2754	20.2701	20.2649	(88)
util rest of house	0.9937	0.9793	0.9146	0.7136	0.4885	0.3167	0.2160	0.2539	0.4708	0.8349	0.9801	0.9956	(89)
MIT 2	19.6009	19.8022	20.0696	20.2488	20.2742	20.2884	20.2885	20.2911	20.2826	20.2140	19.8889	19.5770	(90)
Living area fraction									fLA = Living area / (4) =			0.4810	(91)
MIT	20.0016	20.1823	20.4271	20.5964	20.6224	20.6307	20.6307	20.6321	20.6271	20.5575	20.2556	19.9768	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.0016	20.1823	20.4271	20.5964	20.6224	20.6307	20.6307	20.6321	20.6271	20.5575	20.2556	19.9768	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9930	0.9787	0.9191	0.7310	0.5080	0.3357	0.2360	0.2761	0.4967	0.8504	0.9799	0.9950	(94)
Useful gains	871.1744	995.0005	1094.3289	1028.1480	800.2220	531.3601	355.1692	371.4329	578.8063	827.7516	839.8438	828.4968	(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	1454.7047	1410.5259	1280.5967	1055.0941	801.7562	531.3986	355.1707	371.4384	579.6920	894.7628	1191.3131	1439.6777	(97)
Space heating kWh	434.1466	279.2331	138.5833	19.4012	1.1415	0.0000	0.0000	0.0000	0.0000	49.8563	253.0579	454.7186	(98a)

```
Space heating requirement - total per year (kWh/year)                                                                                 1630.1384
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
               434.1466   279.2331   138.5833    19.4012     1.1415     0.0000     0.0000     0.0000     0.0000    49.8563   253.0579   454.7186 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                        1630.1384
Space heating per m2                                                                                              (98c) / (4) =         14.0529 (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 Heat pump-Space and Water                                                                                1.0000 (303a)
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
               434.1466   279.2331   138.5833    19.4012     1.1415     0.0000     0.0000     0.0000     0.0000    49.8563   253.0579   454.7186 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50
307a           651.2199   418.8497   207.8749    29.1017     1.7122     0.0000     0.0000     0.0000     0.0000    74.7845   379.5869   682.0779
Space heating requirement
               651.2199   418.8497   207.8749    29.1017     1.7122     0.0000     0.0000     0.0000     0.0000    74.7845   379.5869   682.0779 (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
               257.8854   228.0824   242.4979   213.8301   207.6677   187.5632   185.4962   192.6582   194.5336   216.3862   229.4102   255.1647 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50
310a           386.8281   342.1236   363.7469   320.7452   311.5015   281.3447   278.2443   288.9872   291.8004   324.5792   344.1152   382.7470
Water heating fuel
               386.8281   342.1236   363.7469   320.7452   311.5015   281.3447   278.2443   288.9872   291.8004   324.5792   344.1152   382.7470 (310)
Cooling System Energy Efficiency Ratio                                                                                                   0.0000 (314)
Space coolin     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (315)
Pumps and Fa    35.4951    32.0601    35.4951    34.3501    35.4951    34.3501    35.4951    35.4951    34.3501    35.4951    34.3501    35.4951 (331)
Lighting        39.0575    31.3334    28.2122    20.6695    15.9657    13.0441    14.5645    18.9314    24.5901    32.2635    36.4415    40.1430 (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                                                                                                2445.2076 (307)
Space heating fuel - secondary                                                                                                           0.0000 (309)
Water heating fuel - community heating                                                                                                3916.7634 (310)
Efficiency of water heater                                                                                                               0.0000 (311)
Electricity used for heat distribution                                                                                                  24.4521 (313)
Space cooling fuel                                                                                                                       0.0000 (321)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)
   mechanical ventilation fans (SFP =       0.9375)                                                                                    417.9262 (330a)
Total electricity for the above, kWh/year                                                                                              417.9262 (331)
Electricity for lighting (calculated in Appendix L)                                                                                    315.2165 (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                                                                                                   7095.1137 (338)


--------------------------------------------------------------------------------------------------
10b. Fuel costs - using Table 12 prices
--------------------------------------------------------------------------------------------------
                                                                                            Fuel              Fuel price              Fuel cost
                                                                                        kWh/year                   p/kWh                 £/year
Space heating from Heat pump                                                           2445.2076                  4.4400               108.5672 (340a)
Space heating total                                                                                                                    108.5672 (340)
Total CO2 associated with community systems                                                                                              0.0000 (473)
Space heating - secondary                                                                 0.0000                  0.0000                 0.0000 (341)
Water heating from Heat pump                                                           3916.7634                  4.4400               173.9043 (342a)
Water heating total                                                                                                                    173.9043 (342)
Energy for instantaneous electric shower(s)                                               0.0000                 16.4900                 0.0000 (347a)
Pumps, fans and electric keep-hot                                                       417.9262                 16.4900                68.9160 (349)
Energy for lighting                                                                     315.2165                 16.4900                51.9792 (350)
```

Additional standing charges		92.0000 (351)
Total energy cost		495.3667 (355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1077 (357)
SAP value		82.0450
SAP rating (Section 12)		82 (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 Heat pump			412.0000 (367)
Space and Water heating from Heat pump	1544.1677	0.1587	94.1806 (367)
Electrical energy for heat distribution (space & water)	24.4521	0.0000	9.3956 (372)
Overall CO2 factor for heat network			0.0373 (386)
Total CO2 associated with community systems			237.4441 (373)
Space and water heating			237.4441 (376)
Pumps, fans and electric keep-hot	417.9262	0.1387	57.9715 (378)
Energy for lighting	315.2165	0.1443	45.4955 (379)
Total CO2, kg/year			340.9111 (383)
CO2 emissions per m2			2.9400 (384)
EI value			97.1626 (384a)
EI rating			97 (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 FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		116.0000 (1b)	x	3.1500 (2b)	=	365.4000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4000 (5)

---

2. Ventilation rate

---

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		2.5000 (17)
Infiltration rate		0.1250 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1156 (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	0.1214	0.1156	0.1156	0.1070	0.1070	0.0954	0.0983	0.0925	0.0954	0.1012	0.1012	0.1098	(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) =                                    76.5000 (23c)

Effective ac     0.2389     0.2331     0.2331     0.2245     0.2245     0.2129     0.2158     0.2100     0.2129     0.2187     0.2187     0.2273 (25)



-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                         Gross       Openings        NetArea       U-value         A x U       K-value          A x K
                                                   m2             m2             m2         W/m2K           W/K        kJ/m2K           kJ/K
Opening Type 1 (Uw = 1.20)                                                  38.0800        1.1450       43.6031                              (27)
Door                                                                         2.2000        1.3000        2.8600                              (26)
External Wall 1                              117.5900        40.2800        77.3100        0.1800       13.9158      190.0000    14688.9000 (29a)
sheltered wall                                 9.3400                        9.3400        0.1700        1.5878      190.0000     1774.6000 (29a)
Total net area of external elements Aum(A, m2)                             126.9300                                                      (31)
Fabric heat loss, W/K = Sum (A x U)                                     (26)...(30) + (32) =     61.9667                                 (33)
Party Wall 1                                                                46.4000        0.0000        0.0000      180.0000     8352.0000 (32)
Party Floor 1                                                              116.0000                                   40.0000     4640.0000 (32d)
Party Ceiling 1                                                            116.0000                                   40.0000     4640.0000 (32b)
Internal Wall 1                                                            102.9100                                    9.0000      926.1900 (32c)

Heat capacity Cm = Sum(A x k)                                                         (28)...(30) + (32) + (32a)...(32e) =  35021.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                          301.9111 (35)
List of Thermal Bridges
        K1 Element                                                                    Length       Psi-value         Total
        E16 Corner (normal)                                                          25.2000          0.0320        0.8064
        E17 Corner (inverted – internal area greater than external area)             22.0500         -0.1170       -2.5799
        E2 Other lintels (including other steel lintels)                             14.1800          0.0020        0.0284
        E3 Sill                                                                      14.1800          0.0130        0.1843
        E4 Jamb                                                                      37.8000          0.0080        0.3024
        E7 Party floor between dwellings (in blocks of flats)                        74.6600          0.0000        0.0000
        E18 Party wall between dwellings                                              6.3000         -0.0010       -0.0063
        P3 Party wall - Intermediate floor between dwellings (in blocks of flats)    29.4600          0.0000        0.0000
        E6 Intermediate floor within a dwelling                                       2.9600          0.0000        0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                 -1.2647 (36)
Point Thermal bridges                                                                                        (36a) =        0.0000
Total fabric heat loss                                                                              (33) + (36) + (36a) =  60.7020 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m         28.8078    28.1107    28.1107    27.0650    27.0650    25.6708    26.0193    25.3222    25.6708    26.3679    26.3679    27.4136 (38)
Heat transfer coeff
              89.5098    88.8127    88.8127    87.7670    87.7670    86.3728    86.7213    86.0242    86.3728    87.0699    87.0699    88.1156 (39)
Average = Sum(39)m / 12 =                                                                                                          87.5346

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP            0.7716     0.7656     0.7656     0.7566     0.7566     0.7446     0.7476     0.7416     0.7446     0.7506     0.7506     0.7596 (40)
HLP (average)                                                                                                                       0.7546
Days in mont       31         28         31         30         31         30         31         31         30         31         30         31



-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                   2.8464 (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
              82.9886    81.7561    80.0205    76.8203    74.4241    71.7670    70.3318    72.0553    73.9318    76.7750    80.0410    82.7080 (42b)
Hot water usage for other uses
              43.7804    42.1884    40.5964    39.0043    37.4123    35.8203    35.8203    37.4123    39.0043    40.5964    42.1884    43.7804 (42c)
Average daily hot water use (litres/day)                                                                                          116.7438 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
             126.7689   123.9444   120.6168   115.8246   111.8364   107.5873   106.1521   109.4676   112.9362   117.3713   122.2294   126.4884 (44)
Energy conte 200.7710   176.4952   185.3835   158.5581   150.5533   132.2912   128.3818   135.5438   139.2616   159.2718   174.1382   198.0503 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =     1938.6996
Distribution loss  (46)m = 0.15 x (45)m
              30.1157    26.4743    27.8075    23.7837    22.5830    19.8437    19.2573    20.3316    20.8892    23.8908    26.1207    29.7075 (46)
Water storage loss:
Store volume                                                                                                                      180.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                       1.4000 (48)
  Temperature factor from Table 2b                                                                                                  0.7800 (49)
Enter (49) or (54) in (55)                                                                                                          1.0920 (55)
Total storage loss
              33.8520    30.5760    33.8520    32.7600    33.8520    32.7600    33.8520    33.8520    32.7600    33.8520    32.7600    33.8520 (56)
If cylinder contains dedicated solar storage
              33.8520    30.5760    33.8520    32.7600    33.8520    32.7600    33.8520    33.8520    32.7600    33.8520    32.7600    33.8520 (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
             257.8854   228.0824   242.4979   213.8301   207.6677   187.5632   185.4962   192.6582   194.5336   216.3862   229.4102   255.1647 (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
             257.8854   228.0824   242.4979   213.8301   207.6677   187.5632   185.4962   192.6582   194.5336   216.3862   229.4102   255.1647 (64)
```

Total per year (kWh/year) = Sum(64)m = 2611.1756 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	112.4479	99.9544	107.3315	96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	170.7863	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.6222	39.6330	32.2317	24.4015	18.2404	15.3993	16.6395	21.6287	29.0299	36.8602	43.0213	45.8623	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.7766	422.1118	411.1872	387.9300	358.5720	330.9796	312.5462	308.2110	319.1356	342.3928	371.7508	399.3431	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating gains (Table 5)	151.1396	148.7417	144.2628	134.6364	128.6969	122.5061	118.7883	121.9890	125.7251	132.5933	141.8313	149.9237	(72)
Total internal gains	725.3922	722.3403	699.5356	658.8217	617.3631	580.7389	559.8278	563.6825	585.7445	623.7000	668.4572	706.9830	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	22.1800	11.9814	0.3600	0.0000	0.7700	73.6654	(74)
East	15.9000	22.3313	0.3600	0.0000	0.7700	98.4248	(76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	172.0903	300.9973	497.9669	781.8060	974.4253	1089.7924	1017.0605	861.4874	637.3608	382.4465	219.0645	140.8221	(83)
Total gains	897.4825	1023.3376	1197.5025	1440.6277	1591.7885	1670.5313	1576.8883	1425.1699	1223.1052	1006.1466	887.5216	847.8051	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	108.6836	109.5367	109.5367	110.8417	110.8417	112.6309	112.1782	113.0873	112.6309	111.7292	111.7292	110.4033	
alpha	8.2456	8.3024	8.3024	8.3894	8.3894	8.5087	8.4785	8.5392	8.5087	8.4486	8.4486	8.3602	
util living area	0.9916	0.9757	0.8963	0.6678	0.4408	0.2585	0.1705	0.1932	0.4095	0.7825	0.9693	0.9940	(86)
MIT	20.5501	20.6881	20.8864	20.9897	20.9997	21.0000	21.0000	21.0000	20.9999	20.9737	20.7700	20.5280	(87)
Th 2	20.2780	20.2832	20.2832	20.2911	20.2911	20.3016	20.2990	20.3042	20.3016	20.2963	20.2963	20.2885	(88)
util rest of house	0.9886	0.9679	0.8711	0.6280	0.4019	0.2224	0.1319	0.1512	0.3602	0.7345	0.9578	0.9918	(89)
MIT 2	19.7677	19.9433	20.1737	20.2831	20.2909	20.3016	20.2990	20.3042	20.3016	20.2766	20.0567	19.7488	(90)

Living area fraction fLA = Living area / (4) = 0.4810 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	20.1441	20.3016	20.5165	20.6230	20.6318	20.6376	20.6362	20.6389	20.6375	20.6119	20.3998	20.1236	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	20.1441	20.3016	20.5165	20.6230	20.6318	20.6376	20.6362	20.6389	20.6375	20.6119	20.3998	20.1236	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9880	0.9681	0.8798	0.6468	0.4206	0.2398	0.1505	0.1714	0.3839	0.7566	0.9597	0.9912	(94)
Useful gains	886.6802	990.6847	1053.5413	931.7862	669.5507	400.5571	237.2863	244.2163	469.5655	761.2939	851.7408	840.3427	(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	1346.5907	1305.6901	1164.9130	941.1284	669.8231	400.5587	237.2864	244.2163	469.6495	784.6645	1079.6480	1323.8136	(97)
Space heating kWh	342.1734	211.6836	82.8606	6.7263	0.2026	0.0000	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023	(98a)

Space heating requirement - total per year (kWh/year) 1184.8298

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	342.1734	211.6836	82.8606	6.7263	0.2026	0.0000	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 1184.8298

Space heating per m2 (98c) / (4) = 10.2141 (99)

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 Heat pump-Space and Water												1.0000 (303a)
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												
	342.1734	211.6836	82.8606	6.7263	0.2026	0.0000	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50												
307a	513.2601	317.5255	124.2908	10.0895	0.3039	0.0000	0.0000	0.0000	0.0000	26.0816	246.1398	539.5535
Space heating requirement												
	513.2601	317.5255	124.2908	10.0895	0.3039	0.0000	0.0000	0.0000	0.0000	26.0816	246.1398	539.5535 (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												
	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50												
310a	386.8281	342.1236	363.7469	320.7452	311.5015	281.3447	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470
Water heating fuel												
	386.8281	342.1236	363.7469	320.7452	311.5015	281.3447	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	35.4951	32.0601	35.4951	34.3501	35.4951	34.3501	35.4951	35.4951	34.3501	35.4951	34.3501	35.4951 (331)
Lighting	39.0575	31.3334	28.2122	20.6695	15.9657	13.0441	14.5645	18.9314	24.5901	32.2635	36.4415	40.1430 (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	1777.2447 (307)
Space heating fuel - secondary	0.0000 (309)
Water heating fuel - community heating	3916.7634 (310)
Efficiency of water heater	0.0000 (311)
Electricity used for heat distribution	17.7724 (313)
Space cooling fuel	0.0000 (321)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)	
mechanical ventilation fans (SFP = 0.9375)	417.9262 (330a)
Total electricity for the above, kWh/year	417.9262 (331)
Electricity for lighting (calculated in Appendix L)	315.2165 (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	6427.1509 (338)

10b. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	1777.2447	4.8000	85.3077 (340a)
Space heating total			85.3077 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	3916.7634	4.8000	188.0046 (342a)
Water heating total			188.0046 (342)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (347a)
Pumps, fans and electric keep-hot	417.9262	21.5100	89.8959 (349)
Energy for lighting	315.2165	21.5100	67.8031 (350)
Additional standing charges			98.0000 (351)
Total energy cost			529.0114 (355)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			412.0000 (367)

Space and Water heating from Heat pump	1382.0408	0.1596	68.8413 (367)
Electrical energy for heat distribution (space & water)	17.7724	0.0000	8.3516 (372)
Overall CO2 factor for heat network			0.0371 (386)
Total CO2 associated with community systems			211.0608 (373)
Space and water heating			211.0608 (376)
Pumps, fans and electric keep-hot	417.9262	0.1387	57.9715 (378)
Energy for lighting	315.2165	0.1443	45.4955 (379)
Total CO2, kg/year			314.5278 (383)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			412.0000 (467a)
Space and Water heating from Heat pump	1382.0408	1.5907	686.1636 (467)
Electrical energy for heat distribution (space & water)	17.7724	0.0000	87.8312 (472)
Overall CO2 factor for heat network			0.3898 (486)
Total CO2 associated with community systems			2219.6560 (473)
Space and water heating			2219.6560 (476)
Pumps, fans and electric keep-hot	417.9262	1.5128	632.2388 (478)
Energy for lighting	315.2165	1.5338	483.4895 (479)
Total Primary energy kWh/year			3335.3844 (483)

APPENDIX H DHN CORRESPONDENCE

Hasnaat Mahmood

From: Egerton Neil: H&F <Neil.Egerton@lbhf.gov.uk>
Sent: 25 September 2023 14:16
To: Hasnaat Mahmood; Asagba-Power Roy: H&F
Cc: Sushil Pathak
Subject: RE: Ravenscourt Park Hospital - District Heating Network

Hasnaat,

Speaking to my colleagues I am advised that there isn't anything in the immediate vicinity although in the future there could be a Heat Network developed which would provide an opportunity for connection. The best route is for the development to implement an Energy Strategy that is designed in such a way that it is future-proofed and capable of connecting into a heat network in the future. The GLA provide guidance on how to do this in their London Heat Network Manual which can be found here: London Heat Network Manual II | London City Hall

Hope this helps

Regards

Neil Egerton
Team leader (North Team)
Planning
The Economy Department
Hammersmith and Fulham Council
020 8753 3476
0749 386 4826
Neil.egerton@lbhf.gov.uk
www.lbhf.gov.uk

Strategic Director for the Economy: Jon Pickstone

From: Hasnaat Mahmood <hasnaat.mahmood@cuddbentley.co.uk>
Sent: Monday, September 25, 2023 1:38 PM
To: Asagba-Power Roy: H&F <Roy.Asagba-Power@lbhf.gov.uk>
Cc: Sushil Pathak <sushil.pathak@cuddbentley.co.uk>; Egerton Neil: H&F <Neil.Egerton@lbhf.gov.uk>
Subject: RE: Ravenscourt Park Hospital - District Heating Network

Thanks Roy.

Hi Neil,

At this stage, I just need confirmation where there any existing DHN networks to which we can connect our site to. Do let me know if you require any further details.

Thanks

Kind regards

Hasnaat Mahmood | Sustainability Engineer

E: hasnaat.mahmood@cuddbentley.co.uk | **W:** www.cuddbentley.co.uk

T: 01344 628821 | **M:** 07824 415366 | **DDI:** 01344 298828

OUR LOCATIONS Sunninghill | Solihull | London

From: Asagba-Power Roy: H&F <Roy.Asagba-Power@lbhf.gov.uk>
Sent: Monday, September 25, 2023 12:47 PM
To: Hasnaat Mahmood <hasnaat.mahmood@cuddbentley.co.uk>
Cc: Sushil Pathak <sushil.pathak@cuddbentley.co.uk>; Egerton Neil: H&F <Neil.Egerton@lbhf.gov.uk>
Subject: Re: Ravenscourt Park Hospital - District Heating Network

Hi Hasnaat,

My apologies for the delay in coming back to you. Steven no longer works for the Council.

The Ravenscourt Hospital site falls within the North Area which is managed by my colleague Neil Egerton. I have copied Neil into this email.

Regards

Roy Asagba-Power

Team Leader

Economy Department

London Borough of Hammersmith & Fulham

mob: 07776 672344

1st Floor, 3 Shortlands, Hammersmith W6 8DA

e-mail: roy.asagba-power@lbhf.gov.uk

Web: www.lbhf.gov.uk

Strategic Director for the Economy: Jonathan Pickstone

Find out about how to get a Covid-19 vaccination at www.lbhf.gov.uk/vaccines

---

From: Hasnaat Mahmood <hasnaat.mahmood@cuddbentley.co.uk>
Sent: Monday, September 25, 2023 12:14
To: Asagba-Power Roy: H&F <Roy.Asagba-Power@lbhf.gov.uk>
Cc: Sushil Pathak <sushil.pathak@cuddbentley.co.uk>
Subject: RE: Ravenscourt Park Hospital - District Heating Network

You don't often get email from hasnaat.mahmood@cuddbentley.co.uk. Learn why this is important

Hi Roy,

Sorry to chase, can you please look at the query below or get me in touch with the relevant person.

Thanks

Kind regards

Hasnaat Mahmood | Sustainability Engineer

E: hasnaat.mahmood@cuddbentley.co.uk | **W:** www.cuddbentley.co.uk

T: 01344 628821 | **M:** 07824 415366 | **DDI:** 01344 298828

OUR LOCATIONS Sunninghill | Solihull | London

From: Hasnaat Mahmood
Sent: Wednesday, September 20, 2023 2:27 PM
To: 'Roy.Asagba-Power@lbhf.gov.uk' <Roy.Asagba-Power@lbhf.gov.uk>
Subject: RE: Ravenscourt Park Hospital - District Heating Network

Hi Roy,

Hope you are well. I have just emailed Steven earlier, but the email didn't reach his inbox. Can you please help with my query below.

Thanks

Kind regards

Hasnaat Mahmood | Sustainability Engineer

E: hasnaat.mahmood@cuddbentley.co.uk | **W:** www.cuddbentley.co.uk

T: 01344 628821 | **M:** 07824 415366 | **DDI:** 01344 298828

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From: Hasnaat Mahmood
Sent: Wednesday, September 20, 2023 2:19 PM
To: 'Mielczarek Steven: H&F' <Steven.Mielczarek@lbhf.gov.uk>
Subject: Ravenscourt Park Hospital - District Heating Network

Hi Steven,

Hope you are well. I am now working on another scheme within LBHF. I know you confirmed in the email below that there are no district heating points available in the borough, can you please confirm that this still is the case?

Thanks

Kind regards

Hasnaat Mahmood | Sustainability Engineer

E: hasnaat.mahmood@cuddbentley.co.uk | **W:** www.cuddbentley.co.uk

T: 01344 628821 | **M:** 07824 415366 | **DDI:** 01344 298828

OUR LOCATIONS Sunninghill | Solihull | London

From: Mielczarek Steven: H&F <Steven.Mielczarek@lbhf.gov.uk>
Sent: Thursday, May 26, 2022 11:55 AM
To: Hasnaat Mahmood <hasnaat.mahmood@cuddbentley.co.uk>
Cc: Marshall Andrew: H&F <Andrew.Marshall@lbhf.gov.uk>; Asagba-Power Roy: H&F <Roy.Asagba-Power@lbhf.gov.uk>
Subject: RE: 2022/01457/DPLNHP

Dear Hasnaat,

Please be advised this information is not site specific. In general, there is no district heating network points currently available within the borough. However, individual developments should consider incorporating the ability to connect to a district heating network point if they are made available in the future.
If you require more detailed/site specific advice, try our pre-application service. The webpage includes guidance on how to apply, the relevant form and details of the fee for this service.
Kind regards,

Steven Mielczarek
Senior Planning Officer
Economy Department
London Borough of Hammersmith & Fulham
Mob: 07776 672779
6th Floor, 3 Shortlands, Hammersmith W6 8DA

e-mail: steven.mielczarek@lbhf.gov.uk
Web: www.lbhf.gov.uk
Strategic Director of Economy: Jo Rowlands

From: Burke Mandy: H&F <Mandy.Burke@lbhf.gov.uk>
Sent: 26 May 2022 10:19
To: Mielczarek Steven: H&F <Steven.Mielczarek@lbhf.gov.uk>; Asagba-Power Roy: H&F <Roy.Asagba-Power@lbhf.gov.uk>

Cc: Marshall Andrew: H&F <Andrew.Marshall@lbhf.gov.uk>; hasnaat.mahmood@cuddbentley.co.uk
Subject: 2022/01457/DPLNHP

Good morning

The caller had a duty call back on Tuesday regarding a district heating network point – Please could an email be sent to him as advised on the call

He would like confirmation to advise there are no points available at this time

Callers details: Hasnaat Mahmood Tel: 07824415366 email:hasnaat.mahmood@cuddbentley.co.uk

Kind regards

Mandy

Mandy Burke
Resident Access Adviser
Environment Department
Hammersmith & Fulham Council
Email: mandy.burke@lbhf.gov.uk
Tel no: 07825935342

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APPENDIX I ASHP DETAILS

SOUND LEVEL**							
Sound Power - Cooling	dB(A)	76	76	78	79	80	80
Sound Pressure level @1m distance - Cooling	dB(A)	59.7	59.7	61.7	62.2	63.2	62.8
REFRIGERANT CIRCUIT							
Refrigerant type		R32	R32	R32	R32	R32	R32
Refrigerant charge	kg	3	5	5	6.5	6.7	10.2
N. of circuits	No.	1	1	1	1	1	2
PIPING CONNECTIONS							
Evaporator water inlet/outlet	mm	1"1/4 (female)	1"1/4 (female)	1"1/4 (female)	1"1/4 (female)	1"1/4 (female)	2" (female)

MODEL		**EWYT050CZP-A2**	**EWYT064CZP-A2**	**EWYT090CZP-A2**
COOLING PERFORMANCE				
Capacity - Cooling	kW	51.11	64.41	88.77
Capacity control - Type		Inverter Controlled	Inverter Controlled	Inverter Controlled
Capacity control - Minimum capacity	%	12	15	14
Unit power input - Cooling	kW	16.89	21.86	31.13
EER		3.025	2.946	2.852
SEER		5.48	5.34	5.18
IPLV		5.92	5.88	5.61
HEATING PERFORMANCE				
Capacity - Heating	kW	49.49	61.82	85.95
Unit power input - Heating	kW	15.30	19.21	27.26
COP		3.235	3.218	3.153
SCOP Low / Medium Temp		4.12 / 2.98	4.01 / 2.87	4.04 / 2.91
WATER HEAT EXCHANGER HEATING				
Water temperature in	°C	40	40	40
Water temperature out	°C	45	45	45
Water flow rate	l/s	2.4	3.0	4.2
Water pressure drop	kPa	13.9	20.7	19.5
FAN				
Air Temperature		7	7	7
WATER HEAT EXCHANGER COOLING				
Type *		Brazed plate	Brazed plate	Brazed plate
Fluid		Water	Water	Water
Fouling Factor	m2°C/W	0	0	0
Water Volume	l	5	5	8
Water temperature in	°C	12	12	12
Water temperature out	°C	7	7	7
Water flow rate	l/s	2.4	3.1	4.2
Water pressure drop	kPa	14.5	22.0	20.3
Insulation material *		Black closed-cell flexible elastomeric foam	Black closed-cell flexible elastomeric foam	Black closed-cell flexible elastomeric foam
AIR HEAT EXCHANGER				
Type *		Al Fins&Cu Tubes	Al Fins&Cu Tubes	Al Fins&Cu Tubes
FAN				
Type *		Axial	Axial	Axial
Drive *		VFD	VFD	VFD
Nominal air flow	l/s	7048	8967	13402
Air Temperature	°C	35	35	35
Quantity	No.	2	3	4
Speed	rpm	900	800	900
Motor input	kW	1.1	1.2	2.3
CASING				
Colour *		IW	IW	IW
Material *		GPSS	GPSS	GPSS

DIMENSIONS				
Height	mm	1878	1878	1878
Width	mm	2306	2906	3506
Length	mm	814	814	814
WEIGHT				
Unit Weight	kg	546	644	749
Operating Weight	kg	551	650	757
COMPRESSOR				
Type		Scroll	Scroll	Scroll
Oil charge	l	4.4	5.4	6.4
Quantity	No.	2	2	2
SOUND LEVEL**				
Sound Power - Cooling	dB(A)	81	83	85
Sound Pressure level @1m distance - Cooling	dB(A)	63.8	65.4	67
REFRIGERANT CIRCUIT				
Refrigerant type		R32	R32	R32
Refrigerant charge	kg	10.2	11.4	14.4
N. of circuits	No.	2	2	2
PIPING CONNECTIONS				
Evaporator water inlet/outlet	mm	2" (female)	2" (female)	2" (female)

Report created: 21/10/2023

Ravenscourt Park Hospital

Thank you for considering Daikin VRV systems for your project.

Daikin is the world leading manufacturer of VRV systems and HVAC products and is renowned for delivering the highest quality products available in the market.

This report is designed to offer you a complete overview of the system from a legislative perspective and we are happy to discuss any aspects of the report in more detail. Please note that all information contained in this report is based on our best current understanding of legislative practices at the time of origination.

TABLE OF CONTENTS

PROJECT SUMMARY

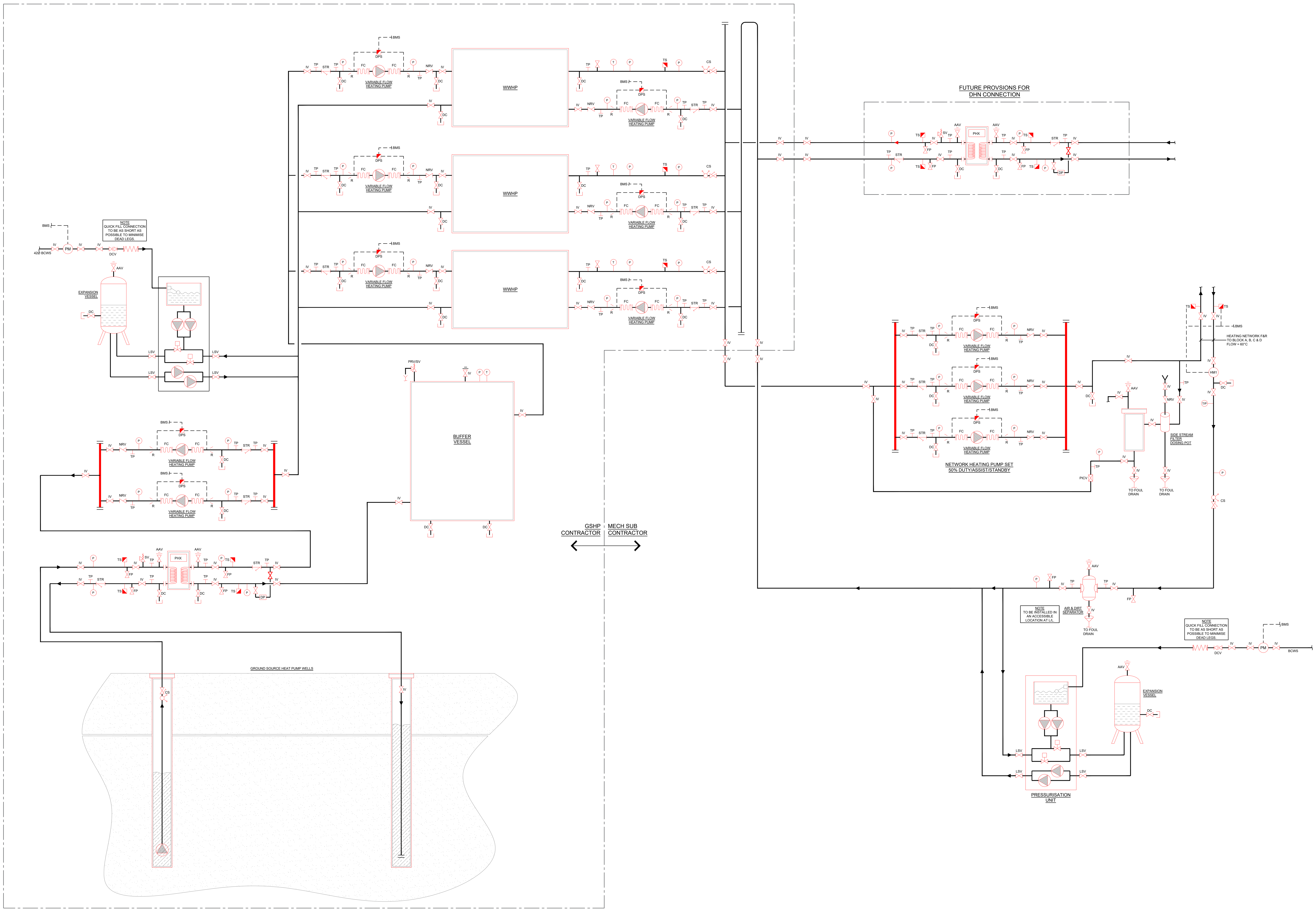
System Name	Efficiencies		DELC (BREEAM)	Embodied Carbon (TM65)
1. Condenser F (1/3)	SEER 3.72	SCoP 4.88	Switch to R32 and gain **1 extra BREEAM point** thanks to Shîrudo Technology 2 Possible Points 0.00 $kgCO_{2e}/kW$ cooling capacity	Switch to R32 and save **up to 53%** on embodied carbon (~**30,920** $kgCO_{2eq}$) 58,339.00 $kgCO_{2eq}$
2. Condenser F (2/3(	SEER 3.72	SCoP 4.88	Switch to R32 and gain **1 extra BREEAM point** thanks to Shîrudo Technology 2 Possible Points 0.00 $kgCO_{2e}/kW$ cooling capacity	Switch to R32 and save **up to 53%** on embodied carbon (~**30,920** $kgCO_{2eq}$) 58,339.00 $kgCO_{2eq}$
3. Condenser F (3/3)	SEER 3.72	SCoP 4.88	Switch to R32 and gain **1 extra BREEAM point** thanks to Shîrudo Technology 2 Possible Points 0.00 $kgCO_{2e}/kW$ cooling capacity	Switch to R32 and save **up to 53%** on embodied carbon (~**30,920** $kgCO_{2eq}$) 58,339.00 $kgCO_{2eq}$

ENERGY EFFICIENCY

System Name	Cooling Condition	Heating Condition	SEER	SCoP
1. Condenser F (1/3)	VRT Cooling	VRT Heating	3.72	4.88
2. Condenser F (2/3(	VRT Cooling	VRT Heating	3.72	4.88
3. Condenser F (3/3)	VRT Cooling	VRT Heating	3.72	4.88

These efficiency calculations are calculated according to the part load presets of Part L. As such, the efficiency calculation is based on the chiller/office application example in the Building Services Non Domestic Compliance guide and are based on performance testing according to EN14511 for cooling and EN14825 in Heating. Please note that systems containing AHUs do not contain any elements of the AHU efficiency. Please consult the technical data from the AHU to determine the specific fan power.

APPENDIX K HEATING SCHEMATIC



NOTES

1. THE HEATING SYSTEM DESIGN AND SPECIFICATION SHALL TAKE INTO CONSIDERATION THE FOLLOWING TO INCREASE SYSTEM EFFICIENCIES, REDUCE SYSTEM CAPACITY AND MINIMISE SYSTEM LOSSES BY:
   - CAREFUL DESIGN OF PIPEWORK DISTRIBUTION SYSTEM TO KEEP CIRCUIT LENGTHS TO AN ABSOLUTE MINIMUM.
   - MINIMISE PIPEWORK DIAMETERS WHILST STAYING WITHIN RECOGNISED GUIDELINES FOR VELOCITIES AND PRESSURE DROPS.
   - UTILISE THE CORRECT DIVERSITY CURSE FOR DOMESTIC HOT WATER TO AVOID OVERSIZING AND NEEDLESSLY INCREASED PLANT, PIPEWORK AND EQUIPMENT SIZES.
   - MAXIMISE INSULATION BY ENSURING ALL SYSTEM ELEMENTS ARE INSULATED AND THAT THE MAXIMUM THICKNESS OF INSULATION IS USED.
   - AVOID USE OF BYPASS AND MINIMISE THE NUMBER OF HEAT EXCHANGERS.
   - SET DOMESTIC HOT WATER OUTLET TEMPERATURES AS LOW AS POSSIBLE WHILST STILL MEETING THE REQUIRED RESPONSE TIMES.
2. LOW LEVEL RISER PIPEWORK TO BE PN16 RATED. HIGH LEVEL RISER PIPEWORK TO BE PN25 RATED.
3. ALL HEATING PIPEWORK TO BE RUN IN MEDIUM WEIGHT BLACK STEEL.
4. PIPEWORK IN PLANTROOMS SHALL BE PROVIDED WITH A 'ISOGENOPAC' FINISH.
5. AIR BOTTLE DISCHARGE PIPES TO RUN TO CONNECT TO NEAREST FOUL DRAINAGE RISER VIA HEPVo VALVE & TUNDISH.
6. AIR VENTS TO BE PROVIDED AT ALL SYSTEM HIGH POINTS AS PER THE CUDD BENTLEY MECHANICAL SERVICES SPECIFICATION.

Revision	Description	Drawn By	Engineer	Approved	Date
P01	STAGE 2 ISSUE	AS	RH	RH	31-10-23

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STAGE 2

Client

TELEREAL TRILLIUM

Project/Site Location

RAVENSCOURT PARK HOSPITAL
HAMMERSMITH

Drawing Title

PLANTROOM HEATING
SCHEMATIC

Scale	Size	Drawn By	Engineer	Approved	Date
NTS	A1	AS	RH	RH	OCT'23

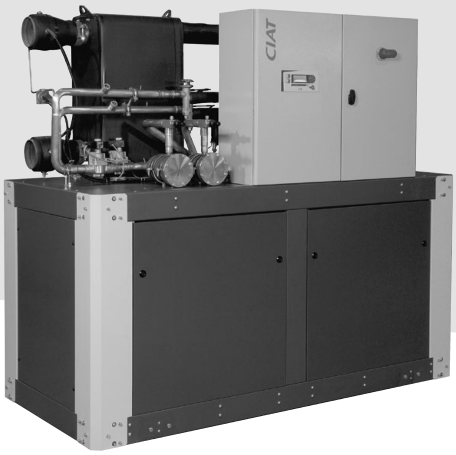
Drawing Reference	Revision
6391-CBC-ZZ-XX-DR-M-50001	P01

File Location:

APPENDIX L GSHP DETAILS

DYNACIAT POWER ™

Water cooled
water chillers



High energy efficiency

Compact and quiet

Scroll compressors

High-efficiency brazed-plate heat exchangers

CIAT self-adjusting electronic control

Cooling capacity: 200 to 700 kW

Heating capacity: 230 to 800 kW

Heating | Cooling only | Cooling and heating | R-410A

EUROVENT CERTIFIED PERFORMANCE
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Use

The new generation of DYNACIAT POWER water cooled water chillers offers an optimal solution for all heating or process cooling applications.

These units are designed to be installed in machine rooms that are protected against freezing temperatures and inclement weather.

The new range has been optimised to use ozone-friendly HFC R410A refrigerant. The use of this refrigerant guarantees compliance with the most demanding requirements for environmental protection and increased seasonal energy efficiency.

Range

DYNACIAT POWER LG series

Cooling-only or heating-only models with water cooled condenser.

The design of the DYNACIAT POWER LGP series heat pump range is identical to that of the DYNACIAT POWER LG series. These machines provide solutions for the most diverse heating problems.

They can also be used in cooling mode by reversing the cycle on the hydraulic circuits.

Acoustic configuration:

a - STANDARD version

b - LOW NOISE version. Compressor casing

c - XTRA LOW NOISE version. Casing with compressor acoustic insulation

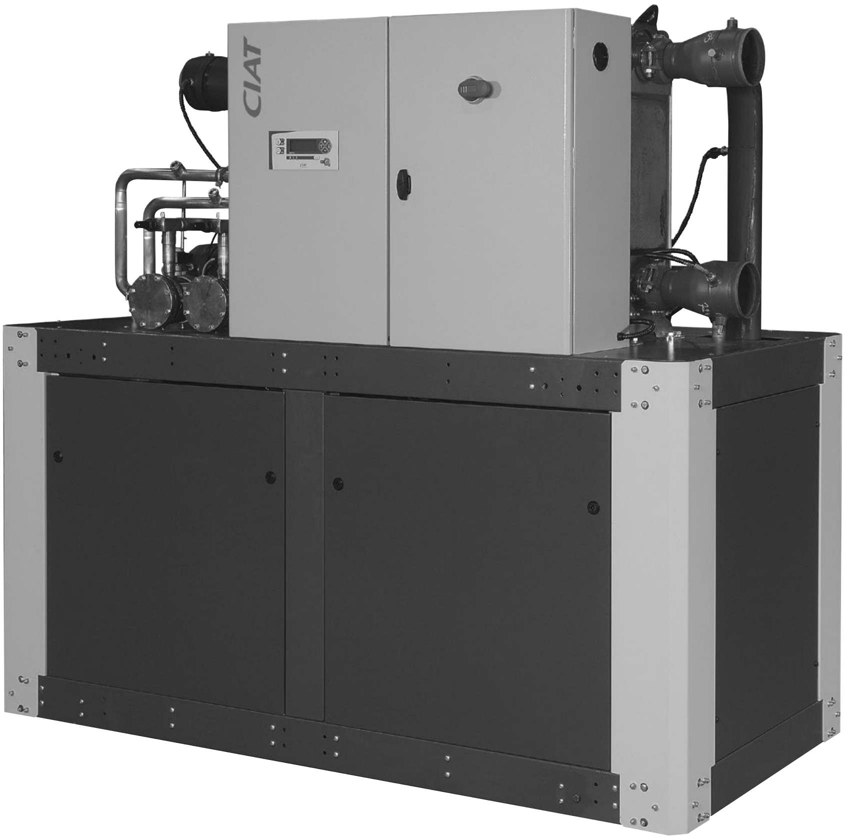
DESCRIPTION

The DYNACIAT POWER LG series units are monoblock machines supplied as standard with the following components:
- Hermetic SCROLL compressors,
- Chilled water evaporator with brazed plates,
- Hot water condenser with brazed plates,
- Electrical power and remote control cabinet:
  - 400V-3ph-50Hz (+10%/-10%) general power supply + earth,
  - Transformer fitted as standard on the machine for supplying the remote control circuit with 230V-1ph-50Hz,
- CIAT CONNECT2 electronic control module.

The entire DYNACIAT POWER range complies with the following EC directives and standards:
- Machinery directive 2006/42/EC, modified
- Electromagnetic compatibility directive 2014/30/EU, modified
- EMC Immunity and Emissions EN 61800-3 “C3”
- Low voltage directive 2014/35/EU, modified
- RoHS 2011/65/EU
- Pressure equipment directive (PED) 2014/68/EU
- Machinery directive EN-60-204-1
- Refrigeration systems and heat pumps EN 378-2

DESCRIPTION

LG	>	Cooling only version	**1200**	>	Unit size
P	>	Heating only version	**V**	>	R410A refrigerant



LG models 700V to 1600V
Xtra Low Noise Version

Description of the main components

■ Compressors
- Hermetic SCROLL type.
- Built-in electric motor, cooled by intake gases.
- Motor protected by internal winding thermostat.
- Placed on anti-vibration mounts.

■ Evaporator
- Brazed-plate exchanger.
- Stainless steel plates.
- Plate patterns optimised for high efficiency.
- Armaflex thermal insulation.

■ Condenser
- Brazed-plate exchanger.
- Stainless steel plates.
- Plate patterns optimised for high efficiency.

■ Refrigerating accessories
- Dehumidifier filters with rechargeable cartridges.
- Hygroscopic sight glasses.
- Solenoid valves on refrigerant lines (700V to 1200V models).
- Thermostatic expansion valves (700V to 1000V models).
- Electronic expansion valves (1100V to 2400V models).

■ Regulation and safety instruments
- High and low pressure sensors.
- High pressure safety valves.
- Water temperature control sensors.
- Evaporator antifreeze protection sensor.
- Factory-fitted evaporator water flow controller.

■ Electrics box
- IP 23.
- 400V-3Ph-50 Hz power supply + Earth (+10%/-10%).
- Disconnect switch with handle on front.
- Control circuit transformer.
- Circuit breaker for compressor motor.
- Contact switches for compressor motor.
- CONNECT2 microprocessor-controlled electronic control module.
- Wire numbering.
- Marking of the main electrical components.
- RAL 7035.

■ CONNECT2 electronic control module
The CIAT electronic control module performs the following main functions:
- Regulation of the chilled or hot water temperature
- Regulation of the water temperature based on the outdoor temperature (water law).
- Regulation for low temperature energy storage.
- Second setpoint management.
- Complete management of compressors with start-up sequence, metering and runtime balancing.
- Self-adjusting and proactive functions with adjustment of parameters on drift control.
- In-series staged capacity-reduction system on compressors based on cooling and heating demands.
- Management of compressor short cycle protection.
- Management of the machine operation limit according to outdoor temperature.
- Operating and fault status diagnostics.
- Management of a fault memory allowing a log of the last 20 incidents to be accessed, with operating readings taken when the fault occurs.
- Master/slave management of the two machines in parallel with runtime balancing and automatic changeover if a fault occurs on one machine.
- Machine time schedule.
- Display and access to the operating parameters via a multilingual LCD screen with 4 lines of 24 characters.

■ Remote management
CONNECT2 is equipped as standard with an RS485 serial port offering a range of remote management, monitoring and diagnostic options via the communication bus.

Several contacts are available as standard which enable the DYNACIAT POWER to be controlled remotely by wired link:
- Automatic operation control: when this contact is open, the machine stops.
- Setpoint 1/setpoint 2 selector: when this contact is closed, a second cooling setpoint is activated (energy storage mode, for example).
- Heating/cooling operating mode selection: this input switches from one operating mode to another.

  Contact closed = heating mode.

  Contact open = cooling mode.
- Setpoint adjustable via 4-20 mA signal: this input is used to adjust the setpoint in heating or cooling mode.
- Compressor load shedding: closing the contact(s) concerned allows the power or refrigerating consumption of the machine to be limited by stopping one or more compressors.
- Water pump 1 and 2 control: these outputs control the switches for one or two water pumps.
- Fault reporting: this contact indicates the presence of a major fault which has caused one or both refrigerating circuits to stop.

■ Power control
In-series staged power control system on the compressors:
- 4 stages for 700V to 1600V models.
- 6 stages for 1800V and 2400V models.
- 8 stages for 2100V models.

■ Casing
Casing made from RAL 7024 and RAL 7035 painted panels.

Description of the main components

■ ABOUND HVAC Performance, the CIAT supervision solution

ABOUND HVAC Performance is a remote supervision solution dedicated to monitoring and controlling several CIAT machines in real time.

Advantages

- Access to the operating trend curves for analysis
- Improved energy performance
- Improved availability rate for the machines

Functions

ABOUND HVAC Performance will send data in real time to the supervision website.

The machine operating data can be accessed from any PC, smartphone or tablet.

Any event can configured to trigger a mail alert.

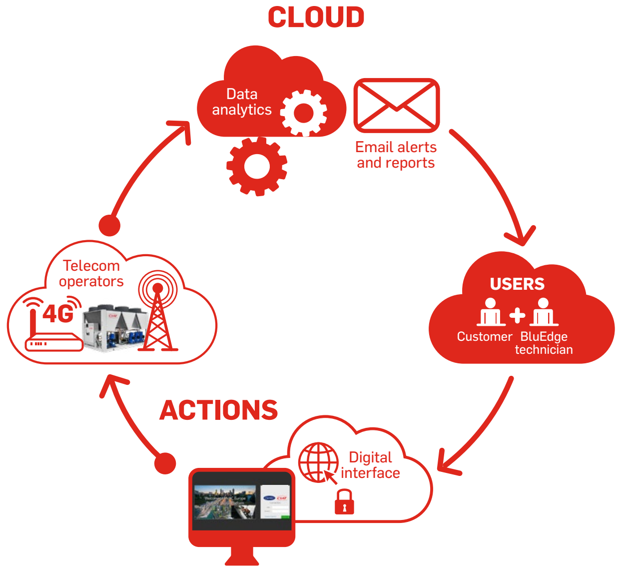
Parameters monitored:
- Overview
- Control panel for the controllers
- Events
- Temperature curves

Monthly and annual reports are available to analyse:
- The performance and operation of the machine Example: operating curves and time, number of compressor start-ups, events, preventive maintenance actions to be performed, etc.

Incidents such as a drift in the measurements on a temperature sensor, incorrectly set control parameters, or even incorrect settings between one compressor stage and the other, are immediately detected, and the corrective actions put in place.

Equipment

This kit box be used on both machines which are already in use (existing inventory), or on new machines.
- 1 transportable cabinet

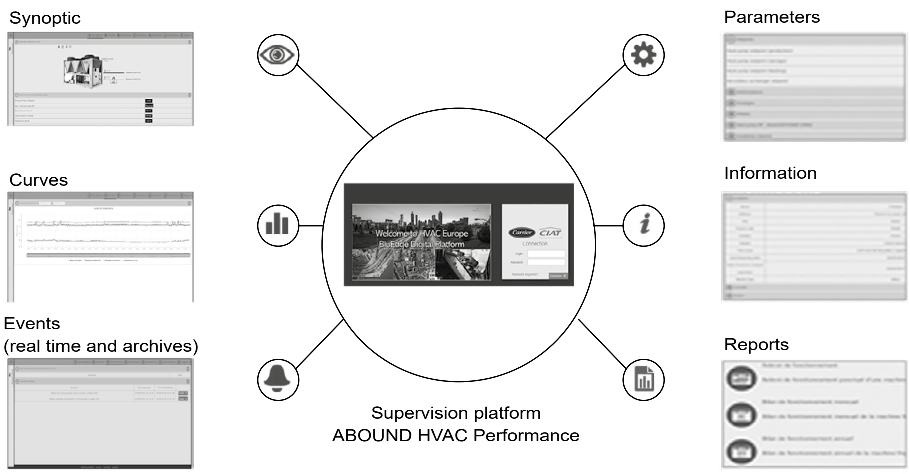


Contents of the box (avalable in 230v and 400v)

- 1 GPRS / 4G LTE-M modem
- 1 SIM SMART card
- 1 24 VDC power supply
- 1 power protection device
- 1 GSM antenna
- Rail mounting
- Enclosed casing to protect the equipment during transport
- Packing box for cable routing (bus, power supply)

Compatibility

Up to five machines per box



STANDARD EQUIPMENT/AVAILABLE OPTIONS

DYNACIATPOWER LG	700V to 2400V
Low-temperature glycol/water mix (0°C to -12°C)	●
Safety switch	●
Control circuit transformer	●
Electrical cabinet wire numbers	●
RS485 communication interface	●
Water flow controller	●
Master/slave control of two machines	●
ETHERNET gateway MODBUS	●
Electronic expansion valve (1)	▲
Low Noise version (compressor casing)	▲
Xtra Low Noise version (compressor casing with acoustic insulation)	▲
Compressor intake shut-off valves	▲
Soft start	▲
Electrical energy meter	▲
Water filter on evaporator and condenser	▮
Phase controller (reversal, loss, asymmetry)	▮
Anti-vibration mounts	▮
Flanged connections	▮
Flexible hydraulic couplings on evaporator and condenser	▮
Relay board with dry contacts	▮
LONWORKS/BACNET gateway	▮
Outdoor temperature sensor	▮

● Supplied as standard
▲ Factory-mounted option
▮ Option supplied as a kit
(1) Standard equipment for 1100V to 2400V models

Technical specifications

DYNACIATPOWER LG			700V	800V	900V	1000V	1100V	1200V	1400V	1600V	1800V	2100V	2400V
Heating													
Standard unit Seasonal energy efficiency** HA1	**SCOP** $_{30/35°C}$	**kW / kW**	**5,30**	**5,53**	**5,45**	**5,47**	**5,43**	**5,49**	**5,49**	**5,48**	**5,44**	**5,46**	**5,24**
	ηs heat $_{30/35°C}$	**%**	**204**	**213**	**210**	**211**	**209**	**212**	**212**	**211**	**210**	**211**	**202**
	P $_{rated}$	**kW**	**246**	**293**	**335**	**384**	**419**	**463**	**530**	**593**	**687**	**795**	**876**
Cooling													
Standard unit Full load performances* CA1	Net cooling capacity	kW	203	242	278	320	348	382	439	495	574	651	703
	Net power input	kW	49	56	64	71	79	86	97	108	125	145	165
	EER	kW / kW	4,18	4,32	4,33	4,50	4,42	4,42	4,55	4,60	4,60	4,49	4,27
Standard unit Seasonal energy efficiency**	**SEPR** $_{-2/-8°C}$ **Process medium temp** ***	**kWh/ kWh**	**3,04**	**3,08**	**3,09**	**3,04**	**3,08**	**3,11**	**3,21**	**3,31**	**3,26**	**3,33**	**3,37**
Standard unit Seasonal energy efficiency**	SEER $_{12/7°C}$ Comfort Low temp.	kW / kW	4,66	4,96	4,92	4,96	4,91	4,92	4,98	4,97	4,99	4,89	4,60
Standard unit	Lw / Lp (1)	dB(A)	89/57	90/58	90/58	89/57	90/58	91/59	95/63	96/64	93/61	95/63	97/65
Unit + Low Noise option	Lw / Lp (1)	dB(A)	84/52	85/53	85/53	86/54	87/55	88/56	90/58	91/59	89/57	90/58	91/59
Unit + Xtra Low Noise	Lw / Lp (1)	dB(A)	79/47	80/48	80/48	80/48	81/49	82/50	85/53	86/54	85/53	86/54	87/55
Refrigerating circuit													
Refrigerant (GWP)			R410 (GWP=2088)										
Number			2										
Refrigerant circuit 1		kg	13,5	15,5	16,4	17	19,7	21,3	21,5	23	31	33	34
Refrigerant circuit 2		kg	14	15	16,4	17,2	19,7	21,3	21	22	31	34	34
Tonne of CO_2 equivalent		TCO_2Eq	57,42	63,68	68,49	71,41	82,27	88,95	88,74	93,96	129,46	139,9	141,98
Compressor													
Type			Hermetic SCROLL - 2900 rpm										
Number			4								6		
Start-up mode			Direct in line in series										
Capacity control		Number of stages	6	4	6	4	6	4	6	4	6	8	6
		%	100-78-71-50-28-21-0	100-75-50-25-0	100-78-71-50-28-21-0	100-75-50-25-0	100-78-71-50-28-21-0	100-75-50-25-0	100-78-71-50-28-21-0	100-75-50-25-0	100-83-66-50-33-16-0	100-84-66-48-36-30-18-15-0	100-83-66-50-33-16-0
Type of oil for R410A			Polyolester POE 160SZ (32cP)						Polyolester POE 3MAF (32cst)				
Oil capacity per circuit		l	6,7 + 6,7	6,7 + 6,7	6,7 + 6,7	6,7 + 6,7	6,7 + 7,2	7,2 + 7,2	6,3 + 6,3	6,3 + 6,3	3 x 6,3	3 x 6,3	3 x 6,3
Evaporator													
Type/Number			Brazed-plate heat exchanger/ 1										
Water capacity		l	20	23	26	29	32	37	50	57	64	77	
Hydraulic connection		Ø	VICTAULIC DN100			VICTAULIC DN125					VICTAULIC DN150		
Max. pressure, water end		bar	10 bars										
Min/max water flow rate		m³/h	22 / 70	26 / 81	29 / 92	33 / 105	35 / 113	38 / 124	44 / 137	51 / 151	61 / 150	68 / 150	74 / 150

*	In accordance with standard EN14511-3:2022.
**	In accordance with standard EN14825:2022, average climate
***	With EG 30%.
HA1	Heating mode conditions: Water heat exchanger water entering/leaving temperature 30°C/35°C, outside air temperature tdb/twb = 7°C db/6°C wb, evaporator fouling factor 0 m². k/W.
CA1	Cooling mode conditions: evaporator water inlet/outlet temperature 12 °C/7 °C, outdoor air temperature 35 °C, evaporator fouling factor 0 m². k/W
ηs heat $_{30/35°C}$ **& SCOP** $_{30/35°C}$	**Values in bold comply with Ecodesign Regulation (EU) No. 813/2013 for Heating applications.**
SEER 12/7°C	Values calculated according to EN14825:2022.
SEPR $_{-2/-8°C}$	**Values in bold comply with Ecodesign Regulation (EU) No. 2015/1095 for Process application**
(1)	**Lw** : overall power level in accordance with standard ISO3744 **Lp** : overall pressure level at 10 metres in a free field calculated using the formula Lp=LW-10logS

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Eurovent certified values

Technical specifications

DYNACIATPOWER LG		700V	800V	900V	1000V	1100V	1200V	1400V	1600V	1800V	2100V	2400V
Water condenser												
Type/ Number		Brazed-plate heat exchanger/ 1										
Water capacity	l	23	26	29	32	37	40	55	61	73	77	77
Hydraulic connection	Ø	VICTAULIC DN100			VICTAULIC DN125					VICTAULIC DN150		
Max. pressure, water end	bar	10 bars										
Min/max water flow rate	m^3/h	19/ 64	22/ 74	25/ 84	28/ 95	31/ 103	33/ 112	38/ 129	43/ 143	52/ 150	59/ 150	66/ 163
Dimensions												
Length	mm	2099						2499		3350		
Width	mm	996										
Height	mm	1869						1887		1970		
Weight												
Weight (empty)	kg	1044	1156	1189	1312	1363	1425	1613	1708	2284	2376	2418
Weight in operation	kg	1088	1205	1246	1378	1436	1510	1713	1818	2472	2588	2637
Max. storage temperature	°C	+50°C										

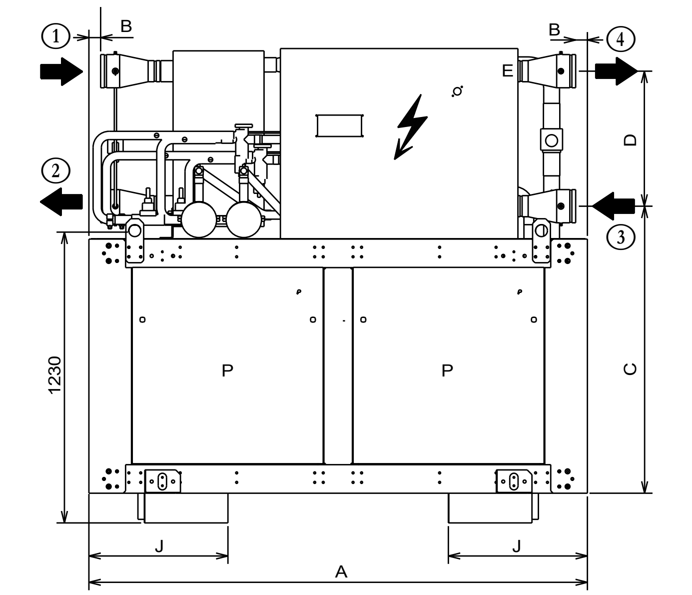
Electrical data

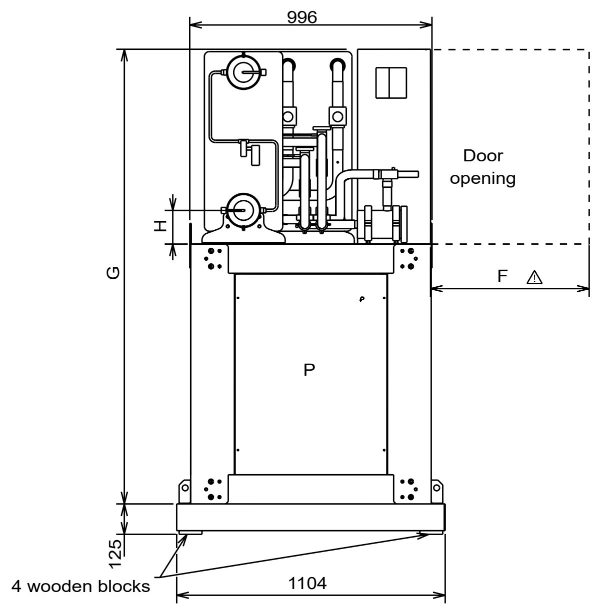
DYNACIATPOWER LG		700V	800V	900V	1000V	1100V	1200V	1400V	1600V	1800V	2100V	2400V
COMPRESSOR												
Voltage	V	400V - 3Ph - 50Hz (+10/- 10%)										
Maximum nominal current	A	140	160	182	205	218	232	266	295	356	399	443
Starting current (1)	A	316	334	391	414	480	494	586	615	607	720	763
Starting current with Soft Start option (1)	A	230	248	287	310	352	366	429	458	483	562	605
REMOTE CONTROL AUXILIARY CIRCUIT												
Voltage	V	230V - 1Ph - 50Hz (+10/- 10%)										
Maximum nominal current	A	0,8						1,3				
Transformer capacity	VA	160						250				
Machine protection rating		IP 21										

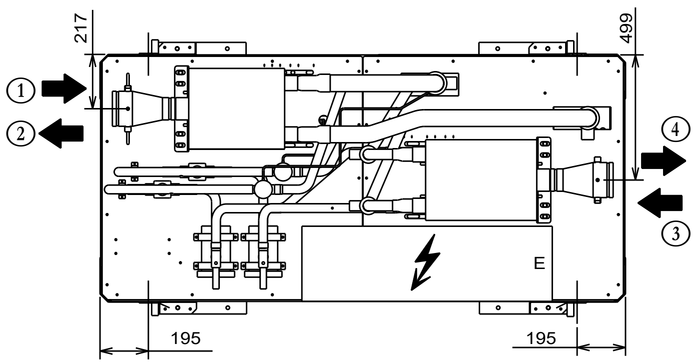
(1) Starting current of largest compressor + maximum current of other compressors under full load
Cable selection nominal current = sum of maximum nominal currents in above tables

Dimensions

700V to 1600V models







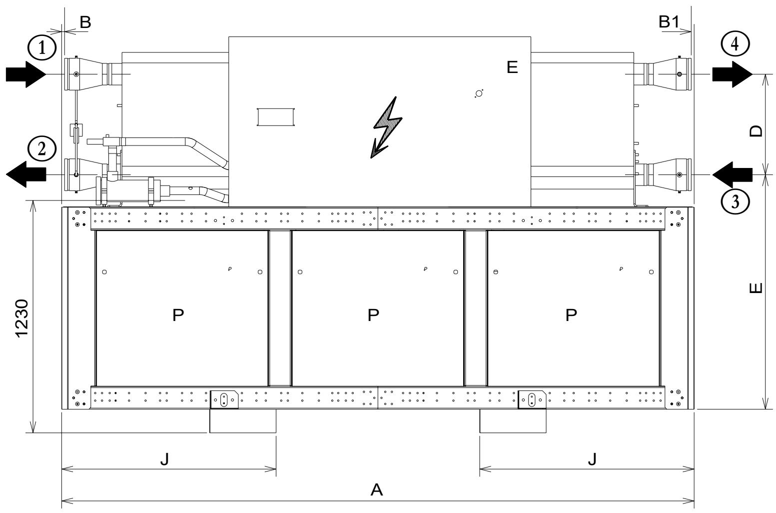
E Electrical connection on the side

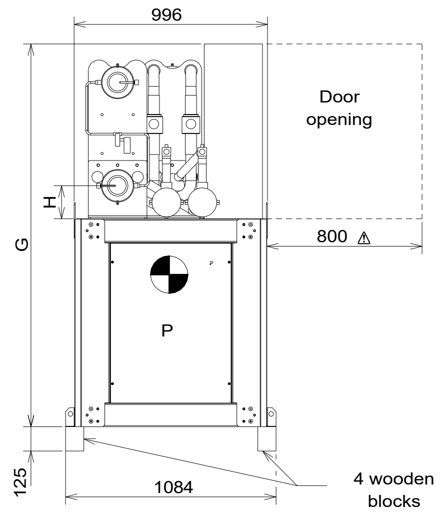
P Noise insulation panels option

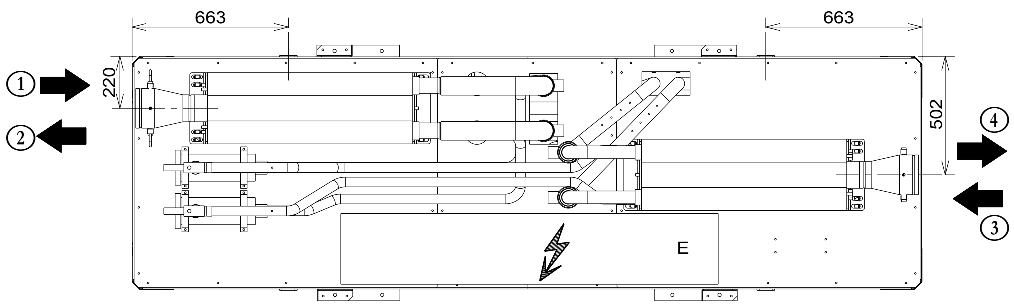
Models	Dimensions (mm)								Chilled water		Hot water		Weight (kg)	
	A	B	C	D	F	G	H	J	Input 1	Outlet 2	Input 3	Outlet 4	empty	in operation
700V	2099	49	1207	568	1000	1869	137	585	VICTAULIC DN 100		VICTAULIC DN 100		1044	1088
800V													1156	1205
900V													1189	1246
1000V									VICTAULIC DN 125		VICTAULIC DN 125		1312	1378
1100V													1363	1436
1200V													1425	1510
1400V	2499	60	1240	532	600	1887	170	715					1613	1713
1600V													1708	1818

Dimensions

■ **1800V to 2400V models**







E Electrical connection on the side

P Noise insulation panels option

Models	Dimensions (mm)								Chilled water		Hot water		Weight (kg)	
	A	B	B1	C	D	G	H	J	Input 1	Outlet 2	Input 1	Outlet 2	empty	in operation
1800V		159	63										2284	2472
2100V	3350	15	15	1240	532	1970	170	1135	VICTAULIC DN 150		VICTAULIC DN 150		2376	2588
2400V													2418	2637