

RAVENSCOURT PARK

FORMER ROYAL MASONIC HOSPITAL



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

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1 EXECUTIVE SUMMARY

This Energy Statement considers the predicted energy demand for the proposed Ravenscourt Park Hospital, London W6 OTN 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 CO₂/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 CO₂/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).

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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:

- <u>13,675,266.65kWh/annum</u>
- 68.8 Tonnes CO₂/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 CO₂/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);

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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 annual heating and hot water demand). Block B,C,D: Ground Source Communal Heating Network via Heating stalled within bore holes (100% of the annual heating demandance).		
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.	

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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.	
	Block A: Electric Point of use	
Hot water (DHW)	Block C: Electric Point of use	
	Block F: ASHP for the Hot water	
	Block A: Meeting rooms cooling will be provided through the GSHP	
Cooling	Block C: GSHP for the cooling within the playroom and workspace	
	Block F: Reception and office cooling through ASHP	
	Block A: MVHR within the meeting room	
Ventilation	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.

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	Carbon Dioxide Emissions (Tonnes CO₂ 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 CO₂ 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 CO₂ 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)

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	Regulated Carbon Dioxide Savings	
	Tonnes CO₂ 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.

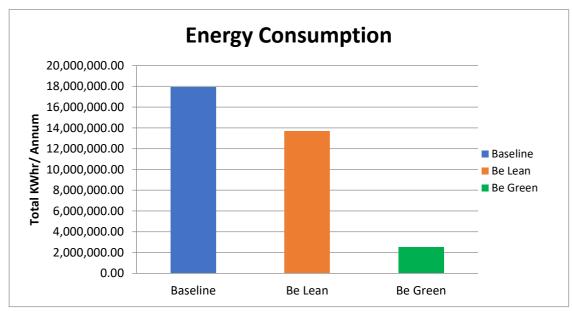


Figure 1.1 Annual Energy Consumption

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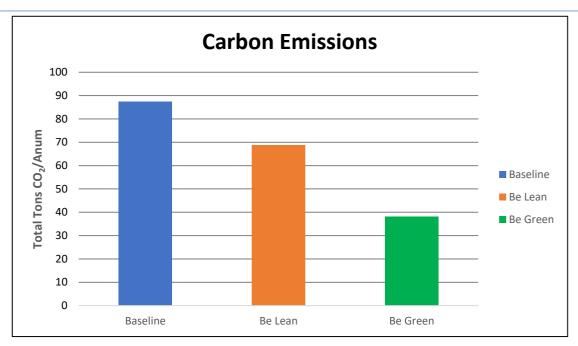


Figure 1.2 Annual Carbon Emissions

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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 onsite 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.

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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.

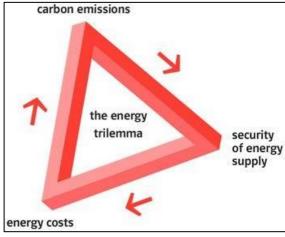


Figure 3.1 The Energy Trilemma

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 long-

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term 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.

Paragraph 154

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.

Paragraph 155

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.

Paragraph 156

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.

Paragraph 157

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.

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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.

Policy D14 Noise

- A. In order to reduce, manage and mitigate noise to improve health and quality of life, residential and 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.

Policy SI 1 Improving Air Quality

- 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

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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

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- 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.

Policy SI 4 Managing Heat Risk

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

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.

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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;
- 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.

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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.

Policy CC2 – Ensuring Sustainable Design and Construction

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

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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 onsite 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

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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

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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

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	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

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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 CO₂/annum

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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

<u>Landscape</u> – 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.

<u>Layout & Design</u> – 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.

<u>Orientation</u> — 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,	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.
and green roofs and walls.	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.

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	U – Value (W/m².K)			
Feature	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	

<u>Table 7.2 U – Values targeted in the new-built residential elements of the development</u>

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

<u>Table 7.2.1 U – Values targeted in the existing residential elements of the development</u>

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

	U – Value (W/m².K)			
Feature	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 m³/hr/	m²@ 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 CO₂/annum

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

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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,	Double glazing to be provided with low G values and shading coefficient to limit the effects of areas of glazing contributing to solar gain.
insulation and green roofs and walls.	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

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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/m²)	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

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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.

Renewable Technology Feasibility Assessment		Feasible?
vehicular access for fuel de <u>Noise</u> Noise levels are generated	by the operation of the bio-fuel boiler and associated deliveries of the enclosure will have to be attenuated to acceptable levels imposed by	No

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Renewable Technology Fea	asibility Assessment	Feasible?
Wind Turbines 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:- 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. 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. The financial viability of a small scale installation on the site would be compromised by the operational efficiency of the units (circa 30%). Wind turbines, can cause electrical interference within a 2km radius. 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
the wind turbines are locat Noise Noise levels are generated	visual impact on the site which will be dependent on the height at which red. by the rotating blades; these noise levels will vary dependent on wind to be in acceptable levels imposed by planning and Acoustician	
Ground Source Heat Pumps Land Use This installation would recommended.	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. Suire Environmental Agency approval. Ground and Hydrology analysis tigate if favourable conditions exist.	Yes

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Renewable Technology Fea	asibility Assessment	Feasible?
There are no noise issues g	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>Noise</u>	I for the installation of Photovoltaic panels. 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
When installing Air Source be positioned to provide s problems. Noise Noise levels are generated dependent on manufacture.	be installed on ground mounted, roof mounted or wall mounted frames. Heat Pumps there are various factors to consider; Heat Pumps should helter from high winds which can reduce efficiency by causing defrost d by fans, and compressors causing vibrations. The noise levels are rer and vary accordingly, these will need to be in acceptable levels	
imposed by planning and A 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

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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

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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 SI 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).

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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 CO₂ 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

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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 (KgCO₂/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 CO₂ 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.

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11 APPENDICES

APPENDIX A ENERGY AND CARBON CALCULATIONS

Residential Carbon Calculations:

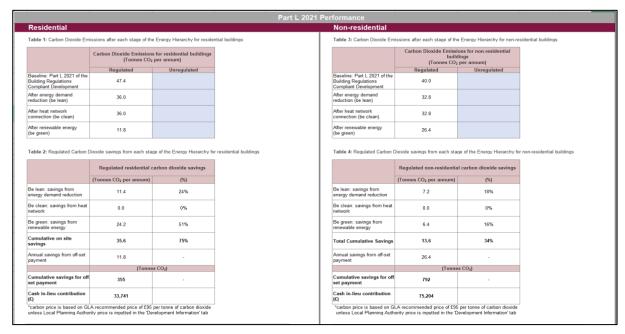
				тис арр	rount should o	omprete un u	ic ngiic biac oi	ens moraamy			LYSIS (PART L		e number or	unto, the rere	DETECENT UNIO	are ir coor	to to .			
				Baseline		'Be Lean'	'Be Clean'	'Be Oreen'	Fabrio Energy Effic	ienoy (FEE)	Baceline			'Be Lean'			'Be Clean'		'00	Green'
Unit identifier (e.g. plot number, dwelling type etc.)	Model total floo area	r Number of unit	t Total area represented by model	TER	Energy saving/generation technologies (-)	DER	DER	DER	Target Fabrio Energy Efficiency	Dwelling Fabrio Energy Efficiency	Part L 2021 CO ₂ emissions	Energy sa ving/generation technologies	Part L 2021 CO ₂ emissions	Part L 2021 CO; emissions with Notional PV savings included	"Be Lean" savings	Part L 2021 CO ₂ emissions	Part L 2021 CO ₂ emissions with Notional PV savings included	"Be Clean" savings	Part L 2021 CO ₂ emissions	"Be Oreen" savings
	(m²) (Row 4)		(m²)	(kgCO ₂ / m ²) (Row 278)	(kgCO ₂ p.a.) (Row 288)	(kgCO ₂ / m ²) (Row 273 or 384)	(kgCO ₂ / m ²) (Row 278 or 384)	(kgCO ₂ / m ²) (Row 278 or 384)	(kWhim')	(kWh/m²)	(RgCO ₂ p.a.)	(kgCO ₂ p.a.)	(kgCO ₂ p.a.)	(kgCO ₂ p.a.)	(RgCO ₂ p.s.)	(kgCO ₂ p.a.)	(kgCO ₂ p.a.)	(kgCO ₂ p.a.)	(kgCO ₂ p.a.)	(kgCO ₂ p.a.)
NEW BUILD A Blook B: TF-A1 Blook B: TF-A1	-8 125	2 4	262 345	10.92 12.07	-181.63 -111.80	10.49 11.38	10.49 11.38	3.33 4.60	35.64 32.15		2,762 4,200	-923 -446	2,843 3,980	2,820 8,614	491 687	2,843 3,980	2,320 3,614	:	839 1,801	1,481 1,913
Blook C: SF.A: Blook D: SF.A: Blook D: SF.A: Blook D: 4F.A:	2.0 94 3.N 66	1 4 2 2	162 276 196 265	9.89 11.98 14.21 12.18	-243.52 -120.67 -83.41 -171.77	9.03 10.17 12.16 11.47	9.88 10.17 12.16 11.47	9.10 1.74 1.82 9.22	35.34 34.20 37.29 41.81	32.01 34.56	1,473 4,604 2,790 3,259	-243 -482 -250 -244	1,418 9,824 2,369 9,074	1,176 9,342 2,119 2,700	298 1,183 871 628	1,418 3,824 2,989 3,074	1,176 3,342 2,119 2,700	0	471 864 966 863	704 2,887 1,784 1,887
Block E: OF.1. Block E: OF.2. Block E: 1F.1/ Block E: 1F.3/ Block E: 1F.4/	A.E 80 LN 78 LB 81 LN 116	2 1 2 4 2	160 80 226 324 232	16.08 14.06 13.21 11.03 12.40	-120.19 -128.19 -120.19 -129.79 -186.76	13.08 12.20 11.22 9.80 10.62	12.08 12.20 11.22 9.80 10.62	0.81 0.48 0.21 2.91 0.06	45.50 42.43 35.79 29.12 41.41	37.80 32.85 25.68 38.43	2,007 1,149 2,972 8,671 2,877	-240 -128 -361 -619 -372	1,962 976 2,626 0,110 2,441	1,722 848 2,164 2,691 2,089	686 301 808 1,080 808	1,982 978 2,626 3,110 2,441	1,722 848 2,164 2,691 2,089	0	672 278 722 845 710	1,160 689 1,442 1,648 1,369
Block E: 2F.5J Block E: 2F.6J Block E: 2F.6J Block E: 4F.1J Block E: 4F.3J Block E: 4F.4J	LB 78 LN 77 LN 78 LB 64	1 1 2 1	108 78 77 78 108 78	13.30 11.84 13.89 14.84 16.13 13.16	-88.68 -123.58 -124.69 -120.19 -88.68 -128.19	11.31 10.07 11.83 12.81 13.71 11.18	11.31 10.07 11.83 12.61 18.71 11.18	8.40 8.00 8.60 8.74 8.80 8.38	28.39 30.35 39.65 43.12 40.73 37.22	27.00 38.68 41.53 38.31	1,436 924 1,070 1,113 1,742 1,026	-175 -125 -126 -120 -173 -128	1,221 786 911 948 1,481 872	1,048 662 788 828 1,308 744	288 281 284 287 434 282	1,221 786 911 948 1,481 872	1,048 682 786 826 1,308 744	0 0 0	284 270 281 421 284	681 428 616 646 888 480
Blook E: 4F.6A EXISTING APA Blook B: GF.A Blook B: GF.A	RTMENTS 1.1 64	2 2	77 105 262	0.16 0.38	-124.89 0.00 0.00	12.82 0.16 0.31	12.82 0.16 0.31	0.08 0.12	45.01 0.00 0.00	0.00	1,182	-126	16 81	882 16 81	300 1 13	987 18 81	862 16 81		8 8 31	668 10 60
Block B: GF.A Block B: GF.A Block B: GF.A Block B: GF.A	8.E 64 7.8 96 11. 113 6.V 126	4 1 4 2	336 96 462 262	0.28 0.33 0.33 0.40	0.00 0.00 0.00 0.00	0.23 0.27 0.27 0.27 0.30 0.18	0.23 0.27 0.27 0.20 0.18	0.12 0.09 0.10 0.11 0.12 0.07	0.00 0.00 0.00 0.00	0.00 0.00 0.00	87 31 149 101 27	0	77 28 122 78	77 28 122 78	10 8 27 26	77 28 122 78 21	77 28 122 78 21		30 10 60 30	47 18 72 46
Block B: GF.A Block B: 1F.A Block B: 1F.A Block B: 1F.A Block B: 1F.A Block B: 2F.A Block B: 2F.A	LE 147 2.V 165 4.N 91 6.6 95 6.6 52	2 3 10 0	115 736 474 1635 665 666 795	0.28 0.38 0.90 0.27 0.28 0.22 0.92	0.00 0.00 0.00 0.00 0.00 0.00	0.18 0.27 2.84 0.22 0.18 0.17 2.87	0.18 0.27 2.84 0.22 0.18 0.17 2.87	0.07 0.11 0.76 0.09 0.08 0.07	00.0 00.0 00.0 00.0 00.0	0.00 0.00 0.00 0.00	243 1,849 442 135 144	0	21 198 1,261 980 108 112 2,290	21 198 1,261 880 108 112 2,280	84 697 82 29 03	21 198 1,251 980 108 112 2,290	21 198 1,261 980 108 112 2,290	0	8 81 958 147 47 48 848	13 118 899 213 69 68 1.844
Blook C: FF.A Blook C: SF.A Blook C: 4F.A	1.9 94	2 8 2	0 100 470 164	0.26 0.21 0.20	0.00 0.00 0.00	0.22 0.16 0.16	0.22 0.16 0.16	0.09 0.08 0.08	0.00 0.00 0.00	0.00	47 99 53	0	41 76 26	41 76 26	8 24 8	41 76 26	41 76 26	0	17 38 10	24 38 16
Block D: OF A Block D: OF A Block D: OF A Block D: OF A Block D: 1F A Block D: 1F A Block D: 1F A	8.V 66 6.5 44 9.1 61 1.8 99 2.8 66	2 4 2 6 2 12	96 172 176 122 894 130 786	0.14 0.28 0.17 0.18 0.23 0.17 0.18	0.00 0.00 0.00 0.00 0.00 0.00	0.12 0.22 0.16 0.18 0.18 0.14	0.12 0.22 0.16 0.18 0.18 0.14 0.14	0.06 0.09 0.06 0.08 0.08 0.08	0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 0.00	15 46 50 22 137 22 121	0 0 0 0 0 0 0	12 38 28 20 107 18 108	12 38 28 20 107 18 108	2 7 4 2 30 4 16	12 38 28 20 107 18 108	12 38 28 20 107 18 108	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 16 9 7 48 8 46	7 22 18 12 69 10
tum		139	12,600	2.0	-34.3	8.2	0.2	0.0	9.0	8.4	47,444	-4,677	40,710	36,034	11,410	40,710	36,034	0	ff,839	24,195

Non-Residential Carbon Calculations:

									NON-RESID	DENTIAL CO2 A	NALYSIS (PART	L2)								
				Baseline		'Be Lean'	"Be Clean"	"Be Green"			Baceline			'Be Lean'			"Be Clean"		180	Oreen'
Building Use	Model Area	Number of units	Total area represented by model (m²)	BRUKL TER (kgCO ₁ / m ²)	Displaced electricity (-)		BRUKL BER	BRUKL BER (kpC0+/m²)			emissions	Energy saving/generation technologies (kgCO ₂ p.a.)	emissions	emissions with Notional PV savings included		Part L 2021 CO; emissions (kgCO; p.a.)	emissions with Notional PV savings included		Part L 2021 CO ₂ emissions (kgCO ₂ p.a.)	'Be Oreen' savings (kgCO ₂ p.a.)
Block G Block G Block F	1154 555 3242	f f f	156 2042	11.42 12.03 6.87		8.81 8.91 6.20	8.85 6.25 6.25	7.52 4.60 4.63			19,646 7,646 19,366	0.00 0.00 0.00	11,707.80 1,707.80 17,117.76	11,768 11,768 17,118	1,007 1,003 1,007	11,700 11,700 17,110	1,706 1,706 1,704 17,118	0 0	8,666 8,660 16,010	9,022 1,299 2,107
Sum		8	6,012	8.0	0.0	8.6	8.6	6.3			39,966	0	32,809	32,800	7,157	32,809	32,809	0	26,388	6,422
вите-мное в	NERGY CONSUMP	TION AND CO; ANA	ALYBIB																	
Total Sum			17,696		100		100				87,410	-4,677	73,520	GE,843	18,566	73,520	68,842	0	38,226	30,617



Carbon Savings:



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	-

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Residential Blocks Baseline Energy Results:

						kWh/ani	num 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	735 474	0.33	0.33	168111.913	0 35.4576	168.1119	419.4315	43356.808	1060281.322	330	0.33
Block B: 1F.A2.W Block B: 1F.A4.N	158 91	18	474 1638	3.90 0.27	3.90 0.27	206332.857 142703.788	35.4576	206.3329 142.7038	423.3859 295.2045	43482.218 41174.689	751440.7542 3317694.935	3900 270	3.90 0.27
Block B: 1F.A4.N Block B: 1F.A5.S	98	18 6	1638 588	0.27	0.27	142703.788	0	142.7038	295.2045 332.4536	41174.089	3317694.935 896118.4674	270	0.27
Block B: 2F.A3.E	82	8	656	0.23	0.23	10/129.83	0	107.1293	275,7719	40126,254	1133063,886	220	0.23
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	12.01	12.01				2000				
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 Block D: 3F.A3.N	94 65	4	376 195	11.98	11.98	67326.69039 49942.62295	0	94.59	277.4	29506.19217 30543.60656	388819.4902 242265.4485	4504.48 2790.45	4.50 2.79
Block D: 3F.A3.N Block D: 4F.A1.N	134	3	195 268	14.31 12.16	14.31 12.16	49942.62295 7797.948686	23.2994	60.93 136.4641	207.99 343.3145	30543.60656 2466.907771	242265.4485 21535.86891	2790.45 3258.88	2.79 3.26
BIOCK U: 4F.A1.N	154	2	268	12.16	12.16	7797.948080	25.2994	130,4041	343.3145	2400.9077/1	21333.86891	3Z36.88	3.20
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.JA.N	80	1	80	14.36	14.36	4493.840134	0	351.55	231.71	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/a	nnum Baseline + Pas	sive/Energy Efficie	ncy Measures					
Typical Unit	Area m²	Quantity	Total Area m ²	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	<u>108</u>	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	<u>95</u>	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	<u>452</u>	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	<u>252</u>	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
2.2.00. 11.711.11	0	0	0	11.51	12.10	7200.211111	24.0001	120.00	010.01	2100.001111	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	11.33	4822.292994		493.61	315.2	2495.916367	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.3A.S	78	1	78	11.31	13.30	2321.290323		313.4	236.82	2332.258065	5203.768387	785.46	0.79
Block E: 2F.4A.S Block E: 2F.5A.N	77	1	77			3261.290323		313.4	239.33	2332.258065	6174.125806	785.46 910.91	0.79
Block E: 2F.SA.N	75	1		11.83	13.89	3261.290323		331.57	239.33	2696,766917	6358.20203	910.91	0.91
		-	7 <u>5</u>	12.61	14.84								
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	<u>77</u>	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

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Residential Blocks Be Green Energy Results:

					kWh/annu	m Baseline + Passive,	/Energy Efficiency	Measures + ASHP					
Typical Unit	Area m²	Quantity	Total Area m²	DER	TER	<u>Heating</u>	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	<u>95</u>	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	<u>452</u>	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	<u>1638</u>	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	<u>798</u>	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	<u>152</u>	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	<u>188</u>	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	<u>470</u>	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	<u>594</u>	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	<u>130</u>	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	<u>195</u>	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	<u>150</u>	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	<u>78</u>	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	<u>75</u>	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	<u>108</u>	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	<u>78</u>	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	<u>77</u>	3.95	15.09	640.9874757	0	307.4281	239.3318	880.8925971	2,068.64	304.15	0.30
<u>Total</u>	<u>3685</u>	<u>139</u>	<u>12583</u>								2,352,103.10	<u>13,408.36</u>	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

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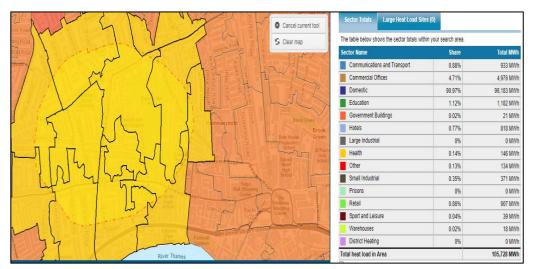
APPENDIX B WIND DATA



Wind Velocity Chart for the Development



APPENDIX C CHP AVAILABILITY



CHP Availability Search

Ravenscourt Park Hospital Energy Statement Issued



APPENDIX D SAMPLE BRUKL REPORTS

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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:

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

Foundation area [m²]: 532

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

Certifier details

Name:

Telephone number: 01344 628821

Address: Cudd Bentley, Ashurst Manor, Sunninghill, SL5

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	5.98
Building CO ₂ emission rate (BER), kgCO ₂ /m²:annum	4.63
Target primary energy rate (TPER), kWh/m²annum	64.1
Building primary energy rate (BPER), kWh/m²: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}	Ua-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_{i-Calc} = Calculated maximum individual element U-values [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

U_{a-Calc} = Calculated area-weighted average 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

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/(I/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/(I/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/(I/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/(I/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					
Α	Local supply or extract ventilation units					
В	Zonal supply system where the fan is remote from the zone					
С	Zonal extract system where the fan is remote from the zone					
D	Zonal balanced supply and extract ventilation system					
Е	Local balanced supply and extract ventilation units					
F	Other local ventilation units					
G	Fan assisted terminal variable air volume units					
Н	Fan coil units					
I	I Kitchen extract with the fan remote from the zone and a grease filter					
NB: L	NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.					

Zone name	SFP [W/(I/s)]								HR efficiency		
ID of system type	Α	В	С	D	Е	F	G	Н	1	nk emclend	
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	† <u> </u>	-	-	_	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	<u> </u>	-	-	_	0.9	-	 	-	-	0.8	N/A
2F.BED13	-	-	-	_	0.9	-	_	-	-	0.8	N/A
2F.BED14	† <u> </u>	-	-	_	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	<u> </u>	-	-	_	0.9	-	 	-	-	0.8	N/A
2F.BED7	-	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED8	ļ_	-	-	-	0.9	-	-	-	-	0.8	N/A
2F.BED9	† <u> </u>	-	-	-	0.9	-	-	-	l -	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	-	-	<u> </u>	-	0.9	-	-	-	-	0.8	N/A
3F.BED7	-	-	-	-	0.9	-	-	-	-	0.8	N/A

Zone name		SFP [W/(I/s)]									
ID of system type	• A	В	С	D	E	F	G	Н	I	HR efficiency	
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	-	-	-	-	8.0	N/A
GF.BED10	-	-	-	-	0.9	-	-	-	-	8.0	N/A
GF.BED11	-	-	-	-	0.9	-	-	-	-	8.0	N/A
GF.BED2	-	-	-	-	0.9	-	-	-	-	8.0	N/A
GF.BED3	-	-	-	-	0.9	-	-	-	-	8.0	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	Displa	y 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.WC10	120	-	_		
2F.WC1	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.QROOM GF.OFF1	130	-	-	
GF.RECEP	130	95	1.421	
1F.STOE2	120	-	-	

General lighting and display lighting	General luminaire	Displa	y 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 [m²]	5975.1	5975.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	1534.54	1857.2
Average U-value [W/m²K]	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/m²]

	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/m²]

	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 & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	350.38	338.71
Primary energy [kWh/m²]	48.86	64.1
Total emissions [kg/m²]	4.63	5.98

H	HVAC Systems Performance									
Sys	stem 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 loca	al room hea	ter - unfanr	ned, [HS] A	SHP, [HFT]	Electricity,	[CFT] Elect	tricity		
	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 loca	al room hea	ter - unfanr	ned, [HS] Di	irect or stor	age electri	c heater, [H	FT] Electric	ity, [CFT] E	lectricity
	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 Heatin	g or Coolin	g							
	Actual	294.4	49.1	0	0	0	0	0	0	0
	Notional	325.2	52.3	0	0	0	0	0		
[ST] Other loca	al room hea	ter - unfanr	ned, [HS] A	SHP, [HFT]	Electricity,	[CFT] Elect	tricity		
	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 m	ulti-split sy	stem, [HS]	ASHP, [HF1	[] Electricity	y, [CFT] Ele	ctricity			
	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 Heatin	g or Coolin	g							
	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

Ravenscourt Park Hospital Energy Statement Issued

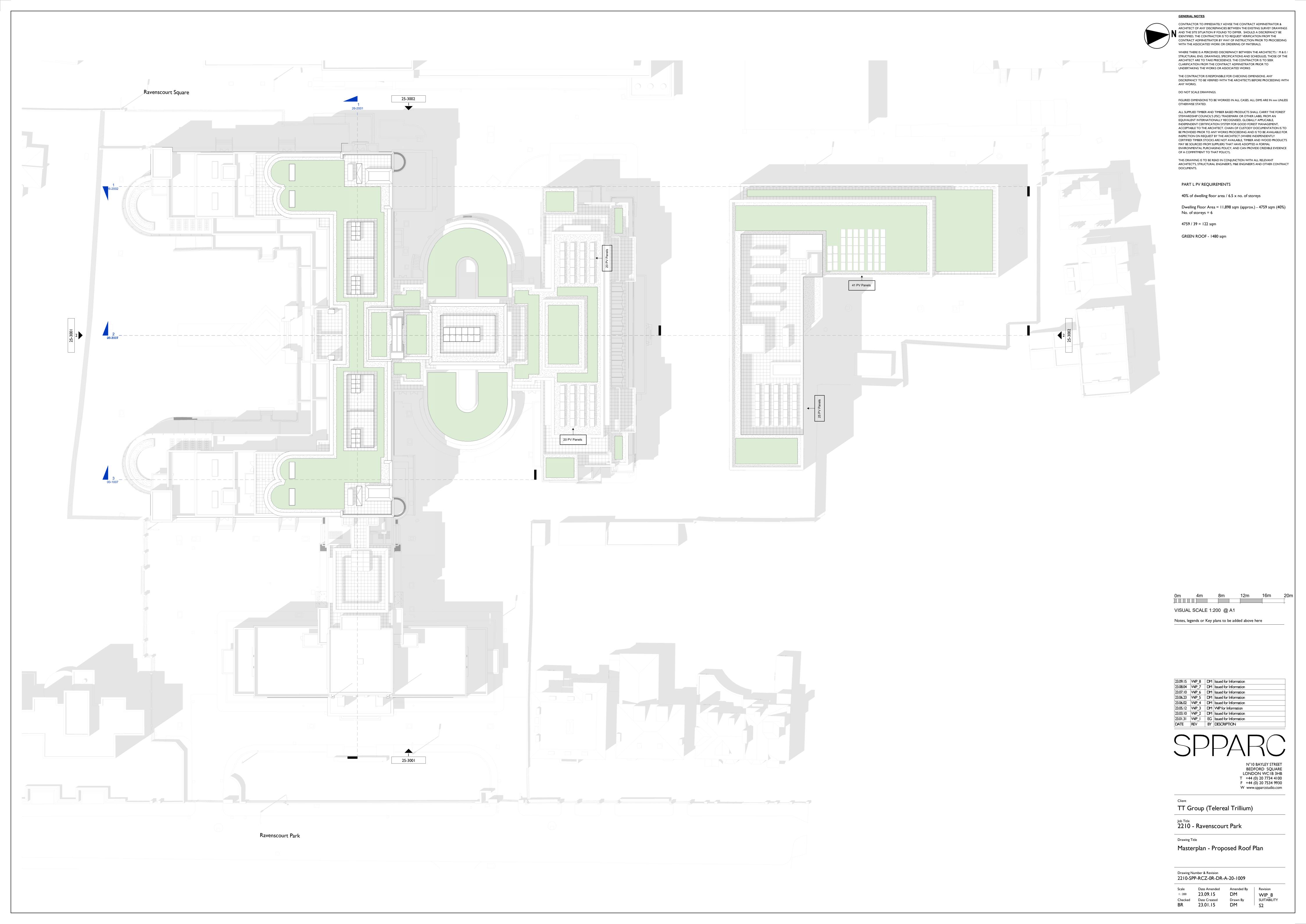


APPENDIX E PV ROOF PLANS

Revision: 001

Ref: 6391-CBC-HR-RP-S-003-P01

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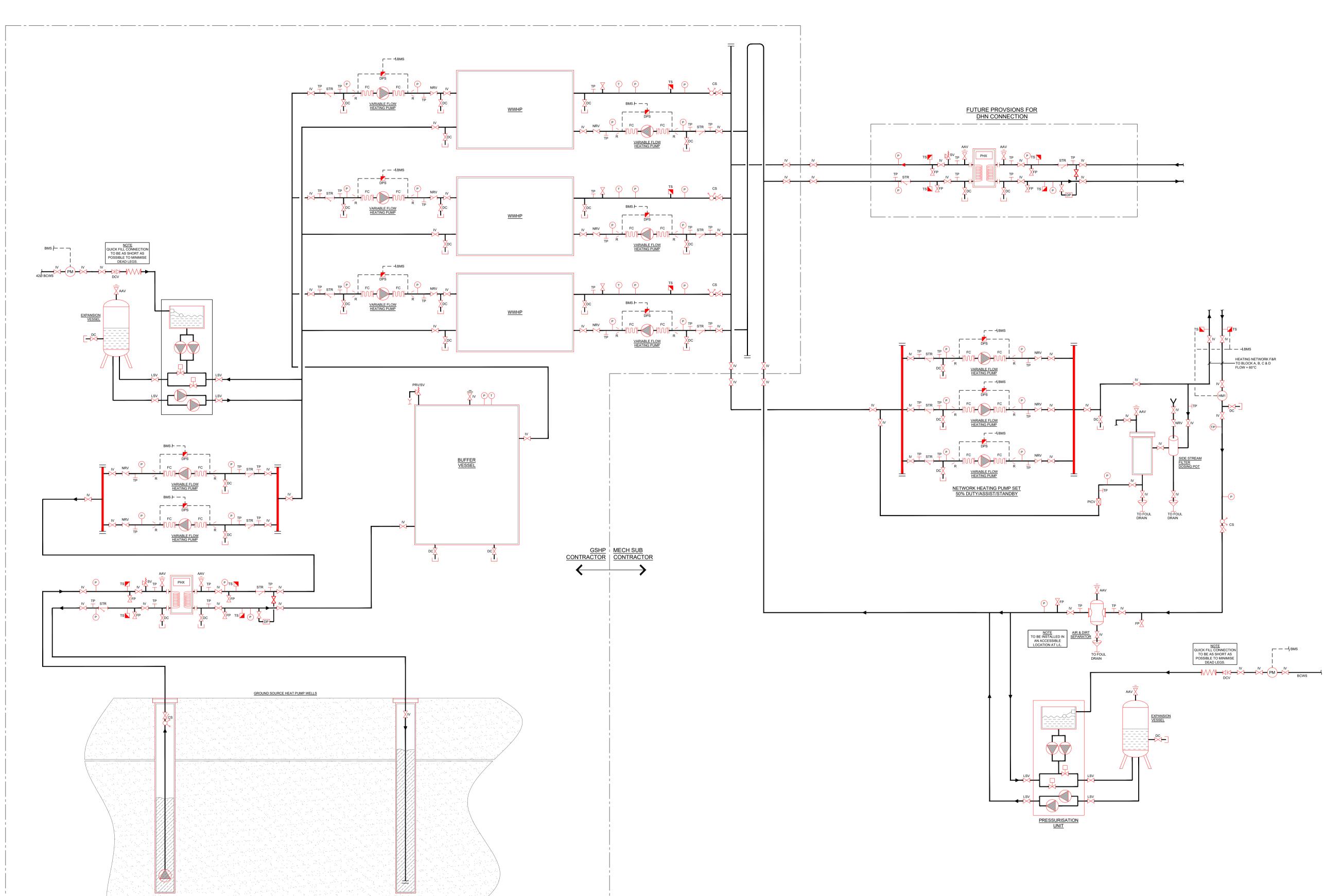
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APPENDIX F DHN FUTURE PROVISION

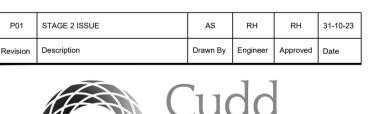
Revision: 001

Ref: 6391-CBC-HR-RP-S-003-P01



NOTES

- THE HEATING SYSTEM DESIGN AND SPECIFICATION SHALL TAKE INTO CONSIDERATION THE FOLLOWING TO INCREASE SYSTEM EFFICIENCIES, REDUCE SYSTEM CAPACITY AND MINIMISE SYSTEM
 CONSTRUCTION.
- 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
- 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.



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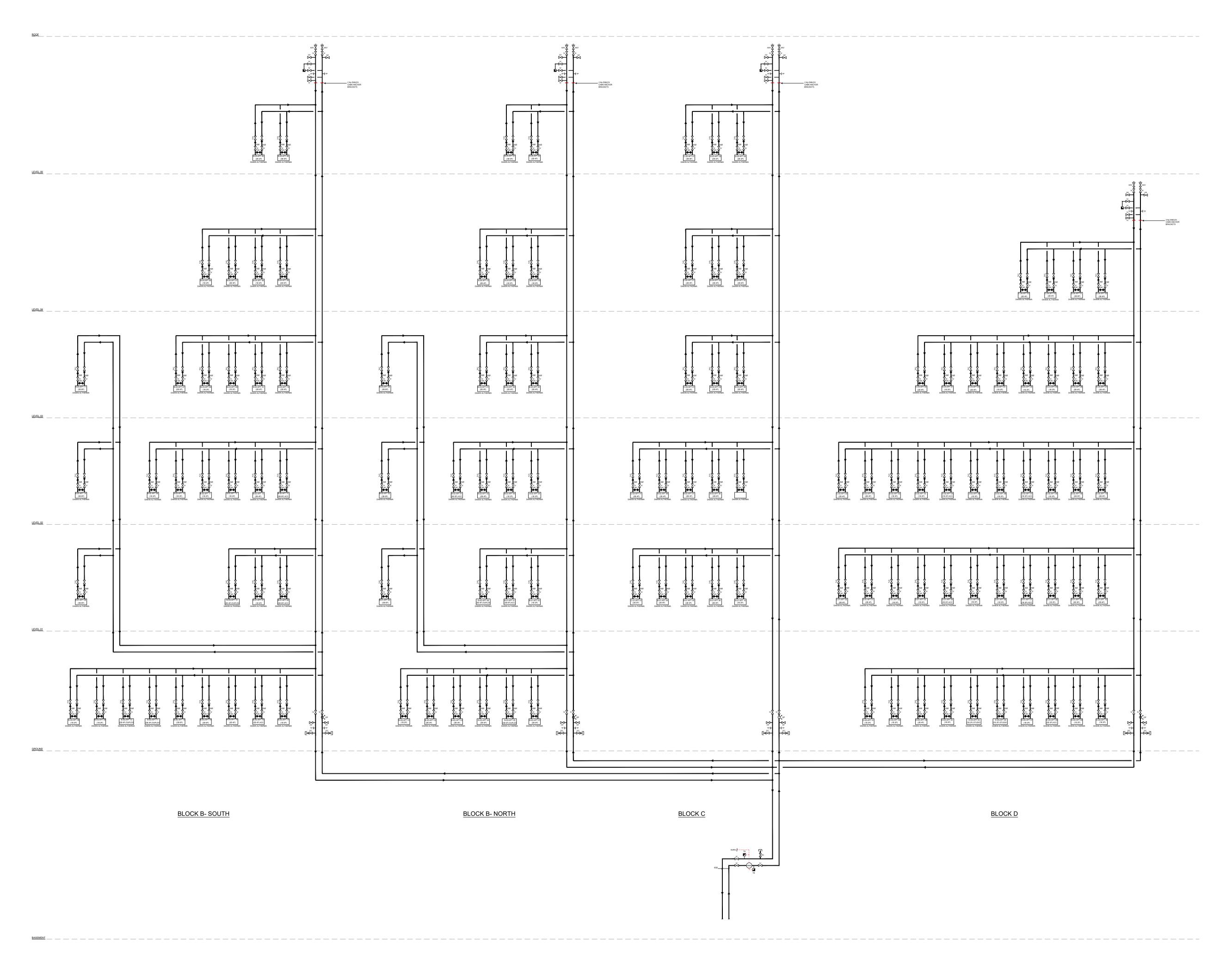
STAGE 2

TELEREAL TRILLIUM

RAVENSCOURT PARK HOSPITAL HAMMERSMITH

PLANTROOM HEATING SCHEMATIC

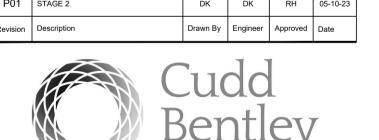
Scale	Size	Drawn By	Engineer	Approved	Date
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6391-C	P01				



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STAGE 2

TELEREAL TRILLIUM

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 Referer	nce				Revision
6391-C	BC-ZZ	-XX-DR-N	M-53002		P01

Ravenscourt Park Hospital Energy Statement Issued



APPENDIX G SAP WORKSHEETS

Revision: 001

Ref: 6391-CBC-HR-RP-S-003-P01



		Ргор Тур	pe Ref		
Property SAP Rating					
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 Pat	hak			Assessor ID	Z621-0001
Client 001, 002					

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 1. Overall dwelling characteristics Storey height Volume (m2) (m3) 116.0000 (1b) 3.1500 (2b) 365.4000 (1b) Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)116.0000 365.4000 (5) Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =2. Ventilation rate m3 per hour Number of open chimneys 0.0000 (6a) Number of open flues Number of chimneys / flues attached to closed fire 0 * 20 = 0.0000 (6b) 0.0000 (6c) 0 * 10 = Number of flues attached to solid fuel boiler 0 * 20 0.0000 (6d) 0 * 35 = Number of flues attached to other heater 0.0000 (6e) Number of blocked chimneys 0 * 20 = 0.0000 (6f) 0 * 10 Number of intermittent extract fans 0.0000 (7a) Number of passive vents Number of flueless gas fires 0 * 10 = 0.0000 (7b) 0 * 40 = 0.0000 (7c) Air changes per hour 0.0000 / (5) = Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 0.0000 (8) Pressure test Yes Pressure Test Method Blower Door 2.5000 (17) Measured/design AP50 Infiltration rate 0.1250 (18) Number of sides sheltered 1 (19) Shelter factor $(20) = 1 - [0.075 \times (19)]$ 0.9250 (20) Infiltration rate adjusted to include shelter factor $(21) = (18) \times (20)$ 0.1156 (21) Aug 3.7000 4.9000 4.4000 4.3000 4.0000 4.5000 4.7000 (22) Wind speed 5.1000 5.0000 3.8000 3.8000 4.3000 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 0.1098 0.1098 0.1156 0.1301 0.1359 (22b) 0.1272 0.1243 0.1070 0.1243 Balanced mechanical ventilation with heat recovery 0.5000 (23a) If mechanical ventilation If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.5000 (23b) 76.5000 (23c) Effective ac 0.2620 0.2591 0.2273 0.2534 (25) 0.2649 0.2447 0.2418 0.2273 0.2245 0.2331 0.2418 0.2476

3. Heat losses and heat loss parame	 ter						
Element	Gross	Openings	NetArea	U-value	AxU	K-value	AxK
	m2	. m2	m2	W/m2K	W/K	kJ/m2K	kJ/K
Opening Type 1 (Uw = 1.20)			38.0800	1.1450	43.6031		(
Door			2.2000	1.3000	2.8600		ĺ
External Wall 1	117.5900	40.2800	77.3100	0.1800	13.9158	190.0000	14688.9000 (

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sheltered wall Total net area Fabric heat los Party Wall 1 Party Floor 1 Party Ceiling 1 Internal Wall 1	s, W/K = S		Aum(A, m2)	9.3400		126 46 116 116	.3400 .9300 (26)(.4000 .0000 .0000	0.1700 30) + (32) 0.0000	1.58 = 61.96 0.00	667 100 18 4	00.0000 00.0000 00.0000 00.0000 00.0000 00.0000	1774.6000 8352.0000 4640.0000 3480.0000 926.1900	(31) (33) (32) (32d) (32b)
E17 Cor E2 Othe E3 Sill E4 Jamb E7 Part E18 Par P3 Part E6 Inte	rameter (Ti Bridges Hent Hener (norma Hener (inver Er lintels Hy floor be Hety wall be Hy wall - I Hermediate f	MP = Cm / 1) ted - inte (including tween dwel tween dwel ntermediat loor withi	rnal area g other stee lings (in b lings e floor bet n a dwellin	reater than l lintels) locks of fl ween dwelli g	ats) ngs (in blo	ŕ	is)	Li 25 22 14 14 37 74 6	, , ,	Psi-value 0.0320 -0.1170 0.0020 0.0130 0.0080 0.0080 0.0000 0.0000 0.0000	(32e) = Tot 0.86 -2.55 0.02 0.18 0.36 0.06 0.06	291.9111 (a) (a) (a) (a) (a) (a) (a) (a) (a) (a)	(35)
Thermal bridges Point Thermal b Total fabric he	ridges	isi) caica	iacea using	Аррениіх к	,				(33) + (36)	(36a) = + (36a) =	-1.2647 0.0000 60.7020	
Ventilation head (38)m Heat transfer of	Jan 31.9448	culated mo Feb 31.5963	nthly (38)m Mar 31.2477	= 0.33 x (Apr 29.5049	25)m x (5) May 29.1564	Jun 27.4136	Jul 27.4136	Aug 27.0650	Sep 28.1107	Oct 29.1564	Nov 29.8535	Dec 30.5506	(38)
Average = Sum(3	92.6468 9)m / 12 =	92.2983	91.9497	90.2069	89.8584	88.1156	88.1156	87.7670	88.8127	89.8584	90.5555	91.2526 90.1198	
HLP HLP (average)	Jan 0.7987	Feb 0.7957	Mar 0.7927	Apr 0.7776	May 0.7746	Jun 0.7596	Jul 0.7596	Aug 0.7566	Sep 0.7656	0ct 0.7746	Nov 0.7807	Dec 0.7867 0.7769	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
Energy conte Energy content Distribution lo Water storage l Store volume a) If manufact	e for mixer 0.0000 e for baths 82.9886 e for other 43.7804 e tot water u Jan 206.7689 200.7710 (annual) e tot se (46) m 30.1157 e tot se currer decla	showers 0.0000 81.7561 uses 42.1884 se (litres Feb 123.9444 176.4952 = 0.15 x (26.4743 red loss f	Mar 120.6168 185.3835 45)m 27.8075	0.0000 76.8203 39.0043 Apr 115.8246 158.5581 23.7837	0.0000 74.4241 37.4123 May 111.8364 150.5533	0.0000 71.7670 35.8203 Jun 107.5873 132.2912 19.8437	0.0000 70.3318 35.8203 Jul 106.1521 128.3818 19.2573	0.0000 72.0553 37.4123 Aug 109.4676 135.5438 20.3316	0.0000 73.9318 39.0043 Sep 112.9362 139.2616	0.0000 76.7750 40.5964 Oct 117.3713 159.2718 Total = \$23.8908	0.0000 80.0410 42.1884 Nov 122.2294 174.1382 sum(45)m = 26.1207	2.8464 0.0000 82.7080 43.7804 116.7438 Dec 126.4884 198.0503 1938.6996 29.7075 180.0000 1.4000	(42a) (42b) (42c) (43) (44) (45) (46) (47) (48)
Temperature f Enter (49) or (Total storage l	54) in (55											0.7800 1.0920	
If cylinder con Primary loss Combi loss	33.8520 23.2624 0.0000	30.5760 21.0112 0.0000	33.8520 23.2624 0.0000	32.7600 32.7600 22.5120 0.0000	33.8520 33.8520 23.2624 0.0000	32.7600 32.7600 22.5120 0.0000	33.8520 33.8520 23.2624 0.0000	33.8520 33.8520 23.2624 0.0000	32.7600 32.7600 22.5120 0.0000	33.8520 33.8520 23.2624 0.0000	32.7600 32.7600 22.5120 0.0000	33.8520 33.8520 23.2624 0.0000	(57) (59)
Total heat requ WWHRS PV diverter Solar input FGHRS Output from w/h	257.8854 0.0000 0.0000 0.0000 0.0000	ater heati 228.0824 0.0000 0.0000 0.0000	ng calculate 242.4979 0.0000 0.0000 0.0000 0.0000	ed for each 213.8301 0.0000 0.0000 0.0000 0.0000	month 207.6677 0.0000 0.0000 0.0000	187.5632 0.0000 0.0000 0.0000 0.0000	185.4962 0.0000 0.0000 0.0000 0.0000	192.6582 0.0000 0.0000 0.0000 0.0000	194.5336 0.0000 0.0000 0.0000 0.0000	216.3862 0.0000 0.0000 0.0000 0.0000	229.4102 0.0000 0.0000 0.0000 0.0000	255.1647 0.0000 0.0000 0.0000 0.0000	(63a) (63b) (63c)
	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582 Total p	194.5336 er year (kw	216.3862 h/year) = S	229.4102 Sum(64)m =	255.1647 2611.1756 2611	
Electric shower		0.0000	0.0000	0.0000 Tot	0.0000 al Energy u	0.0000 sed bv inst	0.0000 antaneous e	0.0000 lectric sho	0.0000 wer(s) (kWh	0.0000 /vear) = Su	0.0000 um(64a)m =	0.0000	(64a)
Heat gains from	water hea 112.4479	ting, kWh/ 99.9544	month 107.3315	96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	
5. Internal gai				 	 May			 Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains	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)

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	141.1826	156.3093		145.8887	141.1826	145.8887	141.1826	141.1826	145.8887	141.1826	145.8887	141.1826	(67)
Appliances ga	ins (calcul 279.9103	ated in App 282.8149		259.9131	or L13a), a 240.2432	lso see Tab 221.7563	ole 5 209.4059	206.5014	213.8208	229.4031	249.0730	267.5599	(68)
Cooking gains	(calculate 37.2322	d in Append 37.2322	dix L, equat 37.2322	ion L15 or 37.2322	L15a), also 37.2322	see Table 37.2322	5 37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	(69)
Pumps, fans Losses e.g. e	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
_	-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 (Tab 151.1396	le 5) 148.7417	144.2628	134.6364	128.6969	122.5061	118.7883	121.9890	125.7251	132.5933	141.8313	149.9237	(72)
Total interna	l 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 gain	S												
[]an]				100	Colon flux		~			Acco		Cains	
[Jan]			P	m2	Solar flux Table 6a	Speci	g fic data.	Specific		Acce fact	or	Gains W	
					W/m2		Table 6b	or Tab	le 6c	Table	6d		
North East			22.1 15.9		10.6334 19.6403		0.3600 0.3600		.0000	0.77 0.77		65.3772 86.5641	
										0177		0013012	(,,,
Solar gains	151.9413	294.2769	491.1774	747.7346		1002.0301	944.9185	781.5459	579.5994	349.6573	188.5865	125.6878	
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 inter	nal tempera	ture (heat:											
Temperature d												21.0000	(85)
Utilisation f						Jun	Jul	Aug	Sep	0ct	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 util living a	7.7684 rea	7.7939	7.8197	7.9514	7.9784	8.1164	8.1164	8.1447	8.0606	7.9784	7.9247	7.8718	
	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 Th 2	20.3432 20.2545	20.5252 20.2571	20.7635 20.2597	20.9613 20.2727	20.9974 20.2754	20.9999 20.2885	21.0000 20.2885	21.0000 20.2911	20.9982 20.2832	20.9033 20.2754	20.5878 20.2701	20.3203 20.2649	
util rest of	house												
MIT 2	0.9964 19.4875	0.9852 19.7201	0.9335 20.0133	0.7357 20.2395	0.5014 20.2736	0.3217 20.2884	0.2196 20.2885	0.2593 20.2911	0.4849 20.2823	0.8627 20.1896	0.9866 19.8114	0.9975 19.4667	(90)
Living area f MIT	raction 19.8991	20.1074	20.3742	20.5867	20.6218	20.6307	20.6307	20.6321	fLA = 20.6267	Living are 20.5329	a / (4) = 20.1849	0.4810 19.8773	
Temperature a adjusted MIT	djustment 19.8991	20.1074	20.3742	20.5867	20.6218	20.6307	20.6307	20.6321	20.6267	20.5329	20.1849	0.0000 19.8773	(93)
													()
8. Space heat	ing require	ment 											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Son	0ct	Nov	Doc	
Utilisation	0.9958	0.9843	0.9360	0.7523	May 0.5213	0.3411	0.2400	Aug 0.2820	Sep 0.5115	0.8755	0.9861	Dec 0.9970	
Useful gains Ext temp.	786.5740 4.3000	932.9376 4.9000	1046.2750 6.5000	1018.4921 8.9000	799.5256 11.7000	531.3402 14.6000	355.1681 16.6000	371.4291 16.4000	578.3555 14.1000	804.1346 10.6000	780.0785 7.1000	747.8304 4.2000	1 1
Heat loss rat		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 Solar heating	requiremen											1869.6063	()
Solar heating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	(98b)
Space heating	kWh				1 (142	0.0000	0.0000	0.0000	0.0000	CE 7020	201 4754		(00.5)
Space heating	•		170.7127 lar contribu	25.7234 tion - tota	1.6143 l per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	65.7828	291.4754	507.9756 1869.6063	` ,
Space heating	per m2									(98c) / (4) =	16.1173	(99)
9b. Energy re													
Fraction of s												0.0000	(301)
Fraction of s	pace heat f	rom communi	ity system		•	.,						1.0000	(302)
Fraction of h Factor for co	ntrol and c	harging met	thod (Table	4c(3)) for	space heati	.ng						1.0000 1.0000	(305)
Factor for ch Distribution												1.0000 1.5000	(305a) (306)
Efficiency of	secondary/											0.0000	1 1
Space heating Space heating	requiremen												
Space heat fr	490.0263 om Heat pum	316.2958 p = (98) x		25.7234) x 1.50	1.6143	0.0000	0.0000	0.0000	0.0000	65.7828	291.4754	507.9756	(98)
307a Space heating	735.0394	474.4437		38.5851	2.4214	0.0000	0.0000	0.0000	0.0000	98.6742	437.2131	761.9634	
Space Heating	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)

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Efficiency of secondary/supplementary heating system in % (from Table 4a or App 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	0.0000	(309)
Water heating Annual water heating requirement							
257.8854 228.0824 242.4979 213.8301 207.6677 187.5632 Water heat from Heat pump = $(64) \times 1.00 \times 1.50$	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(64)
310a 386.8281 342.1236 363.7469 320.7452 311.5015 281.3447 Water heating fuel	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470	
386.8281 342.1236 363.7469 320.7452 311.5015 281.3447 Cooling System Energy Efficiency Ratio	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470 0.0000	
Space coolin 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000	0.0000 35.4951	0.0000 35.4951	0.0000 34.3501	0.0000 35.4951	0.0000 34.3501	0.0000 35.4951	(315)
Lighting 39.0575 31.3334 28.2122 20.6695 15.9657 13.0441 Electricity generated by PVs (Appendix M) (negative quantity)	14.5645	18.9314	24.5901	32.2635	36.4415	40.1430	` '
(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 quant (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 quant (335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	ity) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year Space heating fuel - community heating						2804.4094	, ,
Space heating fuel - secondary Water heating fuel - community heating						0.0000 3916.7634	(309)
Efficiency of water heater Electricity used for heat distribution						0.0000 28.0441	(311)
Space cooling fuel						0.0000	` '
Electricity for pumps and fans: (Palanced With Mont Bosonomy Databases in use factor = 1 2500 SER = 0.0275)							
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375) mechanical ventilation fans (SFP = 0.9375)						417.9262	
Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)						417.9262 315.2165	
Energy saving/generation technologies (Appendices M ,N and Q)							
PV generation Wind generation						0.0000 0.0000	
Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)						0.0000 0.0000	
Appendix Q´- special features Energy saved or generated						-0.0000	
Energy used Total delivered energy for all uses						0.0000 7454.3156	(337)
Total delite to the 6, 10, dil die						, 13 113230	(330)
12b. Carbon dioxide emissions - Community heating scheme							
		Energy		ion factor kg CO2/kWh	l.	Emissions	
Efficiency of heat source Heat pump		kWh/year	,		K,	g CO2/year 412.0000	1 1
Space and Water heating from Heat pump Electrical energy for heat distribution (space & water)		1631.3526 28.0441		0.1585 0.0000		107.8585	(372)
Overall CO2 factor for heat network Total CO2 associated with community systems						0.0374 251.6855	
Space and water heating Pumps, fans and electric keep-hot		417.9262		0.1387		251.6855 57.9715	
Energy for lighting Total CO2, kg/year		315.2165		0.1443		45.4955 355.1525	
EPC Dwelling Carbon Dioxide Emission Rate (DER)						3.0600	
13b. Primary energy - Community heating scheme							
			Primary ene	rgy factor	Prim	ary energy	
Efficiency of heat source Heat pump		kWh/year		kg CO2/kWh		kWh/year 412.0000	(467a)
Space and Water heating from Heat pump Electrical energy for heat distribution (space & water)		1631.3526 28.0441		1.5865 0.0000		1079.9144 104.0537	(467)
Overall CO2 factor for heat network		20.0441		0.0000		0.3912	(486)
Total CO2 associated with community systems Space and water heating		417 0000		4 5400		2629.6294 2629.6294	(476)
Pumps, fans and electric keep-hot Energy for lighting		417.9262 315.2165		1.5128 1.5338		632.2388 483.4895	(479)
Total Primary energy kWh/year Dwelling Primary energy Rate (DPER)						3745.3578 32.2900	
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)							

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CALCULATION OF 1	FARGET EMI	SSIONS											
1. Overall dwell									Chama			V-3	
Ground floor Total floor area Dwelling volume	a TFA = (1	a)+(1b)+(1d)+(1d)+(1e)	(1n)	1:	16.0000		Area (m2) 116.0000	·	y height (m) 3.1500 (3d)+(3e)		Volume (m3) 365.4000 365.4000	(1b) (4)
2. Ventilation r	rate												
											m3	per hour	
Number of open of Number of open f Number of chimne Number of flues Number of flues Number of intern Number of passiv Number of fluele	flues eys / flue attached attached ed chimney mittent ex ve vents	to solid fu to other he s tract fans	el boiler	ire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 4 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 40.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50 te		and fans	= (6a)+(6b))+(6c)+(6d)+	(6e)+(6f)+	(6g)+(7a)+(7b)+(7c) =		40.0000	Air changes 0 / (5) = Bl	0.1095 Yes ower Door 5.0000 0.3595	(17)
Shelter factor Infiltration rat	te adjuste	d to includ	le shelter f	actor					(20) = 1 - (21)		(19)] = x (20) =	0.9250 0.3325	
Wind speed Wind factor	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	
Adj infilt rate Effective ac	0.4239 0.5899	0.4156 0.5864	0.4073 0.5830	0.3658 0.5669	0.3574 0.5639	0.3159 0.5499	0.3159 0.5499	0.3076 0.5473	0.3325 0.5553	0.3574 0.5639	0.3741 0.5700	0.3907 0.5763	
3. Heat losses a	and heat l	oss paramet	er								. 1		
TER Opaque door TER Opening Type External Wall 1 sheltered wall Total net area of Fabric heat loss	of externa	l elements		Gross m2 17.5900 9.3400	Openings m2 40.2800	2 26 77 9 115		U-value W/m2K 1.0000 1.1450 0.1800 0.1800 30) + (32)			(-value kJ/m2K	A x K kJ/K	(26) (27) (29a) (29a) (31) (33)
Party Wall 1 Thermal mass par	namatan (T	MD - Cm / 1	EA) in k1/m	ער		46	.4000	0.0000	0.0000			201 0111	(32)
List of Thermal K1 Eleme E16 Corr E17 Corr E2 Other E3 Sill E4 Jamb E7 Party E18 Part P3 Party E6 Inter Thermal bridges	Bridges ent ner (norma ner (inver r lintels y floor be y wall be y wall - I rmediate f (Sum(L x	l) ted - inter (including tween dwell ntermediate loor withir	enal area groother steel ings (in bloomings efloor betwood a dwelling	eater than lintels) ocks of fla	ngs (in bloc	,	s)	25 22 14 14 37 74 6 29	5.2000	i-value 0.0900 -0.0900 0.0500 0.0500 0.0500 0.0700 0.0600 0.0000	Tota 2.268 -1.984 0.709 0.709 1.890 5.226 0.378 0.000	0 5 0 0 0 2 0 0 0 9.1957	
Point Thermal br Total fabric hea Ventilation heat	at loss	culated mor	thly (38)m	= 0.33 x (25)m x (5)				(33)) + (36)	(36a) = + (36a) =	0.0000 57.6797	(37)
(38)m Heat transfer co	Jan 71.1273	Feb 70.7065 128.3862	Mar 70.2940 127.9737	Apr 68.3567 126.0365	May 67.9943 125.6740	Jun 66.3070 123.9867	Jul 66.3070 123.9867	Aug 65.9945 123.6742	Sep 66.9569 124.6366	0ct 67.9943 125.6740	Nov 68.7275 126.4073	Dec 69.4941 127.1738	
Average = Sum(39	9)m / 12 = Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	126.0347 Dec	
HLP HLP (average) Days in mont	1.1104	1.1068 28	1.1032 31	1.0865	1.0834 31	1.0689 30	1.0689	1.0662	1.0745 30	1.0834	1.0897 30	1.0963 1.0865 31	

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4. Water heat													
Assumed occup Hot water usa	ancy											2.8464	(42)
Hot water usa	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 usa	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)
Average daily	43.7804	42.1884	40.5964 /day)	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804 116.7438	
Daily hot wat	Jan er use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	
Energy conte		123.9444 176.4952	120.6168 185.3835	115.8246 158.5581	111.8364 150.5533	107.5873 132.2912	106.1521 128.3818	109.4676 135.5438	112.9362 139.2616	117.3713 159.2718 Total = S	122.2294 174.1382 um(45)m =	126.4884 198.0503 1938.6996	(45)
Distribution	30.1157	= 0.15 x (26.4743	45)m 27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46)
Water storage Store volume a) If manufa		red loss f	actor is kn	own (kWh/d	lay):							180.0000 1.5520	1 1
	factor from (54) in (55	Table 2b		,	,,							0.5400 0.8381	(49)
	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 c	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 Combi loss	23.2624 0.0000	21.0112 0.0000	23.2624 0.0000	22.5120 0.0000	23.2624 0.0000	22.5120 0.0000	23.2624 0.0000	23.2624 0.0000	22.5120 0.0000	23.2624 0.0000	22.5120 0.0000	23.2624 0.0000	1 1
Total heat re	quired for w	ater heati	ng calculat	ed for each	n month								
WWHRS	250.0137 0.0000	220.9725 0.0000	234.6262 0.0000	206.2123 0.0000	199.7959 0.0000	179.9454 0.0000	177.6244 0.0000	184.7864 0.0000	186.9158 0.0000	208.5144 0.0000	221.7924 0.0000	247.2929 0.0000	1 1
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 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	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	
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)
12Total per y	ear (kWh/yea									h/year) = S		2518.4924	1 1
LIECUIC SHOW	0.0000	0.0000	0.0000	0.0000 Tot	0.0000 al Energy u	0.0000 sed by inst	0.0000 antaneous e	0.0000 electric sho	0.0000 wer(s) (kWh	0.0000 /year) = Su	0.0000 m(64a)m =	0.0000 0.0000	
Heat gains fr	om water hea 106.1505	ting, kWh/ 94.2665	month 101.0342	90.8439	89.4531	82.1102	82.0811	84.4624	84.4278	92.3520	96.0243	105.2458	(65)
5. Internal g Metabolic gai (66)m Lighting gain Appliances ga	ns (Table 5) Jan 142.3219 s (calculate 141.1826	, Watts Feb 142.3219 d in Appen 156.3093 ted in App	Mar 142.3219 dix L, equa 141.1826 endix L, eq	Apr 142.3219 tion L9 or 145.8887 uation L13	May 142.3219 L9a), also: 141.1826 or L13a), a	Jun 142.3219 see Table 5 145.8887	Jul 142.3219 141.1826	Aug 142.3219 141.1826	Sep 142.3219 145.8887	Oct 142.3219 141.1826	Nov 142.3219 145.8887	Dec 142.3219 141.1826	(67)
Cooking gains	279.9103 (calculated	282.8149 in Append				221.7563 see Table	209.4059	206.5014	213.8208	229.4031	249.0730	267.5599	(68)
Pumps, fans	37.2322 3.0000	37.2322 3.0000	37.2322 3.0000	37.2322 3.0000	37.2322 3.0000	37.2322 0.0000	37.2322 0.0000	37.2322 0.0000	37.2322 0.0000	37.2322 3.0000	37.2322 3.0000	37.2322 3.0000	
Water heating	-113.8576	-113.8576			-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
	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 interna	1 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 gain													
[Jan]				rea m2	Solar flux Table 6a W/m2	Speci	g fic data. Table 6b	Specific or Tab		Acce fact Table	or	Gains W	
North East			15.6 11.1		10.6334 19.6403		0.6300 0.6300		.7000 .7000	0.77 0.77		50.7279 67.1660	
Solar gains Total gains	117.8938 750.3587		381.1128 1002.2860	580.1802 1180.8507	743.1957 1313.5508	777.4929 1324.8764	733.1789 1259.7881	606.4151 1133.3204	449.7210 992.3880	271.3050 834.7163	146.3274 743.3528	97.5233 716.4218	
7. Mean inter	 nal temperat												
												21.0000	(85)

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Utilisation factor for	U	,	, ,	,	7	77	A	Com	0.0	New	Dos	
Jan tau 75.525	Feb 3 75.7733	Mar 76.0175	Apr 77.1860	May 77.4086	Jun 78.4620	Jul 78.4620	Aug 78.6603	Sep 78.0529	0ct 77.4086	Nov 76.9596	Dec 76.4957	
alpha 6.035 util living area	1 6.0516	6.0678	6.1457	6.1606	6.2308	6.2308	6.2440	6.2035	6.1606	6.1306	6.0997	
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 19.880		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 util rest of house	19.9953	19.9982	20.0119	20.0144	20.0264	20.0264	20.0286	20.0218	20.0144	20.0092	20.0038	(88)
0.9984		0.9842 19.2379	0.9220	0.7462	0.5041 20.0213	0.3370 20.0260	0.3952	0.7093	0.9626	0.9956 19.0923	0.9988	1 1
MIT 2 18.688! Living area fraction			19.6911	19.9477			20.0277		19.6236 Living are	a / (4) =	18.6743 0.4810	7 7
MIT 19.2619 Temperature adjustment	9 19.4527	19.7530	20.1625	20.4112	20.4869	20.4939	20.4939	20.4457	20.0958	19.6183	19.2460 0.0000	(92)
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)
8. Space heating requi												
_											_	
Jan Utilisation 0.9979	Feb 0.9945	Mar 0.9828	Apr 0.9259	May 0.7714	Jun 0.5448	Jul 0.3826	Aug 0.4451	Sep 0.7478	0ct 0.9640	Nov 0.9948	Dec 0.9984	(94)
Useful gains 748.8123 Ext temp. 4.3000		985.0165 6.5000	1093.3001 8.9000	1013.3221 11.7000	721.8041 14.6000	482.0334 16.6000	504.4776 16.4000	742.0982 14.1000	804.6524 10.6000	739.4975 7.1000	715.3013 4.2000	
Heat loss rate W								790.9057				
Space heating kWh			1419.4906	1094.7698	729.8993	482.7901	506.3125		1193.3758	1582.4076	1913.4532	
876.7164 Space heating requirement		528.9999 er vear (kw	234.8572 Mh/vear)	60.5970	0.0000	0.0000	0.0000	0.0000	289.2102	606.8953	891.4250 4158.4987	(98a)
Solar heating kWh	·	0.0000	- '	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(00h)
0.0000 Solar heating contribut			0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	(980)
Space heating kWh 876.716	4 669.7976	528.9999	234.8572	60.5970	0.0000	0.0000	0.0000	0.0000	289.2102	606.8953	891.4250	(98c)
Space heating requirements	ent after sol	ar contribu	ıtion - tota	l per year	(kWh/year)				(0%c	(4) =	4158.4987 35.8491	
Space nearing per mz									(300	., , (+, -	33.0431	(33)
9a. Energy requirements												
												(224)
Fraction of space heat Fraction of space heat			entary syste	m (labie 11	.)						0.0000 1.0000	
Efficiency of main space Efficiency of main space		stem 1 (in	%)								92 2000	
	e heating sy											(206) (207)
Efficiency of secondary		stem 2 (in	%)								0.0000 0.0000	(207)
		stem 2 (in	%)	May	Jun	Jul	Aug	Sep	0ct	Nov	0.0000	(207)
Efficiency of secondary	//supplementa Feb ent	rstem 2 (in ary heating	%) system, %	May 60.5970	Jun 0.0000	Jul 0.0000	Aug 0.0000	Sep 0.0000	Oct 289.2102	Nov 606.8953	0.0000 0.0000	(207) (208)
Jan Space heating requirements 876.716 Space heating efficient	//supplementa Feb ent 4 669.7976 cy (main heat	Mar 528.9999 ing system	%) system, % Apr 234.8572 1)	60.5970	0.0000	0.0000	0.0000	0.0000	289.2102	606.8953	0.0000 0.0000 Dec 891.4250	(207) (208) (98)
Jan Space heating requirements Space heating efficient 92.3000 Space heating fuel (max)	Feb ent 4 669.7976 by (main heat 9 92.3000 in heating sy	Mar 528.9999 sing system 92.3000 (stem)	%) system, % Apr 234.8572 1) 92.3000	60.5970	0.0000 0.0000	0.0000 0.0000	0.0000	0.0000	289.2102 92.3000	606.8953 92.3000	0.0000 0.0000 Dec 891.4250 92.3000	(207) (208) (98) (210)
Jan Space heating requirements 876.716 Space heating efficien 92.300	//supplementa Feb ent 4 669.7976 cy (main heat 3 92.3000 in heating sy 2 725.6746	Mar 528.9999 sing system 92.3000 estem) 573.1310	%) system, % Apr 234.8572 1) 92.3000 254.4498	60.5970	0.0000	0.0000	0.0000	0.0000	289.2102	606.8953	0.0000 0.0000 Dec 891.4250	(207) (208) (98) (210)
Space heating requirement Space heating refliciency 92.3000 Space heating fuel (mai 949.855) Space heating efficiency 92.3000 Space heating fuel (mai 949.855) Space heating efficiency 9.0000	Feb ent 4 669.7976 cy (main heat 9 92.3000 in heating \$2 725.6746 cy (main heat 9 0.0000	Mar 528.9999 cing system 92.3000 stem) 573.1310 cing system 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498	60.5970	0.0000 0.0000	0.0000 0.0000	0.0000	0.0000	289.2102 92.3000	606.8953 92.3000	0.0000 0.0000 Dec 891.4250 92.3000	(207) (208) (98) (210) (211)
Space heating requiremment friendly space heating requiremment space heating efficient space heating fuel (maximum space heating fuel maximum space heating efficient space heating fuel (maximum space heating fuel maximum space heating fu	//supplementa Feb ent 4 669.7976 cy (main heat 92.3000 in heating sy 2 725.6746 cy (main heat 9 0.0000 in heating sy 0 0.0000	Mar 528.9999 cing system 92.3000 stem) 573.1310 cing system 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2)	60.5970 92.3000 65.6523	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	289.2102 92.3000 313.3372	606.8953 92.3000 657.5247	0.0000 0.0000 Dec 891.4250 92.3000 965.7909	(207) (208) (98) (210) (211) (212)
Jan Space heating requirement 876.716 Space heating efficient 92.3000 Space heating fuel (max 949.855) Space heating efficient 0.0000 Space heating fuel (max 9.0000) Space heating fuel (max 9.0000)	//supplementa Feb ent 4 669.7976 cy (main heat 0 92.3000 in heating sy 2 725.6746 cy (main heat 0 0.0000 in heating sy 0 0.0000	Mar 528.9999 cing system 92.3000 (stem) 573.1310 (sing system 0.0000 (stem 2)	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000	60.5970 92.3000 65.6523 0.0000	0.00000.00000.0000	0.0000 0.0000 0.0000 0.0000	0.00000.00000.00000.0000	0.0000 0.0000 0.0000 0.0000	289.2102 92.3000 313.3372 0.0000	606.8953 92.3000 657.5247 0.0000	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000	(207) (208) (98) (210) (211) (212) (213)
Space heating fuel (max 9.000) Space heating efficient 949.855; Space heating efficient 949.855; Space heating efficient 9.0000 Space heating fuel (max 0.0000) Space heating fuel (see 0.0000)	//supplementa Feb ent 4 669.7976 cy (main heat 0 92.3000 in heating sy 2 725.6746 cy (main heat 0 0.0000 in heating sy 0 0.0000	Mar 528.9999 (ing system 92.3000 (stem) 573.1310 (ing system 0.0000 (stem 2) 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000	60.5970 92.3000 65.6523 0.0000	0.0000 0.0000 0.0000 0.0000	0.00000.00000.00000.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	289.2102 92.3000 313.3372 0.0000 0.0000	606.8953 92.3000 657.5247 0.0000 0.0000	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000	(207) (208) (98) (210) (211) (212) (213)
Space heating requiremment of secondary space heating requiremment space heating efficient space heating fuel (maximum space heating efficient space heating efficient space heating fuel (maximum space heating fuel (second space heating fuel fuel space fuel fuel fuel fuel fuel fuel fuel fue	//supplementa Feb ent 4 669.7976 cy (main heat 9 92.3000 in heating sy 2 725.6746 cy (main heat 0 0.0000 in heating sy 0 0.0000 condary) 0 0.0000	Mar 528.9999 ing system 92.3000 rstem) 573.1310 ing system 0.0000 rstem 2) 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000	60.5970 92.3000 65.6523 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	289.2102 92.3000 313.3372 0.0000 0.0000	606.8953 92.3000 657.5247 0.0000 0.0000	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000 0.0000	(207) (208) (98) (210) (211) (212) (213) (215)
Space heating requiremment of secondary space heating requiremment space heating efficient space heating fuel (main space heating efficient space heating efficient space heating fuel (main space heating fuel (main space heating fuel (see space heating fuel (see space heating space	//supplementa Feb ent 4 669.7976 27 (main heat 6) 92.3000 in heating sy 2 725.6746 6) 0.0000 in heating sy 6) 0.0000 condary) 6) 0.0000	Mar 528.9999 (ing system 92.3000 (stem) 573.1310 (ing system 0.0000 (stem 2) 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000	60.5970 92.3000 65.6523 0.0000	0.0000 0.0000 0.0000 0.0000	0.00000.00000.00000.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	289.2102 92.3000 313.3372 0.0000 0.0000	606.8953 92.3000 657.5247 0.0000 0.0000	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000	(207) (208) (98) (210) (211) (212) (213) (215)
Space heating requiremments fuel (mail of the content of the conte	Feb ent 4 669.7976 cy (main heat 9 2.3000 in heating sy 2 725.6746 cy (main heat 0 0.0000 in heating sy 0 0.0000 condary) 0 0.0000 ent 7 220.9725 ater	Mar 528.9999 ing system 92.3000 rstem) 573.1310 ing system 0.0000 rstem 2) 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000	60.5970 92.3000 65.6523 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000	289.2102 92.3000 313.3372 0.0000 0.0000	606.8953 92.3000 657.5247 0.0000 0.0000	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000 0.0000	(207) (208) (98) (210) (211) (212) (213) (215) (64) (216)
Space heating requiremment of the state of t	//supplementa Feb ent 4 669.7976 cy (main heat 0 92.3000 in heating sy 2 725.6746 cy (main heat 0 0.0000 in heating sy 0 0.0000 condary) 0 0.0000	Mar 528.9999 Sing system 92.3000 (stem) 573.1310 6.0000 0.0000 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000 206.2123	60.5970 92.3000 65.6523 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	289.2102 92.3000 313.3372 0.0000 0.0000 0.0000	606.8953 92.3000 657.5247 0.0000 0.0000 0.0000	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000 0.0000	(207) (208) (98) (210) (211) (212) (213) (215) (64) (216) (217)
Jan Space heating requirement 876.716 Space heating efficient 92.3000 Space heating fuel (max 949.855) Space heating efficient 0.0000 Space heating fuel (max 0.0000 Space heating fuel (max 0.0000 Space heating fuel (max 0.0000) Space heating fuel (see 0.0000) Water heating fuel (see 0.0000) Water heating requirement 250.013 Efficiency of water heating Fuel for water heating	//supplementa Feb ent 4 669.7976 cy (main heat 3 92.3000 in heating sy 2 725.6746 cy (main heat 0 0.0000 in heating sy 0 0.0000 condary) 0 0.0000 ent 7 220.9725 ster 0 86.3832 , kWh/month	Mar 528.9999 ing system 92.3000 sstem) 573.1310 ing system 0.0000 stem 2) 0.0000 234.6262 85.8259	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000 206.2123 84.3522	60.5970 92.3000 65.6523 0.0000 0.0000 199.7959 81.7276	0.0000 0.0000 0.0000 0.0000 0.0000 179.9454 79.8000	0.0000 0.0000 0.0000 0.0000 0.0000 177.6244 79.8000	0.0000 0.0000 0.0000 0.0000 0.0000 184.7864 79.8000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 186.9158 79.8000	289.2102 92.3000 313.3372 0.0000 0.0000 0.0000 208.5144 84.7936	606.8953 92.3000 657.5247 0.0000 0.0000 221.7924 86.1981	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000 0.0000 247.2929 79.8000 86.6771	(207) (208) (98) (210) (211) (212) (213) (215) (64) (216) (217) (219)
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Space heating requirements of secondary second	Feb ent 4 669.7976 2y (main heat 0 92.3000 in heating sy 2 725.6746 2y (main heat 0 0.0000 in heating sy 0 0.0000 condary) 0 0.0000 ent 7 220.9725 ster 0 86.3832 x kWh/month 3 255.8049 direment 0 0.0000 1 6.5973 0 23.5336 by PVs (Apper 7 -44.2206 7 0.0000	Mar 528.9999 sing system 92.3000 stem) 573.1310 sing system 0.0000 0.0000 234.6262 85.8259 273.3746 0.0000 7.3041 21.1894 ddix M) (neg-66.0386 6.0000 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000 206.2123 84.3522 244.4658 0.0000 7.0685 15.5243 gative quant -77.2158 gix M) (nega 0.0000	60.5970 92.3000 65.6523 0.0000 0.0000 199.7959 81.7276 244.4656 0.0000 7.3041 11.9914 ity) -85.8054 tive quanti 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 179.9454 79.8000 225.4954 0.0000 7.0685 9.7971 -80.9710 ty) 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 177.6244 79.8000 222.5870 0.0000 7.3041 10.9389 -79.9337 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 184.7864 79.8000 231.5619 0.0000 7.3041 14.2188	0.0000 0.0000 0.0000 0.0000 0.0000 186.9158 79.8000 234.2303 0.0000 7.0685 18.4689	289.2102 92.3000 313.3372 0.0000 0.0000 208.5144 84.7936 245.9081 0.0000 7.3041 24.2322	606.8953 92.3000 657.5247 0.0000 0.0000 221.7924 86.1981 257.3054 0.0000 7.0685 27.3702	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000 0.0000 247.2929 79.8000 86.6771 285.3038 0.0000 7.3041 30.1503	(207) (208) (98) (210) (211) (212) (213) (215) (64) (216) (217) (219) (221) (231) (232)
Jan Space heating requiremment 876.716. Space heating efficience 92.3000 Space heating fuel (maximum 949.855. Space heating fuel requiremment 950.013. Efficiency of water heating 250.013. Efficiency of water heating 288.592. Space cooling fuel requiremment 96.8592. Lighting 29.335. Electricity generated 16.233a)m -30.171. Electricity generated 16.233a)m -0.0000. Electricity generated 16.235a)m 0.0000.	Feb ent 4 669.7976 29 (main heating sy 2 725.6746 29 0.0000 20 0.00000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.0000 20 0.	Mar 528.9999 sing system 92.3000 stem) 573.1310 sing system 0.0000 cstem 2) 0.0000 234.6262 85.8259 273.3746 0.0000 7.3041 21.1894 ddix M) (neg -66.0386 nes (Append 0.0000 tric genera 0.0000	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000 206.2123 84.3522 244.4658 0.0000 7.0685 15.5243 gative quant -77.2158 dix M) (nega 0.0000 ators (Appen 0.0000	60.5970 92.3000 65.6523 0.0000 0.0000 199.7959 81.7276 244.4656 0.0000 7.3041 11.9914 ity) -85.8054 tive quanti 0.0000 dix M) (neg 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 179.9454 79.8000 225.4954 0.0000 7.0685 9.7971 -80.9710 ty) 0.0000 ative quant 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 177.6244 79.8000 222.5870 0.0000 7.3041 10.9389 -79.9337 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 184.7864 79.8000 231.5619 0.0000 7.3041 14.2188 -74.1797 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 186.9158 79.8000 234.2303 0.0000 7.0685 18.4689 -64.5034	289.2102 92.3000 313.3372 0.0000 0.0000 208.5144 84.7936 245.9081 0.0000 7.3041 24.2322 -51.8289	606.8953 92.3000 657.5247 0.0000 0.0000 221.7924 86.1981 257.3054 0.0000 7.0685 27.3702 -33.7473	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000 0.0000 247.2929 79.8000 86.6771 285.3038 0.0000 7.3041 30.1503 -25.8890 0.0000	(207) (208) (98) (210) (211) (212) (213) (215) (64) (216) (217) (219) (221) (231) (232) (233a)
Space heating requirements of secondary second	Feb ent 4 669.7976 cy (main heat 8 9 2.3000 in heating sy 2 725.6746 cy (main heat 8 0.0000 in heating sy 0 0.0000 condary) 0 0.0000 ent 7 220.9725 ster 0 86.3832 cy kWh/month 8 255.8049 wirement 0 0.0000 1 6.5973 0 23.5336 cy PVs (Apper 7 -44.2206 cy wind turbi 0 0.0000 cy hydro-elec 0 0.0000 cy electricity 0 0.0000	Mar 528.9999 sing system 92.3000 stem) 573.1310 sing system 0.0000 cstem 2) 0.0000 234.6262 85.8259 273.3746 0.0000 7.3041 21.1894 ddix M) (neg -66.0386 cne (Appendo 0.0000 cgenerated 0.0000 cgenerated 0.0000 cgenerated	%) system, % Apr 234.8572 1) 92.3000 254.4498 2) 0.0000 0.0000 0.0000 206.2123 84.3522 244.4658 0.0000 7.0685 15.5243 sative quant -77.2158 stive quant -77.2158 stive quant -77.2158 defix M) (negal ologo of the cologo of t	60.5970 92.3000 65.6523 0.0000 0.0000 199.7959 81.7276 244.4656 0.0000 7.3041 11.9914 ity) -85.8054 tive quanti 0.0000 dix M) (neg 0.0000 P (Appendix 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 179.9454 79.8000 225.4954 0.0000 7.0685 9.7971 -80.9710 ty) 0.0000 ative quant 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 177.6244 79.8000 222.5870 0.0000 7.3041 10.9389 -79.9337 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 184.7864 79.8000 231.5619 0.0000 7.3041 14.2188 -74.1797 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 186.9158 79.8000 234.2303 0.0000 7.0685 18.4689 -64.5034 0.0000	289.2102 92.3000 313.3372 0.0000 0.0000 208.5144 84.7936 245.9081 0.0000 7.3041 24.2322 -51.8289 0.0000	606.8953 92.3000 657.5247 0.0000 0.0000 221.7924 86.1981 257.3054 0.0000 7.0685 27.3702 -33.7473 0.0000	0.0000 0.0000 Dec 891.4250 92.3000 965.7909 0.0000 0.0000 247.2929 79.8000 86.6771 285.3038 0.0000 7.3041 30.1503 -25.8890 0.0000	(207) (208) (98) (210) (211) (212) (213) (215) (64) (217) (219) (221) (231) (232) (233a) (234a)
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Space heating fuel - secondary Efficiency of water heater Water heating fuel used Space cooling fuel			79.8 3009.0	0000 (215) 8000 0958 (219) 0000 (221)
Electricity for pumps and fans: Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)				0000 (231) 7499 (232)
Energy saving/generation technologies (Appendices M ,N and Q) PV generation Wind generation Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)			0.0	3977 (233) 3000 (234) 3000 (235a) 3000 (235)
Appendix Q - special features Energy saved or generated Energy used Total delivered energy for all uses			0.0	0000 (236) 0000 (237) 8637 (238)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP				
Space heating - main system 1	Energy kWh/year 4505.4157	Emission factor kg CO2/kWh		year 1373 (261)
Total CO2 associated with community systems Water heating (other fuel) Space and water heating	3009.0958		631.9 1578.0	0000 (373) 9101 (264) 0474 (265)
Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies	86.0000 236.7499			9293 (267) 1703 (268)
PV Unit electricity used in dwelling PV Unit electricity exported Total	-714.5049 -718.8927		-95.! -90.: -185.:	
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER)				3715 (272) 4000 (273)
13a. Primary energy - Individual heating systems including micro-CHP				
	Energy	Primary energy factor	Primary en	
Space heating - main system 1 Total CO2 associated with community systems	kWh/year 4505.4157	1.1300	0.0	1197 (275) 2000 (473)
Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot	3009.0958 86.0000 236.7499	1.5128	8491.3 130.3	2782 (278) 3979 (279) 1008 (281)
Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling	-714.5049		-1067.	1349 (282) 7816
PV Unit electricity exported Total Total Primary energy kWh/year	-718.8927		-331.0 -1398.1	
Target Primary Energy Rate (TPER)				4000 (287)
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY				
1. Overall dwelling characteristics				
Ground floor	Area (m2) 116.0000	(m)		lume (m3) 4000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) 116.0000 Dwelling volume		3a)+(3b)+(3c)+(3d)+(3e)	•	(4) 4000 (5)
2. Ventilation rate			m3 per l	nour
Number of open chimneys				
Number of open chimneys Number of open flues Number of chimneys / flues attached to closed fire			0 * 20 = 0.0	0000 (6a) 0000 (6b) 0000 (6c)

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Number of flues attached to solid fuel boiler
                                                                                                                                      0 * 20
                                                                                                                                                     0.0000 (6d)
                                                                                                                                     0 * 35 =
Number of flues attached to other heater
                                                                                                                                                     0.0000 (6e)
                                                                                                                                      0 * 20 =
Number of blocked chimneys
                                                                                                                                                     0.0000 (6f)
Number of intermittent extract fans
                                                                                                                                      4 * 10 =
                                                                                                                                                    40.0000
                                                                                                                                                            (7a)
                                                                                                                                     0 * 10 =
Number of passive vents
                                                                                                                                                     0.0000 (7h)
Number of flueless gas fires
                                                                                                                                                     0.0000
                                                                                                                                                            (7c)
                                                                                                                                     Air changes per hour
40.0000 / (5) =
                                                                                                                                                     0.1095 (8)
Pressure test
Pressure Test Method
                                                                                                                                                        Yes
                                                                                                                                               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) \times (20)
                                                                                                                                                     0.2169 (21)
                                                                  May
4.3000
                                                                                         Jul
                                                                                                     Aug
3.7000
                              Feb
                                          Mar
                                                      Apr
                                                                              Jun
                                                                                                                 Sen
                                                                                                                             0ct
                                                                                                                                         Nov
                                                                                                                                                     Dec
                                                                                                                 4.0000
Wind speed
                  5.1000
                              5.0000
                                          4,9000
                                                      4.4000
                                                                              3.8000
                                                                                         3.8000
                                                                                                                             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) = Effective ac 0.5382 0.5367 0.5353 0.5285 0.5272 0.5212 0.5212
                                                                                                                                                     0.0000 (23c)
                  0.5382
                                                                                                     0.5201
                                                                                                                 0.5235
                                                                                                                             0.5272
                                                                                                                                         0.5298
                                                                                                                                                     0.5325 (25)
3. Heat losses and heat loss parameter
Element
                                                    Gross
                                                                  Openings
                                                                                   NetArea
                                                                                                   U-value
                                                                                                                     A \times U
                                                                                                                                   K-value
                                                                                                                                                      A x K
                                                                                                                       W/K
                                                                                                     W/m2K
                                                                                                                                    kJ/m2K
                                                                                                                                                       kJ/K
                                                       m2
                                                                        m2
                                                                                        m2
Opening Type 1 (Uw = 1.20)
                                                                                   38.0800
                                                                                                    1.1450
                                                                                                                   43.6031
                                                                                                                                                             (27)
                                                                                   2.2000
77.3100
                                                                                                    1.3000
                                                                                                                    2.8600
                                                                                                                                                             (26)
Door
External Wall 1
                                                 117.5900
                                                                  40.2800
                                                                                                    0.1800
                                                                                                                   13.9158
                                                                                                                                   190.0000
                                                                                                                                                 14688.9000 (29a)
sheltered wall
                                                                                    9.3400
                                                                                                    0.1700
                                                                                                                    1.5878
                                                                                                                                   190.0000
                                                                                                                                                 1774.6000
                                                                                                                                                             (29a)
Total net area of external elements Aum(A, m2)
                                                                                  126.9300
                                                                                                                                                             (31)
                                                                                        (26)...(30) + (32) =
                                                                                                                   61.9667
Fabric heat loss, W/K = Sum (A \times U)
                                                                                                                                                             (33)
Party Wall 1
                                                                                   46.4000
                                                                                                    0.0000
                                                                                                                                   180.0000
                                                                                                                                                  8352.0000
Party Floor 1
Party Ceiling 1
                                                                                  116.0000
                                                                                                                                   40,0000
                                                                                                                                                 4640.0000 (32d)
                                                                                  116.0000
                                                                                                                                    40.0000
                                                                                                                                                  4640.0000 (32b)
Internal Wall 1
                                                                                  102.9100
                                                                                                                                                   926.1900 (32c)
Heat capacity Cm = Sum(A \times k)
                                                                                                       (28)...(30) + (32) + (32a)...(32e) =
                                                                                                                                                35021.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K
List of Thermal Bridges
                                                                                                                                                   301.9111 (35)
        K1 Element
                                                                                                            Length
                                                                                                                        Psi-value
                                                                                                                                             Total
                                                                                                           25.2000
                                                                                                                            0.0320
        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
                                                                                                           14.1800
                                                                                                                            0.0130
                                                                                                                                            0.1843
        E4 Jamb
                                                                                                           37,8000
                                                                                                                            a aasa
                                                                                                                                            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
        P3 Party wall - Intermediate floor between dwellings (in blocks of flats)
E6 Intermediate floor within a dwelling
                                                                                                           29,4600
                                                                                                                            a aaaa
                                                                                                                                            a aaaa
                                                                                                            2.9600
                                                                                                                            0.0000
                                                                                                                                            0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
                                                                                                                                                    -1.2647 (36)
                                                                                                                        (36a) = (33) + (36) + (36a) =
Point Thermal bridges
Total fabric heat loss
                                                                                                                                                     0.0000
                                                                                                                                                    60.7020 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 \times (25)m \times (5)
                                                                                         Jul
                  Jan
                              Feb
                                                      Apr
                                                                             Jun
                                                                                                     Aug
                                                                                                                 Sep
                                                                                                                             0ct
                                                                                                                                         Nov
                                                                                                                                                     Dec
                                         64.5468
                                                                63.5684
                                                                                                    62.7176
                 64.9013
                             64.7223
                                                     63.7226
                                                                            62.8505
                                                                                        62.8505
                                                                                                                63.1270
                                                                                                                            63.5684
                                                                                                                                        63.8803
                                                                                                                                                   64.2065 (38)
Heat transfer coeff
                                                                                                                                                   124.9085 (39)
                125.6033
                           125.4243
                                       125.2488
                                                   124.4246
                                                               124.2704
                                                                           123.5525
                                                                                       123.5525
                                                                                                   123.4196
                                                                                                               123.8290
                                                                                                                           124.2704
                                                                                                                                       124.5823
Average = Sum(39)m / 12 =
                                                                                         Jul
                  Jan
                              Feb
                                          Mar
                                                      Apr
                                                                              Jun
                                                                                                     Aug
                                                                                                                 Sen
                                                                                                                             Oct
                                                                                                                                         Nov
                                                                                                                                                     Dec
                                                                  1.0713
                  1.0828
                                          1.0797
                                                      1.0726
                                                                             1.0651
                                                                                         1.0651
                                                                                                     1.0640
                                                                                                                 1.0675
                                                                                                                             1.0713
                                                                                                                                         1.0740
                                                                                                                                                     1.0768 (40)
HLP (average)
                                                                                                                                                     1.0726
                      31
                                  28
                                              31
                                                          30
                                                                      31
                                                                                  30
                                                                                             31
                                                                                                         31
                                                                                                                      30
                                                                                                                                 31
                                                                                                                                             30
Days in mont
                                                                                                                                                         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 (42a)
Hot water usage for baths
                             30,6007
                 31,0620
                                         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)
                                                                                                                                                    68.5997 (43)
Average daily hot water use (litres/day)
                              Feb
                                                      Apr
                                                                  May
                                                                             Jun
                                                                                         Jul
                                                                                                     Aug
                                                                                                                 Sep
                                                                                                                             0ct
                                                                                                                                         Nov
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
                            103.6507
                                       108.4288
                                                     92.7568
                                                                 87.8642
                                                                                        75.1590
                                                                                                    79.7185
                                                                                                                82.2188
                                                                                                                            94.0838
                                                                                                                                       102.7868
                                                                                                                                                   117.0207 (45)
```

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Energy content										Total = S	um(45)m =	1139.2952	
Distribution 1	0.0000	= 0.15 x (0.0000	45)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 ((46)
Water storage Total storage		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 co				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (
Primary loss Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 (0.0000 (
Total heat req	100.7523	88.1031	92.1645	78.8433	74.6846	65.5138	63.8851	67.7607	69.8860	79.9712	87.3688	99.4676 (
WWHRS PV diverter 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	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 (0.0000 (0.0000 ((63b)
FGHRS Output from w/	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (` '
	100.7523	88.1031	92.1645	78.8433	74.6846	65.5138	63.8851	67.7607 Total p	69.8860 er year (kW	79.9712 h/year) = S	87.3688 um(64)m =	99.4676 (968.4010 ((64)
12Total per ye Electric showe	r(s)		55 0574		5.4.4000	54 0055			52 4040	55 0574		968 (
Hoot gains fro	57.6161	51.3365	56.0574	53.4949 Tot	54.4988 al Energy u	51.9865 sed by inst	53.7194 antaneous e	54.4988 lectric sho	53.4949 wer(s) (kWh	56.0574 /year) = Su	55.0034 m(64a)m =	57.6161 (655.3803 (
Heat gains fro	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 ga			5a)										
Metabolic gain			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains		142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219	142.3219 ((66)
Appliances gai								141.1826	145.8887	141.1826	145.8887	141.1826 (
Cooking gains			275.4954 lix L, equat 37.2322					206.5014	213.8208	229.4031	249.0730	267.5599 (
Pumps, fans Losses e.g. ev	37.2322 0.0000	37.2322 0.0000 (negative v	0.0000	37.2322 0.0000 le 5)	37.2322 0.0000	37.2322 0.0000	37.2322 0.0000	37.2322 0.0000	37.2322 0.0000	37.2322 0.0000	37.2322 0.0000	37.2322 (0.0000 (
	-113.8576	-113.8576			-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576 ((71)
Total internal	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)
	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													
6. Solar gains				 rea m2	Solar flux		g fic data	Specific	FF data	Acce fact		Gains ພ	
			A	rea m2	Solar flux Table 6a W/m2	Speci	g fic data Table 6b	Specific or Tab	data	Acce fact Table	or	Gains W	
			22.1 15.9	m2 800	Table 6a	Speci or	fic data	or Tab	data	fact	or 6d 00		
[Jan]	151.9413	294.2769	22.1	m2 800	Table 6a W/m2 10.6334 19.6403	Speci or	fic data Table 6b 0.3600	or Tab	data le 6c .0000	fact Table 0.77	or 6d 00	W 65.3772 ((76)
[Jan] North East			22.1 15.9	m2 800 000 747.7346	Table 6a W/m2 10.6334 19.6403	Speci or 1002.0301	fic data Table 6b 0.3600 0.3600 944.9185	or Tab 0 0 781.5459	data le 6c .0000 .0000	fact Table 0.77 0.77	or 6d 00 00	W 65.3772 (86.5641 ((76)
[Jan] North East Solar gains	151.9413	850.9725	22.1 15.9 491.1774 1023.3577	m2 800 000 747.7346 1265.1838	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590	Speci or 	fic data Table 6b 	781.5459 1236.0083	data le 6c .0000 .0000	fact Table 0.77 0.77 349.6573	or 6d 00 00 188.5865	W 65.3772 (86.5641 (125.6878 ((76)
[Jan] North East Solar gains	151.9413 691.9460	850.9725 ture (heati	22.1 15.9 491.1774 1023.3577	m2 	Table 6a W/m2 	Speci or 	fic data Table 6b 0.3600 0.3600 944.9185 1400.7213	781.5459 1236.0083	data le 6c .0000 .0000	fact Table 0.77 0.77 349.6573	or 6d 00 00 188.5865	W 65.3772 (86.5641 (125.6878 ((76)
[Jan] North East Solar gains Total gains	151.9413 691.9460 al temperat	850.9725 ture (heati	22.1 15.9 491.1774 1023.3577	m2 800 000 747.7346 1265.1838	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590	Speci or 	fic data Table 6b 0.3600 0.3600 944.9185 1400.7213	781.5459 1236.0083	data le 6c .0000 .0000	fact Table 0.77 0.77 349.6573	or 6d 00 00 188.5865	W 65.3772 (86.5641 (125.6878 ((76) (83) (84)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa	151.9413 691.9460 	850.9725 ture (heati 	22.1 15.9 491.1774 1023.3577 	m2 800 000 747.7346 1265.1838 	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 m Table 9, Table 9a) May 78.2829	Speci or 	fic data Table 6b 0.3600 0.3600 944.9185 1400.7213 Jul 78.7378	781.5459 1236.0083	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829	or 6d 00 00 188.5865 698.6795 Nov 78.0869	W 65.3772 (86.5641 (86.5	(76) (83) (84)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa	151.9413 691.9460 al temperaturing heating ctor for gran 77.4522 61635	850.9725 ture (heati 	491.1774 1023.3577 	m2 800 000 747.7346 1265.1838 	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 Table 9a) May 78.2829 6.2189	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492	fic data Table 6b	781.5459 1236.0083 Aug 78.8226 6.2548	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829 6.2189	or 6d 00 00 188.5865 698.6795 Nov 78.0869 6.2058	W 65.3772 (186.5641 (197.685) (197.6	(76) (83) (84) (85)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa tau alpha util living ar	151.9413 691.9460 	850.9725 ture (heati ng periods ains for li Feb 77.5627 6.1708 0.9972	22.1 15.9 491.1774 1023.3577 in the livi ving area, Mar 77.6714 6.1781 0.9872	m2 800 000 747.7346 1265.1838 ng area fronin,m (see Apr 78.1859 6.2124 0.9242	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 m Table 9, Table 9a) May 78.2829 6.2189 0.7487	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492 0.5306	Jul 78.7378 6.2492 0.3875	781.5459 1236.0083 Aug 78.8226 6.2548 0.4574	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375 0.7608	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829 6.2189 0.9760	Nov 78.0869 6.2058 0.9979	W 65.3772 (86.5641 (86.5	(83) (84) (85)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa	151.9413 691.9460 al temperaturing heating ctor for gran 77.4522 60.9993 19.8719 20.0149	850.9725 ture (heati 	491.1774 1023.3577 	m2 800 000 747.7346 1265.1838 	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 Table 9a) May 78.2829 6.2189	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492	fic data Table 6b	781.5459 1236.0083 Aug 78.8226 6.2548	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829 6.2189	or 6d 00 00 188.5865 698.6795 Nov 78.0869 6.2058	W 65.3772 (186.5641 (197.685) (197.6	(76) (83) (84) (85) (86) (87)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa tau alpha util living ar MIT Th 2 util rest of h	151.9413 691.9460 al temperat ring heatin ctor for ga Jan 77.4522 6.1635 ea 0.9993 19.8719 20.0149 ouse 0.9990 18.9860	850.9725 ture (heati 	22.1 15.9 491.1774 1023.3577 ing season) in the livi ving area, Mar 77.6714 6.1781 0.9872 20.3532	m2 800 000 747.7346 1265.1838 ng area fronil,m (see Apr 78.1859 6.2124 0.9242 20.7298	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 om Table 9, Table 9a) May 78.2829 6.2189 0.7487 20.9426	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492 0.5306 20.9940	fic data Table 6b	781.5459 1236.0083 Aug 78.8226 6.2548 0.4574 20.9981	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375 0.7608 20.9540 20.0275 0.6758 20.0067	fact Table 0.77 0.77 349.6573 831.6482 0ct 78.2829 6.2189 0.9760 20.6137 20.0243 0.9623 19.7263	Nov 78.0869 6.2058 0.9979 20.1689 20.0221 0.9968 19.2883	W 65.3772 (* 86.5641 (* 86.5641 (* 125.6878 (* 652.9104 (* 652.910	(76) (83) (84) (85) (85) (87) (88) (89) (90)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa tau alpha util living ar MIT Th 2 util rest of h MIT 2 Living area fr MIT	151.9413 691.9460 all temperations of the second of the s	850.9725 ture (heati ng periods ains for li Feb 77.5627 6.1708 0.9972 20.0605 20.0162 0.9961	22.1 15.9 491.1774 1023.3577 ing season) in the livi ving area, Mar 77.6714 6.1781 0.9872 20.3532 20.0174 0.9819	m2 800 747.7346 1265.1838 ng area fronin,m (see Apr 78.1859 6.2124 0.9242 20.7298 20.0233 0.8969	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 Table 9a) May 78.2829 6.2189 0.7487 20.9426 20.0243 0.6866	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492 0.5306 20.9940 20.0294 0.4526	Jul 78.7378 6.2492 0.3875 20.9993 20.0294 0.3024	781.5459 1236.0083 Aug 78.8226 6.2548 0.4574 20.9981 20.0304 0.3621	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375 0.7608 20.9540 20.0275 0.6758 20.0067	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829 6.2189 0.9760 20.6137 20.0243 0.9623	Nov 78.0869 6.2058 0.9979 20.1689 20.0221 0.9968 19.2883	W 65.3772 (86.5641 (125.6878 (652.9104 (652.9104 (125.6878 (652.9104 (125.6878 ((76) (83) (84) (85) (86) (87) (88) (89) (90) (91)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa tau alpha util living ar MIT Th 2 util rest of h MIT 2 Living area fr	151.9413 691.9460 all temperations of the second of the s	850.9725 ture (heati 	22.1 15.9 491.1774 1023.3577 	m2 800 000 747.7346 1265.1838	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 Table 9a) May 78.2829 6.2189 0.7487 20.9426 20.0243 0.6866 19.9922	Speci or 	Jul 78.7378 6.2492 0.3875 20.9993 20.0294 0.3024 20.0293	Aug 78.8226 6.2548 0.4574 20.9981 20.0300	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375 0.7608 20.9540 20.0275 0.6758 20.0067 fLA =	fact Table 0.77 0.77 349.6573 831.6482 0ct 78.2829 6.2189 0.9760 20.6137 20.0243 0.9623 19.7263 Living are	Nov 78.0869 6.2058 0.9979 20.1689 20.0221 0.9968 19.2883 a / (4) =	W 65.3772 (86.5641 (125.6878 (652.9104 (652.9104 (125.6878 (652.9104 (125.6878 ((83) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa tau alpha util living ar MIT Th 2 util rest of h MIT 2 Living area fr MIT Temperature ad	151.9413 691.9460 all temperations of the second of the s	850.9725 ture (heati- ng periods ains for li Feb 77.5627 6.1708 0.9972 20.0605 20.0162 0.9961 19.1750 19.6010	22.1 15.9 491.1774 1023.3577 in the livi ving area, Mar 77.6714 6.1781 0.9872 20.3532 20.0174 0.9819 19.4650	m2 800 747.7346 1265.1838 ng area froni1,m (see Apr 78.1859 6.2124 0.9242 20.7298 20.0233 0.8969 19.8229 20.2592	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 Table 9a) May 78.2829 6.2189 0.7487 20.9426 20.0243 0.6866 19.9922 20.4494	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492 0.5306 20.9940 20.0294 0.4526 20.0273 20.4923	Jul 78.7378 6.2492 0.3875 20.9993 20.4959	781.5459 1236.0083 Aug 78.8226 6.2548 0.4574 20.9981 20.0304 0.3621 20.0300 20.4957	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375 0.7608 20.9540 20.0275 0.6758 20.0067 fLA = 20.4624	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829 6.2189 0.9760 20.6137 20.0243 0.9623 19.7263 Living are 20.1531	Nov 78.0869 6.2058 0.9979 20.1689 20.0221 0.9968 19.2883 a / (4) = 19.7119	W 65.3772 (86.5641 (86.5	(83) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa tau alpha util living ar MIT Th 2 util rest of h MIT 2 Living area fr MIT Temperature ad adjusted MIT 8. Space heati	151.9413 691.9460 	850.9725 ture (heati ng periods ains for li Feb 77.5627 6.1708 0.9972 20.0605 20.0162 0.9961 19.1750 19.6010	22.1 15.9 491.1774 1023.3577 in the livi ving area, Mar 77.6714 6.1781 0.9872 20.3532 20.0174 0.9819 19.4650 19.8923	m2 800 000 747.7346 1265.1838 ng area fronii,m (see Apr 78.1859 6.2124 0.9242 20.7298 20.0233 0.8969 19.8229 20.2592 20.2592	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 m Table 9, Table 9a) May 78.2829 6.2189 0.7487 20.9426 20.0243 0.6866 19.9922 20.4494 20.4494	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492 0.5306 20.9940 20.0294 0.4526 20.0273 20.4923	Jul 78.7378 6.2492 0.3875 20.9993 20.4959 20.4959	781.5459 1236.0083 Aug 78.8226 6.2548 0.4574 20.9981 20.0304 0.3621 20.0300 20.4957	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375 0.7608 20.9540 20.0275 0.6758 20.0067 fLA = 20.4624	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829 6.2189 0.9760 20.6137 20.0243 0.9623 19.7263 Living are 20.1531	Nov 78.0869 6.2058 0.9979 20.1689 20.0221 0.9968 19.2883 a / (4) = 19.7119	W 65.3772 (86.5641 (86.5	(83) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
[Jan] North East Solar gains Total gains 7. Mean intern Temperature du Utilisation fa tau alpha util living ar MIT Th 2 util rest of h MIT 2 Living area fr MIT Temperature ad adjusted MIT 8. Space heati	151.9413 691.9460 	850.9725 ture (heati ng periods ains for li Feb 77.5627 6.1708 0.9972 20.0605 20.0162 0.9961 19.1750 19.6010	22.1 15.9 491.1774 1023.3577 in the livi ving area, Mar 77.6714 6.1781 0.9872 20.3532 20.0174 0.9819 19.4650 19.8923	m2 800 000 747.7346 1265.1838 ng area fronii,m (see Apr 78.1859 6.2124 0.9242 20.7298 20.0233 0.8969 19.8229 20.2592 20.2592	Table 6a W/m2 10.6334 19.6403 957.8282 1448.3590 m Table 9, Table 9a) May 78.2829 6.2189 0.7487 20.9426 20.0243 0.6866 19.9922 20.4494 20.4494	Speci or 1002.0301 1476.1704 Th1 (C) Jun 78.7378 6.2492 0.5306 20.9940 20.0294 0.4526 20.0273 20.4923	Jul 78.7378 6.2492 0.3875 20.9993 20.4959 20.4959	781.5459 1236.0083 Aug 78.8226 6.2548 0.4574 20.9981 20.0304 0.3621 20.0300 20.4957	data le 6c .0000 .0000 579.5994 1047.8461 Sep 78.5619 6.2375 0.7608 20.9540 20.0275 0.6758 20.0067 fLA = 20.4624	fact Table 0.77 0.77 349.6573 831.6482 Oct 78.2829 6.2189 0.9760 20.6137 20.0243 0.9623 19.7263 Living are 20.1531	Nov 78.0869 6.2058 0.9979 20.1689 20.0221 0.9968 19.2883 a / (4) = 19.7119	W 65.3772 (86.5641 (86.5	(83) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92)

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Utilisation Useful gains Ext temp.	0.9987 691.0704 4.3000	0.9954 847.0772 4.9000	0.9810 1003.9550 6.5000	0.9042 1144.0106 8.9000	0.7147 1035.1473 11.7000	0.4901 723.5296 14.6000	0.3434 480.9480 16.6000	0.4081 504.3710 16.4000	0.7158 750.0431 14.1000	0.9645 802.1617 10.6000	0.9964 696.1333 7.1000	0.9991 652.3290 4.2000	(95)
Heat loss rate Space heating	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 Solar heating	898.0561 requirement	669.8363 - total po	501.0162 er year (kWh	193.9307 n/year)	38.7953	0.0000	0.0000	0.0000	0.0000	286.4483	630.0641	925.4889 4143.6359	(98a)
Solar heating Space heating	0.0000 contribution	0.0000 n - total	0.0000 per year (kk	0.0000 Nh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	(98b)
Space heating	898.0561	669.8363		193.9307 tion - tota	38.7953 1 per vear	0.0000 (kWh/year)	0.0000	0.0000	0.0000	286.4483	630.0641	925.4889 4143.6359	(98c)
Space heating					_ po. ,ou.	(, , , ,				(98c)) / (4) =	35.7210	(99)
8c. Space coo		ment											
Calculated fo	 r June, July		t. See Table										
Ext. temp.	Jan 4.3000	Feb 4.9000	Mar 6.5000	Apr 8.9000	May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000	
Heat loss rat	e 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 Useful loss	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.9658 1121.7093	0.9860 901.4942	0.9707 910.5220	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	
Total gains Space cooling	0.0000 kWh	0.0000	0.0000	0.0000	0.0000	1667.1891	1581.7156	1391.9918	0.0000	0.0000	0.0000	0.0000	(103)
Cooled fracti		0.0000	0.0000	0.0000	0.0000	392.7454	506.0848	358.2136	0.0000 fC =	0.0000 cooled area	0.0000 a / (4) =	0.0000 1.0000	
Intermittency	0.2500	le 10b) 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	0.0000	0.0000	0.0000	0.0000	0.0000	98.1864	126.5212	89.5534	0.0000	0.0000	0.0000	0.0000	` '
Space cooling Energy for sp	ace heating											314.2609 35.7210	(99)
Energy for spa	_											2.7091 38.4301	(109)
Fabric Energy	Efficiency ((DFEE)										38.4	(109)
SAP 10 WORKSH	EET FOR New E	Build (As I	Designed)		0.2, Februa	ary 2022)							
CALCULATION O	F TARGET FABI												
1. Overall dw	elling charac												
								Area	Sto	rey height		Volume	
Ground floor								(m2) 116.0000		(m) 3.1500	(2b) =	(m3) 365.4000	(1b) -
Total floor a Dwelling volu		a)+(1b)+(1	c)+(1d)+(1e))(1n)		116.0000				:)+(3d)+(3e)		365.4000	(4)
DWCIIIIIG VOIG	iii C							(3	.u/1(30/1(30	.,,(30),(30)	(511) =	30314000	(3)
2. Ventilation	 n nato												
2. Ventilation											m	3 per hour	
Number of ope	n chimnovs										0 * 80 =	0.0000	(62)
Number of ope	n flues		414	C:							0 * 20 =	0.0000	(6b)
Number of chi	es attached 1	to solid fo	uel boiler	rire							0 * 10 = 0 * 20 =	0.0000 0.0000	(6d)
Number of flu Number of blo	cked chimneys	s	eater								0 * 35 = 0 * 20 =	0.0000 0.0000	
Number of into		tract fans									4 * 10 = 0 * 10 =	40.0000 0.0000	
Number of flu	eless gas fir	res									0 * 40 =	0.0000	(7c)
Infiltration	due to chimne	eys, flues	and fans	= (6a)+(6b)+(6c)+(6d))+(6e)+(6f)+	(6g)+(7a)+(7b)+(7c) =		40.0000	Air change / (5) =	s per hour 0.1095	(8)
Pressure test Pressure Test								•				Yes lower Door	
Measured/desi Infiltration	gn AP50											5.0000 0.3595	
Number of sid													(19)
Shelter facto		d to inclu	de shelter d	factor						- [0.075 x [21] = (18) x		0.9250 0.3325	
1111111 011011	i ace aujustet	a co inciu	ac SHETTER I	1 40 001					(.22) - (10)	. (20) -	0.3323	(41)

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Wind speed Wind factor Adj infilt rate	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	٠,
·	0.4239	0.4156	0.4073	0.3658	0.3574	0.3159	0.3159	0.3076	0.3325	0.3574	0.3741	0.3907	
<pre>[f exhaust air h [f balanced with Effective ac</pre>									0.5553	0.5639	0.5700	0.0000 0.0000 0.5763	(230
. Heat losses a	nd heat l	oss paramet	er										
lement				Gross	Openings		tArea	U-value	Α×U		-value	AxK	
TER Opaque door TER Opening Type External Wall 1 sheltered wall Total net area o Fabric heat loss Party Wall 1	f externa	l elements		m2 17.5900 9.3400	m2 40.2800	2 26 77 9 115	m2 .2000 .8000 .3100 .3400 .6500 (26)(W/m2K 1.0000 1.1450 0.1800 0.1800 30) + (32) = 0.0000	W/K 2.2000 30.6870 13.9158 1.6812 48.4840 0.0000		kJ/m2K	kJ/K	(26) (27) (29a (29a (31) (33) (32)
hermal mass par ist of Thermal		MP = Cm / T	FA) in kJ/m	2K								301.9111	(35)
K1 Eleme E16 Corn E17 Corn E2 Other E3 Sill E4 Jamb E7 Party E18 Party P3 Party	nt er (norma er (inver lintels floor be y wall be wall - I mediate f (Sum(L x idges	ted - inter (including tween dwell tween dwell ntermediate loor within	other steel ings (in bl ings floor betw a dwelling	lintels) ocks of fla	ngs (in bloc	ŕ	5)	Len 25.2 22.0 14.1 14.1 37.8 74.6 6.3 29.4 2.9	909 500 800 800 900 600 600 600	i-value 0.0900 -0.0900 0.0500 0.0500 0.0500 0.0500 0.0600 0.0600 0.0000) + (36)	Tota 2.268 -1.984 0.709 0.709 1.896 5.226 0.378 0.006 0.006	80 15 90 90 90 62 80) ` ´
/entilation heat		culated mon	thlv (38)m	= 0.33 x (2	25)m x (5)				(33) + (30) -	r (30a) -	37.0737	(37)
	Jan 71.1273	Feb 70.7065	Mar 70.2940	Apr 68.3567	May 67.9943	Jun 66.3070	Jul 66.3070	Aug 65.9945	Sep 66.9569	Oct 67.9943	Nov 68.7275	Dec 69.4941	(38)
eat transfer co	eff 28.8070	128.3862	127.9737	126.0365	125.6740	123.9867	123.9867			125.6740	126.4073	127.1738 126.0347	(39)
HLP HLP (average)	Jan 1.1104	Feb 1.1068	Mar 1.1032	Apr 1.0865	May 1.0834	Jun 1.0689	Jul 1.0689	Aug 1.0662	Sep 1.0745	0ct 1.0834	Nov 1.0897	Dec 1.0963 1.0865	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
. Water heating	energy r	equirements	(kWh/year)										
ssumed occupanc		chouons										2.8464	(42
ot water usage ot water usage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42
	31.0620	30.6007	29.9511	28.7533	27.8564	26.8619	26.3247	26.9698	27.6722	28.7363	29.9588	30.9570	(42
	43.7804	42.1884	40.5964 day)	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804 68.5997	
aily hot water	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	
•	74.8424 18.5321	72.7891 103.6507	70.5474 108.4288	67.7576 92.7568	65.2687 87.8642	62.6822 77.0751	62.1450 75.1590	64.3821 79.7185	66.6765 82.2188	69.3327 94.0838 Total = S	72.1471 102.7868 um(45)m =	74.7374 117.0207 1139.2952	(45
istribution los ater storage lo	0.0000	0.15 x (4 0.0000	5)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46
otal storage lo f cylinder cont	ss 0.0000	0.0000	0.0000 storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56
•	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
rimary loss ombi loss otal heat requi	0.0000 0.0000 red for w	0.0000 0.0000 ater heatin	0.0000 0.0000 g calculate	0.0000 0.0000 d for each	0.0000 0.0000 month	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	
1	00.7523	88.1031	92.1645	78.8433	74.6846	65.5138	63.8851	67.7607	69.8860	79.9712	87.3688	99.4676	
WHRS V 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	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	
olar 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	(63
GHRS utput from w/h 1	0.0000 00.7523	0.0000 88.1031	0.0000 92.1645	0.0000 78.8433	0.0000 74.6846	0.0000 65.5138	0.0000 63.8851	0.0000 67.7607	0.0000 69.8860 year (kWh/	0.0000 79.9712	0.0000 87.3688	99.4676 968.4010	(64

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Heat gains fro	om water hea 39.5921	ating, kWh/ 34.8599	/month 37.0555	33.0846	32.2958	29.3751	29.4011	30.5649	30.8452	34.0072	35.5930	39.2709	(65)
5. Internal ga	ins (see Ta												
Metabolic gair	 ıs (Table 5)												
(66)m	Jan 142.3219	Feb 142.3219		Apr 142.3219	May 142.3219		Jul 142.3219	Aug 142.3219	Sep 142.3219	0ct 142.3219	Nov 142.3219	Dec 142.3219	(66)
Lighting gains	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 gai	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	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322	37.2322 0.0000	37.2322	37.2322	
Pumps, fans Losses e.g. ev					0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	
Water heating	gains (Tabl	.e 5)	-113.8576				-113.8576	-113.8576		-113.8576	-113.8576	-113.8576	
Total internal		51.8748	49.8058	45.9508	43.4084	40.7987	39.5177	41.0818	42.8406	45.7086	49.4348	52.7835	
	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]			Α	rea m2	Solar flux Table 6a W/m2	s Speci or	g fic data Table 6b	Specific or Tab		Acces facto Table (or	Gains W	
North East			15.6 11.1	100	10.6334 19.6403		0.6300 0.6300	0	.7000 .7000	0.770 0.770		50.7279 67.1660	
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				1251.6332			917.9677	753.2958	656.4205	624.7459	
7. Mean interr	al temperat	ure (heati											
Temperature du	ring heatin	ng periods	in the livi	ng area fro	m Table 9,							21.0000	(85)
Utilisation fa	Jan	ins for li Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	
tau alpha	75.5258 6.0351	75.7733 6.0516	76.0175 6.0678	77.1860 6.1457	77.4086 6.1606	78.4620 6.2308	78.4620 6.2308	78.6603 6.2440	78.0529 6.2035	77.4086 6.1606	76.9596 6.1306	76.4957 6.0997	
util living ar	ea 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	` '
Th 2 util rest of h		19.9953	19.9982	20.0119	20.0144	20.0264	20.0264	20.0286	20.0218	20.0144	20.0092	20.0038	
MIT 2	0.9992 18.9029	0.9975 19.0722	0.9900 19.3399	0.9413 19.7174	0.7800 19.9481	0.5323 20.0211	0.3569 20.0260	0.4219 20.0276	0.7526 19.9838	0.9766 19.6554	0.9977 19.2264	0.9994 18.8948	(90)
Living area fr	19.3378	19.5062	19.7736	20.1522	20.4011	20.4851	20.4936	20.4932	20.4353	Living area 20.0843	19.6549	0.4810 19.3252	
Temperature ac adjusted MIT	19.3378	19.5062	19.7736	20.1522	20.4011	20.4851	20.4936	20.4932	20.4353	20.0843	19.6549	0.0000 19.3252	(93)
8. Space heati	ng requirem	ent											
									Com	Oot	Nev	Doo	
Utilisation	Jan 0.9990	Feb 0.9970	Mar 0.9892	Apr 0.9443	May 0.8035	Jun 0.5744	Jul 0.4051	Aug 0.4747	Sep 0.7888	0ct 0.9774	Nov 0.9974	Dec 0.9993	. ,
Useful gains Ext temp.	657.2559 4.3000	782.6762 4.9000	903.3905 6.5000	1036.4494 8.9000	991.3380 11.7000	718.9154 14.6000	481.7134 16.6000	503.6086 16.4000	724.1053 14.1000	736.2485 10.6000	654.6999 7.1000	624.3031 4.2000	
Heat loss rate	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 Space heating	952.1129		591.6852 ber year (kW		76.0127	0.0000	0.0000	0.0000	0.0000	339.0314	671.2783	966.6243 4605.7882	(98a)
Solar heating Solar heating	0.0000	0.0000 on - total	0.0000 per year (k	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	(98b)
Space heating		734.1959		274.8474	76.0127	0.0000	0.0000	0.0000	0.0000	339.0314	671.2783	966.6243	(98c)
Space heating Space heating		after sol	lar contribu	tion - tota	l per year	(kWh/year)				(98c)) / (4) =	4605.7882 39.7051	
8c. Space cool													
Calculated for													
carcaraceu 101	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	

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Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	V 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 Useful loss	0.0000 0.0000	0.0000 0.0000	0.0000	0.0000	0.0000	0.9282 1081.7594	0.9675 887.7211	0.9406 884.1187	0.0000	0.0000	0.0000	0.0000	(101)
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	
Space cooling kW Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	232.5482	332.2010	225.5620	0.0000 fC = 0	0.0000 cooled are	0.0000 a / (4) =	0.0000 1.0000	
Intermittency fa	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 kW	0.0000	0.0000	0.0000	0.0000	0.0000	58.1371	83.0503	56.3905	0.0000	0.0000	0.0000	0.0000	1 1
Space cooling re Energy for space Energy for space Total Fabric Energy Ef	heating cooling	FEE)										197.5778 39.7051 1.7033 41.4083 41.4	(99) (108)
SAP 10 WORKSHEET													
CALCULATION OF E	ENERGY RATIN	IG											
1. Overall dwell	ling charact	eristics											
								Area	Store	ey height		Volume	
Ground floor Total floor area Dwelling volume	a TFA = (1a)	+(1b)+(1c)	+(1d)+(1e).	(1n)	:	116.0000		(m2) 116.0000	(1b) x Ba)+(3b)+(3c)-	(m) 3.1500 +(3d)+(3e)		(m3) 365.4000 365.4000	(4)
2. Ventilation r	rate											3 non houn	
Number of comm												3 per hour	(5-)
Number of open of Number of open of Number of chimme Number of flues Number of flues Number of intern Number of passiv Number of fluele	flues eys / flues attached to attached to ed chimneys mittent extr ve vents	solid fue o other hear	l boiler	re							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Tu Cilturation dur			. 4 . 6	(c-) . (ch)	. (6-) . (64)	. (6-) . (65) .	(6-).(7-).(75. (7.)		0 0000	Air change	•	(0)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50 ce	s, Tiues a	iu ialis -	(00)+(00)	+(00)+(00)	+(0e)+(01)+	(Ug)+(7a)+(70)+(70) -		0.0000	/ (5) = B	0.0000 Yes lower Door 2.5000 0.1250	(17)
Shelter factor Infiltration rat	ce adjusted	to include	shelter fa	ctor					(20) = 1 - (2)	[0.075 x 1) = (18)		0.9250 0.1156	1 1
Wind speed Wind factor Adj infilt rate	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	
Balanced mechan	0.1474 nical ventil	0.1445 ation with	0.1416	0.1272	0.1243	0.1098	0.1098	0.1070	0.1156	0.1243	0.1301	0.1359	(22b)
If mechanical ve If exhaust air h If balanced with	entilation neat pump us	ing Append	ix N, (23b)	= (23a) x					Ba)			0.5000 0.5000 76.5000	(23b)
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 a	and heat los	s paramete	•										
Element				Gross	Opening:	s Ne	tArea	U-value	Axl		-value	A x K	
Opening Type 1 ((Uw = 1.20)			m2	m:	38 2	m2 .0800 .2000	W/m2K 1.1450 1.3000	W/I 43.603 2.8600	1 0	kJ/m2K	kJ/K	(27) (26)
External Wall 1			11	7.5900	40.280	u 77	.3100	0.1800	13.915	s 19	0.0000	14688.9000	(29a)

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sheltered wall Total net area of external Fabric heat loss, W/K = Su Party Wall 1 Party Floor 1 Party Ceiling 1 Internal Wall 1			9.3400		126 46 116 116	.3400 .9300 (26)(.4000 .0000 .0000	0.1700 30) + (32) = 0.0000	1.58; = 61.966 0.000	57 90 18 4 4	0.0000 0.0000 0.0000 0.0000 9.0000	1774.6000 8352.0000 4640.0000 4640.0000 926.1900	(31) (33) (32) (32d) (32b)
Heat capacity Cm = Sum(A x Thermal mass parameter (TM List of Thermal Bridges K1 Element E16 Corner (normal E17 Corner (invert E2 Other lintels (E3 Sill E4 Jamb E7 Party floor bet E18 Party wall bet P3 Party wall - Ir E6 Intermediate fl	MP = Cm / Company of the company of	rnal area gr other steel lings (in bl lings e floor betw	reater than lintels) locks of fl: veen dwelli	ats)		5)	L6 25. 22. 14. 14. 37. 74. 6. 29.	ength 1 2000 0500 1800 1800 8000 6600 3000 4600	2) + (32a). Psi-value 0.0320 -0.1170 0.0020 0.0130 0.0080 0.0000 -0.0010 0.0000 0.0000	(32e) = Tot 0.86 -2.57 0.02 0.18 0.36 0.06 -0.06 0.06	301.9111 sal 1664 1799 1884 1843 1924 1900 1663 1900	
Thermal bridges (Sum(L x F Point Thermal bridges Total fabric heat loss)			2.		33) + (36)	(36a) =	-1.2647 0.0000 60.7020	, ,
Ventilation heat loss cald Jan (38)m 31.9448 Heat transfer coeff	rulated mon Feb 31.5963	nthly (38)m Mar 31.2477	= 0.33 x (2 Apr 29.5049	25)m x (5) May 29.1564	Jun 27.4136	Jul 27.4136	Aug 27.0650	Sep 28.1107	Oct 29.1564	Nov 29.8535	Dec 30.5506	(38)
92.6468 Average = Sum(39)m / 12 =	92.2983	91.9497	90.2069	89.8584	88.1156	88.1156	87.7670	88.8127	89.8584	90.5555	91.2526 90.1198	
Jan HLP 0.7987 HLP (average)	Feb 0.7957	Mar 0.7927	Apr 0.7776	May 0.7746	Jun 0.7596	Jul 0.7596	Aug 0.7566	Sep 0.7656	Oct 0.7746	Nov 0.7807	Dec 0.7867 0.7769	
Days in mont 31	28	31	30	31	30	31	31	30	31	30	31	
Assumed occupancy Hot water usage for mixer 0.0000 Hot water usage for baths 82.9886 Hot water usage for other 43.7804 Average daily hot water us Jan Daily hot water use 126.7689 Energy conte 200.7710 Energy content (annual) Distribution loss (46)m = 30.1157 Water storage loss:	showers 0.0000 81.7561 uses 42.1884 te (litres Feb 123.9444 176.4952	0.0000 80.0205 40.5964 /day) Mar 120.6168 185.3835)		0.0000 71.7670 35.8203 Jun 107.5873 132.2912			0.0000 73.9318 39.0043 Sep 112.9362 139.2616 20.8892	0.0000 76.7750 40.5964 Oct 117.3713 159.2718 Total = S 23.8908	0.0000 80.0410 42.1884 Nov 122.2294 174.1382 um(45)m = 26.1207	2.8464 0.0000 82.7080 43.7804 116.7438 Dec 126.4884 198.0503 1938.6996 29.7075	(42a) (42b) (42c) (43) (44) (45)
Store volume a) If manufacturer declar Temperature factor from Enter (49) or (54) in (55) Total storage loss	Table 2b	actor is kno	own (kWh/da	ay):							180.0000 1.4000 0.7800 1.0920	(48) (49)
33.8520 If cylinder contains dedice 33.8520 Primary loss 23.2624 Combi loss 0.0000 Total heat required for wa	30.5760 21.0112 0.0000	33.8520 23.2624 0.0000	32.7600 32.7600 22.5120 0.0000 ed for each	33.8520 33.8520 23.2624 0.0000 month	32.7600 32.7600 22.5120 0.0000	33.8520 33.8520 23.2624 0.0000	33.8520 33.8520 23.2624 0.0000	32.7600 32.7600 22.5120 0.0000	33.8520 33.8520 23.2624 0.0000	32.7600 32.7600 22.5120 0.0000	33.8520 33.8520 23.2624 0.0000	(57) (59)
257.8854 WWHRS 0.0000 PV diverter 0.0000 Solar input 0.0000 FGHRS 0.0000 Output from w/h	228.0824 0.0000 0.0000 0.0000 0.0000	242.4979 0.0000 0.0000 0.0000 0.0000	213.8301 0.0000 0.0000 0.0000 0.0000	207.6677 0.0000 0.0000 0.0000 0.0000	187.5632 0.0000 0.0000 0.0000 0.0000	185.4962 0.0000 0.0000 0.0000 0.0000	192.6582 0.0000 0.0000 0.0000 0.0000	194.5336 0.0000 0.0000 0.0000 0.0000	216.3862 0.0000 0.0000 0.0000 0.0000	229.4102 0.0000 0.0000 0.0000 0.0000	255.1647 0.0000 0.0000 0.0000 0.0000	(63a) (63b) (63c) (63d)
Electric shower(s)	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962		194.5336 er year (kWh			255.1647 2611.1756	(64)
0.0000 Heat gains from water heat 112.4479	0.0000 ing, kWh/i 99.9544	0.0000 month 107.3315	0.0000 Tota 96.9382	0.0000 al Energy u 95.7505	0.0000 sed by insta 88.2044	0.0000 antaneous e 88.3785	0.0000 lectric show 90.7598	0.0000 wer(s) (kWh, 90.5221	0.0000 /year) = Su 98.6494	0.0000 m(64a)m = 102.1185	0.0000 0.0000 111.5432	(64a)
5. Internal gains (see Tab	ole 5 and	5a)										
Metabolic gains (Table 5), Jan (66)m 170.7863 Lighting gains (calculated 44.6222	Feb 170.7863	Mar 170.7863 dix L, equat 32.2317	Apr 170.7863 tion L9 or 1 24.4015	May 170.7863 L9a), also 18.2404	Jun 170.7863 see Table 5 15.3993	Jul 170.7863 16.6395	Aug 170.7863 21.6287	Sep 170.7863 29.0299	Oct 170.7863 36.8602	Nov 170.7863 43.0213	Dec 170.7863 45.8623	

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A	(11-				142-)	T.b	1. 5						
Appliances gai	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 54.9251	d in Append 54.9251	dix L, equat 54.9251	ion L15 or 54.9251	L15a), also 54.9251	54.9251	5 54.9251	54.9251	54.9251	54.9251	54.9251	54.9251	(69)
Pumps, fans Losses e.g. ev	0.0000	0.0000 (negative v	0.0000 (alues) (Tah	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
_	-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	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]			А	m2	Solar flux Table 6a W/m2	Speci	g fic data Table 6b	Specific or Tab		Acce fact Table	or	Gains W	
North			22.1	 800	10.6334		0.3600		.0000	0.77	00	65.3772	(74)
East			15.9		19.6403		0.3600		.0000	0.77		86.5641	
Solar gains	151.9413	294.2769	491.1774	747.7346		1002.0301	944.9185	781.5459	579.5994	349.6573	188.5865	125.6878	
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 intern			ing season)										
Temperature du	ring heatir	ng periods	in the livi	ng area fro	om Table 9,							21.0000	(85)
Utilisation fa	ictor for ga Jan	eins for li Feb	iving area, Mar	nil,m (see Apr	Table 9a) May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	
tau alpha	105.0036 8.0002	105.4001 8.0267	105.7997 8.0533	107.8437 8.1896	108.2620 8.2175	110.4033 8.3602	110.4033 8.3602	110.8417 8.3894	109.5367 8.3024	108.2620 8.2175	107.4286 8.1619	106.6079 8.1072	
util living ar	ea 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 util rest of h	20.2545 louse	20.2571	20.2597	20.2727	20.2754	20.2885	20.2885	20.2911	20.2832	20.2754	20.2701	20.2649	(88)
MIT 2	0.9937 19.6009	0.9793 19.8022	0.9146 20.0696	0.7136 20.2488	0.4885 20.2742	0.3167 20.2884	0.2160 20.2885	0.2539 20.2911	0.4708 20.2826	0.8349 20.2140	0.9801 19.8889	0.9956 19.5770	1 1
Living area fr MIT	action 20.0016	20.1823	20.4271	20.5964	20.6224	20.6307	20.6307	20.6321	fLA = 20.6271	Living are 20.5575	a / (4) = 20.2556	0.4810 19.9768	1 1
Temperature ad		20.1823	20.4271	20.5964	20.6224	20.6307	20.6307	20.6321	20.6271	20.5575	20.2556	0.0000 19.9768	
aujusteu HII	20.0010	20.1025	20.42/1	20.5504	20.0224	20.0307	20.0307	20.0321	20.02/1	20.5575	20.2550	13.5700	(33)
8. Space heati	ng requiren	nent											
Utilisation	Jan 0.9930	Feb 0.9787	Mar 0.9191	Apr 0.7310	May 0.5080	Jun 0.3357	Jul 0.2360	Aug 0.2761	Sep 0.4967	Oct 0.8504	Nov 0.9799	Dec 0.9950	(94)
Useful gains Ext temp.	871.1744	995.0005	1094.3289	1028.1480	800.2220 11.7000	531.3601 14.6000	355.1692 16.6000	371.4329	578.8063	827.7516 10.6000	839.8438	828.4968	(95)
Heat loss rate								16.4000	14.1000		7.1000	4.2000	
Space heating	kWh	1410.5259	1280.5967		801.7562	531.3986	355.1707	371.4384	579.6920	894.7628	1191.3131	1439.6777	(97)
Space heating Solar heating		279.2331 t - total p		19.4012 h/year)	1.1415	0.0000	0.0000	0.0000	0.0000	49.8563	253.0579	454.7186 1630.1384	(98a)
Solar heating	0.0000 contributio	0.0000 on - total	0.0000 per year (k	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	(98b)
Space heating	434.1466		138.5833	19.4012	1.1415	0.0000	0.0000	0.0000	0.0000	49.8563	253.0579	454.7186	(98c)
Space heating Space heating		t after sol	lar contribu	tion - tota	al per year	(kWh/year)				(98c) / (4) =	1630.1384 14.0529	(99)
9b. Energy red	uirements												
Fraction of sp Fraction of sp				ntary syste	em (Table 11	.)						0.0000 1.0000	
Fraction of he	at from com	nmunity Hea	at pump-Spac			na						1.0000	(303a
Factor for con Factor for cha	rging metho	od (Table 4	1c(3)) for w	ater heatin	ng	·''8						1.0000	(305a
Distribution 1 Efficiency of					ng system							1.5000 0.0000	1 1
Space heating: Space heating	_		3										•
Space heat fro	434.1466	279.2331		19.4012	1.1415	0.0000	0.0000	0.0000	0.0000	49.8563	253.0579	454.7186	(98)
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	651.2199	418.8497		29.1017	1.7122	0.0000	0.0000	0.0000	0.0000	74.7845	379.5869	682.0779	1 1
Efficiency of	secondary/s	supplementa	ary heating	system in %	(from Tabl	e 4a or App	endix E)					0.0000	(308)

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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	(300)
Water heating Annual water heating requirement	0.0000	0.0000	3.0000	0.0000	0.0000	(303)
257.8854 228.0824 242.4979 213.8301 207.6677 187.5632 185.4962 Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50	192.6582	194.5336	216.3862	229.4102	255.1647	(64)
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	
Cooling System Energy Efficiency Ratio Space coolin			0.0000	0.0000	0.0000	(315)
Pumps and Fa 35.4951 32.0601 35.4951 34.3501 35.4951 34.3501 35.4951 Lighting 39.0575 31.3334 28.2122 20.6695 15.9657 13.0441 14.5645			35.4951 32.2635	34.3501 36.4415	35.4951 40.1430	
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		(335b)
Annual totals kWh/year Space heating fuel - community heating					2445.2076	
Space heating fuel - secondary Water heating fuel - community heating					0.0000 3916.7634	(309)
Efficiency of water heater Electricity used for heat distribution					0.0000 24.4521	(311)
Space cooling fuel					0.0000	
Electricity for pumps and fans: (Ralaccodwith Heattercovery Database; in use factor = 1 2500 SER = 0.9275)						
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375) mechanical ventilation fans (SFP = 0.9375) Tabalacticity for the party (1998)					417.9262	
Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)					417.9262 315.2165	
Energy saving/generation technologies (Appendices M ,N and Q)						
PV generation Wind generation					0.0000 0.0000	
Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)					0.0000 0.0000	(335a) (335)
Appendix Q - special features Energy saved or generated					-0.0000	(336)
Energy used Total delivered energy for all uses					0.0000 7095.1137	
10b. Fuel costs - using Table 12 prices						
	Fuel kWh/year		uel price p/kWh		Fuel cost £/year	
Space heating from Heat pump	2445.2076		4.4400		108.5672	(340a)
Total CO2 associated with community systems			0.0000		108.5672	(473)
Space heating - secondary Water heating from Heat pump	0.0000 3916.7634		0.0000 4.4400		0.0000 173.9043	(342a)
Water heating total Energy for instantaneous electric shower(s)	0.0000		16.4900			(347a)
Pumps, fans and electric keep-hot Energy for lighting	417.9262 315.2165		16.4900 16.4900		68.9160 51.9792	
Additional standing charges Total energy cost					92.0000 495.3667	
						,
11b CAD nating Community boating school						
11b. SAP rating - Community heating scheme					0.350-	(256)
Francisco de Clatar (Table 12)					0.3600	
Energy cost deflator (Table 12): Energy cost factor (ECF)		(255) x (256)] / [(4) +	45.0] =	1.1077	
Energy cost factor (ECF) SAP value SAP rating (Section 12)		(255) x (256)] / [(4) +	45.0] =	82.0450 82	(358)
Energy cost factor (ECF) SAP value		(255) x (256)] / [(4) +	45.0] =	82.0450	(358)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band]	(255) x (256)] / [(4) +	45.0] =	82.0450 82	(358)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band				45.0] =	82.0450 82 B	(358)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band 12b. Carbon dioxide emissions - Community heating scheme		Emissi	on factor		82.0450 82 B Emissions kg CO2/year	(358)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Heat pump Space and Water heating from Heat pump	Energy kWh/year 1544.1677	Emissi k	on factor ng CO2/kWh 0.1587		82.0450 82 B Emissions kg CO2/year 412.0000 94.1806	(358) (367) (367)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Heat pump Space and Water heating from Heat pump Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network	Energy kWh/year	Emissi k	on factor g CO2/kWh		82.0450 82 B Emissions kg CO2/year 412.0000 94.1806 9.3956 0.0373	(358) (367) (367) (372) (386)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Heat pump Space and Water heating from Heat pump Electrical energy for heat distribution (space & water)	Energy kWh/year 1544.1677	Emissi k	on factor ng CO2/kWh 0.1587		82.0450 82 B Emissions kg CO2/year 412.0000 94.1886 9.3956	(358) (367) (367) (372) (386) (373) (376)

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Energy for ligh Total CO2, kg/y CO2 emissions p EI value EI rating EI band	/ear							315.2165		0.1443		45.4955 340.9111 2.9400 97.1626 97 A	(383) (384) (384a) (385)
SAP 10 WORKSHEE CALCULATION OF	EPC COSTS,		ND PRIMARY	ENERGY	0.2, February	2022)							
1. Overall dwel													
Ground floor Total floor are Dwelling volume)+(1b)+(1c)	+(1d)+(1e)	(1n)	11	6.0000		Area (m2) 116.0000		y height (m) 3.1500 ((3d)+(3e).	,	Volume (m3) 365.4000 365.4000	(1b) - (4)
2. Ventilation	rate												
Number of open Number of open Number of chimm Number of flues Number of block Number of inter Number of passi Number of fluel	flues neys / flues s attached t s attached t ked chimneys mittent ext ive vents	o solid fue o other hea ract fans	l boiler	ire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 40 =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration du Pressure test Pressure Test M Measured/design Infiltration ra Number of sides	Method n AP50 ate	ys, flues a	nd fans =	= (6a)+(6b)	+(6c)+(6d)+(6e)+(6f)+((6g)+(7a)+(1	7b)+(7c) =		0.0000	/ (5) =	es per hour 0.0000 Yes Blower Door 2.5000 0.1250	(8) (17)
Shelter factor Infiltration ra	ate adjusted	to include	shelter fa	actor					(20) = 1 - (21	[0.075 x) = (18) >		0.9250 0.1156	
Wind speed Wind factor	Jan 4.2000 1.0500	Feb 4.0000 1.0000	Mar 4.0000 1.0000	Apr 3.7000 0.9250	May 3.7000 0.9250	Jun 3.3000 0.8250	Jul 3.4000 0.8500	Aug 3.2000 0.8000	Sep 3.3000 0.8250	Oct 3.5000 0.8750	Nov 3.5000 0.8750		
Balanced mecha If mechanical v If exhaust air If balanced wit	0.1214 anical venti ventilation heat pump u	sing Append	ix N, (23b)	= (23a) >					0.0954 3a)	0.1012	0.1012	0.1098 0.5000 0.5000 76.5000	(23a) (23b)
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		ss paramete	r										
Element Opening Type 1	(Uw = 1.20)			Gross m2	Openings m2		tArea m2 .0800	U-value W/m2K 1.1450	A x U W/K 43.6031	ŀ	-value cJ/m2K	A x K kJ/K	
Door External Wall 1 sheltered wall	Ĺ			17.5900 9.3400	40.2800	2. 77. 9.	.2000 .3100 .3400	1.3000 0.1800 0.1700	2.8600 13.9158 1.5878	196	0.0000 0.0000	14688.9000 1774.6000	(26) (29a) (29a)
Total net area Fabric heat los Party Wall 1 Party Floor 1 Party Ceiling 1 Internal Wall 1	ss, W/K = Su L		um(A, m2)			46. 116. 116.	.9300 (26)(3 .4000 .0000 .0000 .9100	30) + (32) 0.0000	= 61.9667 0.0000	186 46 46	0.0000 0.0000 0.0000 0.0000	8352.0000 4640.0000 4640.0000 926.1900	(32d) (32b)
Heat capacity C Thermal mass pa List of Thermal K1 Elem	arameter (TM L Bridges		A) in kJ/mí	2K					(30) + (32) Length Ps	+ (32a) i-value		35021.6900 301.9111 tal	

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E17 Co E2 Oth E3 Sil E4 Jam E7 Par E18 Pa P3 Par	er lintels b ty floor b rty wall b ty wall - ermediate s (Sum(L > bridges	erted - inte s (including between dwel between dwel Intermediat floor withi	te floor bet in a dwellin	l lintels) locks of fl ween dwelli g	ats) ngs (in blo		s)	22 14 14 37 74 6 29	. 2000 .0500 .1800 .1800 .1800 .6600 .3000 .4600 .9600	0.0320 -0.1170 0.0020 0.0130 0.0080 0.0000 -0.0010 0.0000 0.0000	0.86 -2.57 0.02 0.18 0.36 0.00 -0.00 0.00 (36a) = + (36a) =	999 184 1843 1924 1900 1963	` '
Ventilation he						Tun	201	Aug	Con	Oct	Nov	Doc	
(38)m Heat transfer	Jan 28.8078 coeff	Feb 28.1107	Mar 28.1107	Apr 27.0650	May 27.0650	Jun 25.6708	Jul 26.0193	Aug 25.3222	Sep 25.6708	0ct 26.3679	Nov 26.3679	Dec 27.4136	(38)
Average = Sum(89.5098	88.8127 =	88.8127	87.7670	87.7670	86.3728	86.7213	86.0242	86.3728	87.0699	87.0699	88.1156 87.5346	(39)
HLP	Jan 0.7716	Feb 0.7656	Mar 0.7656	Apr 0.7566	May 0.7566	Jun 0.7446	Jul 0.7476	Aug 0.7416	Sep 0.7446	Oct 0.7506	Nov 0.7506	Dec 0.7596	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	0.7546 31	
4. Water heati			s (kWh/year)									
Assumed occupa	ncy											2.8464	(42)
Hot water usag	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 usag	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 usag Average daily	43.7804	42.1884	40.5964 s/day)	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804 116.7438	
5.17	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	
Daily hot wate Energy conte Energy content	126.7689 200.7710 (annual)	123.9444 176.4952	120.6168 185.3835	115.8246 158.5581	111.8364 150.5533	107.5873 132.2912	106.1521 128.3818	109.4676 135.5438	112.9362 139.2616	117.3713 159.2718 Total = S	122.2294 174.1382 sum(45)m =	126.4884 198.0503 1938.6996	
Distribution 1	30.1157	n = 0.15 x (26.4743	(45)m 27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46)
Water storage Store volume a) If manufac Temperature Enter (49) or Total storage	turer dec] factor fro (54) in (5	om Table 2b	factor is kn	own (kWh/d	lay):							180.0000 1.4000 0.7800 1.0920	(48) (49)
If cylinder co	33.8520	30.5760 dicated sola	33.8520 ar storage	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	33.8520	(56)
Primary loss	33.8520 23.2624	30.5760 21.0112	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	
Combi loss Total heat req	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
WWHRS	257.8854	228.0824	242.4979	213.8301 0.0000	207.6677	187.5632 0.0000	185.4962 0.0000	192.6582 0.0000	194.5336 0.0000	216.3862 0.0000	229.4102 0.0000	255.1647 0.0000	
PV diverter 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	(63b)
FGHRS Output from w/	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
·	257.8854	228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582 Total p	194.5336 er year (kW	216.3862 Wh/year) = S	229.4102 Sum(64)m =	255.1647 2611.1756	
Electric showe	0.0000	0.0000	0.0000	0.0000 Tot	0.0000	0.0000 sed by inst	0.0000	0.0000	0.0000 wer(s) (kWh	0.0000 (vear) = Su	0.0000 m(64a)m =	0.0000 0.0000	
Heat gains fro	m water he 112.4479	eating, kWh/ 99.9544	/month 107.3315	96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	, ,
5. Internal ga		Table 5 and	5a)										
(66)m	Jan 170.7863	Feb 170.7863	Mar 170.7863	Apr 170.7863	May 170.7863	Jun 170.7863	Jul 170.7863	Aug 170.7863	Sep 170.7863	Oct 170.7863	Nov 170.7863	Dec 170.7863	(66)
Lighting gains Appliances gai	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)
Cooking gains	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)
Pumps, fans	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	54.9251 0.0000	
Losses e.g. ev		(negative v			-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	
Water heating	151.1396	ole 5) 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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Jan]			А	rea	Solar flux		g		FF	Acces		Gains	
-				m2	Table 6a W/m2	Speci or	fic data Table 6b	Specific or Tab	data	facto Table (or	W	
lorth ast			22.1 15.9		11.9814 22.3313		0.3600 0.3600	6	0.0000 0.0000	0.770 0.770		73.6654 98.4248	
olar gains otal gains	172.0903 897.4825	300.9973 1023.3376	497.9669 1197.5025	781.8060 1440.6277		1089.7924 1670.5313		861.4874 1425.1699	637.3608 1223.1052	382.4465 1006.1466	219.0645 887.5216	140.8221 847.8051	
. Mean inter	nal tempera	ture (heati											
emperature di tilisation fa	uring heati	ng periods	in the livi	ng area fro	m Table 9,							21.0000	(85)
au 1pha	Jan 108.6836 8.2456	Feb 109.5367 8.3024	Mar 109.5367 8.3024	Apr 110.8417 8.3894	May 110.8417 8.3894	Jun 112.6309 8.5087	Jul 112.1782 8.4785	Aug 113.0873 8.5392	Sep 112.6309 8.5087	Oct 111.7292 8.4486	Nov 111.7292 8.4486	Dec 110.4033 8.3602	
til living a	rea 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
IT h 2	20.5501 20.2780	20.6881 20.2832	20.8864 20.2832	20.9897 20.2911	20.9997 20.2911	21.0000 20.3016	21.0000 20.2990	21.0000 20.3042	20.9999 20.3016	20.9737 20.2963	20.7700 20.2963	20.5280 20.2885	
til rest of IT 2 iving area f	0.9886 19.7677	0.9679 19.9433	0.8711 20.1737	0.6280 20.2831	0.4019 20.2909	0.2224 20.3016	0.1319 20.2990	0.1512 20.3042	0.3602 20.3016 fLA =	0.7345 20.2766 Living area	0.9578 20.0567 a / (4) =	0.9918 19.7488 0.4810	(90
IT emperature a diversed MIT		20.3016	20.5165	20.6230	20.6318	20.6376	20.6362	20.6389	20.6375	20.6119	20.3998	20.1236	
djusted 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
Space heat:													
			Man						Con	Oot	Nov	Doo	
cilisation seful gains ct temp.	Jan 0.9880 886.6802 5.1000	Feb 0.9681 990.6847 5.6000	Mar 0.8798 1053.5413 7.4000	Apr 0.6468 931.7862 9.9000	May 0.4206 669.5507 13.0000	Jun 0.2398 400.5571 16.0000	Jul 0.1505 237.2863 17.9000	Aug 0.1714 244.2163 17.8000	Sep 0.3839 469.5655 15.2000	0ct 0.7566 761.2939 11.6000	Nov 0.9597 851.7408 8.0000	Dec 0.9912 840.3427 5.1000	(95
eat loss rate	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
pace heating pace heating plar heating	342.1734 requirement	211.6836 t - total p	82.8606 per year (kW	6.7263 h/year)	0.2026	0.0000	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023 1184.8298	
olar heating	0.0000 contributi	0.0000 on - total	0.0000 per year (k	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	
pace heating	342.1734	211.6836	82.8606	6.7263	0.2026	0.0000 (kWh/vear)	0.0000	0.0000	0.0000	17.3877	164.0932	359.7023 1184.8298	•
pace heating		c arter sor	ar concribu	cion - coca	i per year	(KWII/ year)				(98c)) / (4) =	10.2141	
b. Energy re	auirements												
raction of spraction of he action for conactor for conactor for confistribution of fficiency of pace heating	pace heat fi pace heat fi eat from con ntrol and cl arging methol loss factor secondary/	rom seconda rom communi mmunity Hea narging met od (Table 4 (Table 12c	ty system It pump-Spac hod (Table c(3)) for w i) for commu	ntary syste e and Water 4c(3)) for ater heatin nity heatin	m (Table 11 space heati g)						0.0000 1.0000 1.0000 1.0000 1.0000 1.5000 0.0000	(30 (30 (30 (30 (30
pace 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
pace heat fro 07a 02co hoating	513.2601	317.5255	1.00 x 1.00 124.2908	x 1.50 10.0895	0.3039	0.0000	0.0000	0.0000	0.0000	26.0816	246.1398	539.5535	
ficiency of bace heating	513.2601 secondary/	317.5255 supplementa			0.3039 (from Tabl	0.0000 e 4a or App	0.0000 endix E)	0.0000	0.0000	26.0816	246.1398	539.5535 0.0000	
ccucing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(36
ter heating nual water l		uirement 228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582	194.5336	216.3862	229.4102	255.1647	(64
ater heat fro 10a	386.8281	$0 = (64) \times 342.1236$	1.00 x 1.00 363.7469	x 1.50 320.7452	311.5015	281.3447	278.2443	288.9872	291.8004	324.5792	344.1152	382.7470	
ater 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	
		ficiency Ra										0.0000	10

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Pumps and Fa 35.4951 32.0601 35.4951 34.3501 35.4951 34.3501 35.4951 Lighting 39.0575 31.3334 28.2122 20.6695 15.9657 13.0441 14.5645 Electricity generated by PVs (Appendix M) (negative quantity) (333a)m 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000	18.9314 0.0000 0.0000 0.0000 0.0000	34.3501 35.4951 24.5901 32.2635 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	34.3501 35.4951 (331) 36.4415 40.1430 (332) 0.0000 0.0000 (333a) 0.0000 0.0000 (334a) 0.0000 0.0000 (335a) 0.0000 0.0000 (333b) 0.0000 0.0000 (333b) 0.0000 0.0000 (333b) 1777.2447 (307) 0.0000 (309) 3916.7634 (310) 0.0000 (311) 17.7724 (313) 0.0000 (321)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375) mechanical ventilation fans (SFP = 0.9375) Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)			417.9262 (330a) 417.9262 (331) 315.2165 (332)
Energy saving/generation technologies (Appendices M ,N and Q) PV generation Wind generation Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N) Appendix Q - special features			0.0000 (333) 0.0000 (334) 0.0000 (335a) 0.0000 (335)
Energy saved or generated Energy used Total delivered energy for all uses			-0.0000 (336) 0.0000 (337) 6427.1509 (338)
10b. Fuel costs - using BEDF prices (528)		Fuel and a	Evil vist
Space heating from Heat pump Space heating total Total CO2 associated with community systems Space heating - secondary Water heating from Heat pump Water heating total Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot Energy for lighting Additional standing charges Total energy cost	Fuel kWh/year 1777.2447 0.0000 3916.7634 0.0000 417.9262 315.2165	Fuel price p/kWh 4.8000 0.0000 4.8000 21.5100 21.5100 21.5100	Fuel cost f/year 85.3077 (340a) 85.3077 (340) 0.0000 (473) 0.0000 (341) 188.0046 (342a) 188.0046 (342) 0.0000 (347a) 89.8959 (349) 67.8031 (350) 98.0000 (351) 529.0114 (355)
12b. Carbon dioxide emissions - Community heating scheme			
Efficiency of heat source Heat pump Space and Water heating from Heat pump Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total CO2, kg/year	Energy kWh/year 1382.0408 17.7724 417.9262 315.2165	Emission factor kg CO2/kWh 0.1596 0.0000 0.1387 0.1443	Emissions kg CO2/year 412.0000 (367) 68.8413 (367) 8.3516 (372) 0.0371 (386) 211.0608 (373) 211.0608 (376) 57.9715 (378) 45.4955 (379) 314.5278 (383)
13b. Primary energy - Community heating scheme			
Efficiency of heat source Heat pump Space and Water heating from Heat pump Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Pumps, fans and electric keep-hot Energy for lighting	Energy kWh/year 1382.0408 17.7724 417.9262 315.2165	Primary energy factor kg CO2/kWh 1.5907 0.0000 1.5128 1.5338	Primary energy kWh/year 412.0000 (467a) 686.1636 (467) 87.8312 (472) 0.3898 (486) 2219.6560 (473) 2219.6560 (476) 632.2388 (478) 483.4895 (479)
Total Primary energy kWh/year	323.2203	1.5530	3335.3844 (483)

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SAP 10 EPC IMPROVEMENTS
Be Green
Current energy efficiency rating:
Current environmental impact rating:
                                                                                 A 97
   Solar water heating
                                                                                   Not applicable
   Solar photovoltaic panels
                                                                                   Not applicable
V2 Wind turbine
                                                                                   Not applicable
Recommended measures:
                                                SAP change
                                                              Cost change
                                                                                CO2 change
(none)
                                                                                Energy Environmental efficiency impact
                                                Typical annual savings
Recommended measures
(none)
                              Total Savings
                                                    £0
                                                                   0.00 kg/m<sup>2</sup>
Potential energy efficiency rating:
Potential environmental impact rating:
                                                                                B 82
                                                                                           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)
Saving
  Electricity
                                                                           £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
CO2 emissions per m<sup>2</sup>
                                             0.3 tonnes
3 kg/m²
                                                              0.3 tonnes
3 kg/m²
                                                                               0.0 tonnes
                                                                               0 kg/m<sup>2</sup>
  Primary energy
                                                              29 kWh/m²
SAP 10 WORKSHEET FOR New Build (As Designed)
                                                     (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING
1. Overall dwelling characteristics
                                                                                                                           Storey height
                                                                                                                                                            Volume
                                                                                                             Area
                                                                                                             (m2)
                                                                                                                                                               (m3)
Ground floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)
                                                                                                        116.0000 (1b)
                                                                                                                                    3.1500 (2b)
                                                                                                                                                          365.4000 (1b) -
                                                                             116.0000
                                                                                                                (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =
                                                                                                                                                          365.4000 (5)
Dwelling volume
2. Ventilation rate
                                                                                                                                                       m3 per hour
Number of open chimneys
                                                                                                                                                            0.0000 (6a)
                                                                                                                                            0 * 20
Number of open flues
                                                                                                                                                            0.0000 (6b)
                                                                                                                                            0 * 10
0 * 20
Number of chimneys / flues attached to closed fire
                                                                                                                                                            0.0000
                                                                                                                                                                    (6c)
Number of flues attached to solid fuel boiler
Number of flues attached to other heater
                                                                                                                                                            0.0000
                                                                                                                                                                    (6d)
                                                                                                                                                 35
                                                                                                                                                            0.0000
                                                                                                                                                                    (6e)
Number of blocked chimneys
                                                                                                                                             0 * 20
                                                                                                                                                            0.0000 (6f)
                                                                                                                                             0 * 10 =
Number of intermittent extract fans
                                                                                                                                                            0.0000 (7a)
                                                                                                                                            0 * 10 =
Number of passive vents
Number of flueless gas fires
                                                                                                                                                            0.0000
                                                                                                                                                                    (7b)
                                                                                                                                                            0.0000 (7c)
                                                                                                                                            Air changes per hour
                                                                                                                                     0.0000 / (5) =
                                                                                                                                                            0.0000 (8)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =
Pressure test
Pressure Test Method
                                                                                                                                                       Blower Door
Measured/design AP50
                                                                                                                                                            2.5000 (17)
Infiltration rate
                                                                                                                                                            0.1250 (18)
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Number of sides	sheltered											1	(19)
Shelter factor		* - 4 1 1	lb.14 ((20) = 1 -			0.9250	
Infiltration ra	te adjusted	to includ	ie sneiter f	actor					(21) = (18) :	x (20) =	0.1156	(21)
Wind speed Wind factor	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	
Adj infilt rate Balanced mechan	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)
If mechanical ve If exhaust air b If balanced with	entilation heat pump u	sing Appen	ndix N, (23b) = (23a) >)			0.5000 0.5000 76.5000	(23b)
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													
Element				Gross	Openings	. Net	tArea	U-value	Α×U	K	-value	Α×Κ	
Opening Type 1	(Uw = 1.20)			m2	m2		m2 .0800	W/m2K 1.1450	W/K 43.6031		kJ/m2K	kJ/K	(27)
Door External Wall 1 sheltered wall				17.5900 9.3400	40.2800) 77 9	.2000 .3100 .3400	1.3000 0.1800 0.1700	2.8600 13.9158 1.5878	19	0.0000 0.0000	14688.9000 1774.6000	(29a)
Total net area of Fabric heat loss Party Wall 1 Party Floor 1			Aum(A, m2)			46 116	. 4000 . 0000	30) + (32) = 0.0000	61.9667 0.0000	18 4	0.0000 0.0000	8352.0000 4640.0000	(32d)
Party Ceiling 1 Internal Wall 1							.0000 .9100				0.0000 9.0000	4640.0000 926.1900	
Heat capacity Cr Thermal mass par List of Thermal	rameter (TM		FA) in kJ/m	12K				(28)	.(30) + (32)	+ (32a).	(32e) =	35021.6900 301.9111	
K1 Eleme E16 Cori E17 Cori E2 Othei E3 Sill E4 Jamb E7 Party E18 Party P3 Party	ent ner (normal ner (invert r lintels (y floor bet ty wall bet y wall - In	ed – inter including ween dwell ween dwell termediate	other steel ings (in bl	lintels) ocks of fla	external ar ots) ngs (in bloc		5)	25. 22. 14. 14. 37. 74. 6.	2000 0500 1800 1800 8000 6600	i-value 0.0320 -0.1170 0.0020 0.0130 0.0080 0.0000 -0.0010 0.0000 0.0000	Tot 0.86 -2.57 0.02 0.18 0.36 -0.06 0.06	964 799 284 343 924 900 963	
Thermal bridges Point Thermal b Total fabric hea	(Sum(L x P ridges)				(33) + (36)	(36a) = + (36a) =	-1.2647 0.0000 60.7020	` ,
Ventilation heat	t loss calc Jan	ulated mon	nthly (38)m Mar	= 0.33 x (2	25)m x (5) May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	
(38)m Heat transfer co	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)
Average = Sum(39	92.6468	92.2983	91.9497	90.2069	89.8584	88.1156	88.1156	87.7670	88.8127	89.8584	90.5555	91.2526 90.1198	(39)
HLP	Jan 0.7987	Feb 0.7957	Mar 0.7927	Apr 0.7776	May 0.7746	Jun 0.7596	Jul 0.7596	Aug 0.7566	Sep 0.7656	Oct 0.7746	Nov 0.7807	Dec 0.7867	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	0.7769 31	
4. Water heatin	g energy re	quirements	(kWh/year)										
Assumed occupand Hot water usage		showers 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.8464 0.0000	
Hot water usage		81.7561	80.0205	76.8203	74.4241	71.7670	70.3318	72.0553	73.9318	76.7750	80.0410	82.7080	. ,
Hot water usage Average daily ho	for other 43.7804	uses 42.1884	40.5964	39.0043	37.4123	35.8203	35.8203	37.4123	39.0043	40.5964	42.1884	43.7804 116.7438	(42c)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	
Daily hot water Energy conte 2 Energy content	126.7689 200.7710	123.9444 176.4952	120.6168 185.3835	115.8246 158.5581	111.8364 150.5533	107.5873 132.2912	106.1521 128.3818	109.4676 135.5438	139.2616	117.3713 159.2718 Total = S	122.2294 174.1382 um(45)m =	126.4884 198.0503 1938.6996	
Distribution los	ss (46)m = 30.1157	0.15 x (4 26.4743	15)m 27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46)
Water storage lo Store volume a) If manufacto Temperature fa	urer declar actor from		actor is kno	wn (kWh/da	ay):							180.0000 1.4000 0.7800	(48) (49)
Enter (49) or (Total storage lo		30.5760	33.8520	32.7600	33.8520	32.7600	33.8520	33.8520	32.7600	33.8520	32.7600	1.0920 33.8520	

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If cylinder co			U	22.7600	22 0520	22.7600	22 0520	22 0520	22.7600	22 0520	22.7600	22 0520	(57)
Primary loss	33.8520 23.2624	30.5760 21.0112	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	32.7600 22.5120	33.8520 23.2624	
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 red	quired for 257.8854	water heati 228.0824	ng calculat 242.4979	ed for each: 213.8301	1 month 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 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 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000	0.0000	
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	
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 p	er year (kW			2611.1756	
Electric show	er(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)
					al Energy u							0.0000	
Heat gains fro	om water he 112.4479	ating, kWh/ 99.9544	month 107.3315	96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	(65)
													(,
5. Internal ga	 ainc (coo T	ahle 5 and											
	•		•										
Metabolic gain	ns (Table 5 Jan), Watts Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	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	s (calculat 44.6222	ed in Apper 39.6330	ndix L, equa 32.2317	tion L9 or 24.4015	L9a), also 18.2404	see Table 5 15.3993	16.6395	21.6287	29.0299	36.8602	43.0213	45.8623	(67)
Appliances gas		ated in App	endix L, eq	uation L13	or L13a), a	lso see Tab		21.0207	23.0233		43.0213	43.0023	(07)
Cooking gains	417.7766 (calculate	422.1118 d in Append	411.1872 lix L. equat	387.9300 ion L15 or	358.5720 L15a), also	330.9796 see Table	312.5462 5	308.2110	319.1356	342.3928	371.7508	399.3431	(68)
	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 Losses e.g. ev	0.0000 vanoration	0.0000 (negative v	0.0000 values) (Tab	0.0000 le 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
	-113.8576	-113.8576			-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	-113.8576	(71)
Water heating	gains (Tab 151.1396	le 5) 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	l 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]			А	rea m2	Solar flux		g fic data	Snacific	FF data	Acce		Gains	
[Jan]			А	m2	Solar flux Table 6a W/m2	Speci	g fic data Table 6b	Specific or Tab	data	Acce fact Table	or	Gains W	
				m2	Table 6a W/m2	Speci or	fic data Table 6b 	or Tab	data le 6c	fact Table	or 6d	W	(74)
[Jan] North East			22.1 15.9	m2 .800	Table 6a	Speci or	fic data	or Tab	data	fact	or 6d 700		
North			22.1	m2 .800	Table 6a W/m2 10.6334	Speci or	fic data Table 6b 0.3600	or Tab	data le 6c .0000	fact Table 0.77	or 6d 700	W 65.3772	
North East	151.9413	294.2769	22.1 15.9 491.1774	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403	Speci or 	fic data Table 6b0.3600 0.3600	or Tab 0 0 781.5459	data le 6c .0000 .0000	fact Table 0.77 0.77	or 6d 00 00 188.5865	65.3772 86.5641 125.6878	(76)
North East			22.1 15.9	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403	Speci or 	fic data Table 6b0.3600 0.3600	or Tab	data le 6c .0000 .0000	fact Table 0.77 0.77	or 6d 00	65.3772 86.5641	(76)
North East			22.1 15.9 491.1774	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403	Speci or 	fic data Table 6b0.3600 0.3600	or Tab 0 0 781.5459	data le 6c .0000 .0000	fact Table 0.77 0.77	or 6d 00 00 188.5865	65.3772 86.5641 125.6878	(76)
North East 	877.3335	1016.6173	22.1 15.9 491.1774 1190.7130	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403	Speci or 	fic data Table 6b0.3600 0.3600	or Tab 0 0 781.5459	data le 6c .0000 .0000	fact Table 0.77 0.77	or 6d 00 00 188.5865	65.3772 86.5641 125.6878	(76)
North East	877.3335	1016.6173	22.1 15.9 491.1774 1190.7130	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403	Speci or 	fic data Table 6b0.3600 0.3600	or Tab 0 0 781.5459	data le 6c .0000 .0000	fact Table 0.77 0.77	or 6d 00 00 188.5865	65.3772 86.5641 125.6878	(76)
North East	877.3335 nal tempera uring heati	1016.6173 ture (heati	22.1 15.9 491.1774 1190.7130 in the livi	m2 .800 .000 .747.7346 .1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913	Speci or 	fic data Table 6b0.3600 0.3600	or Tab 0 0 781.5459	data le 6c .0000 .0000	fact Table 0.77 0.77	or 6d 00 00 188.5865	65.3772 86.5641 125.6878	(76) (83) (84)
North East Solar gains Total gains 7. Mean intern	877.3335 nal tempera uring heati actor for g	1016.6173 ture (heati ng periods ains for li	22.1 15.9 491.1774 1190.7130 ng season) in the livi	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913	Speci or 	944.9185	781.5459 1345.2284	data le 6c .0000 .0000 579.5994 1165.3439	fact Table 0.77 0.77 349.6573 973.3573	188.5865 857.0436	W 65.3772 86.5641 125.6878 832.6708	(76) (83) (84)
North East	877.3335 nal tempera uring heati actor for g Jan 105.0036	1016.6173 ture (heati ng periods ains for li Feb 105.4001	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033	fic data Table 6b 0.3600 0.3600 944.9185 1504.7463	781.5459 1345.2284 Aug 110.8417	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367	fact Table 0.77 0.77 349.6573 973.3573	188.5865 857.0436	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079	(76) (83) (84)
North East	877.3335 nal tempera uring heati actor for g Jan 105.0036 8.0002	1016.6173 ture (heati ng periods ains for li Feb	22.1 15.9 491.1774 1190.7130 ng season) in the livi ving area,	m2 	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May	Speci or 	fic data Table 6b 0.3600 0.3600 944.9185 1504.7463	781.5459 1345.2284	data le 6c .0000 .0000 579.5994 1165.3439	fact Table 0.77 0.77 349.6573 973.3573	188.5865 857.0436	W 65.3772 86.5641 125.6878 832.6708	(76) (83) (84)
North East Solar gains Total gains 7. Mean interr Temperature duutilisation fa	877.3335 nal tempera uring heati actor for g Jan 105.0036 8.0002	1016.6173 ture (heati ng periods ains for li Feb 105.4001	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033	fic data Table 6b 0.3600 0.3600 944.9185 1504.7463	781.5459 1345.2284 Aug 110.8417	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367	fact Table 0.77 0.77 349.6573 973.3573	188.5865 857.0436	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079	(76) (83) (84) (85)
North East Solar gains Total gains 7. Mean interr Temperature duutilisation fa	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002	1016.6173 ture (heati 	22.1 15.9 491.1774 1190.7130 ing season) in the livi ving area, Mar 105.7997 8.0533	m2 .800 .000 	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620 8.2175	Speci or 	944.9185 1504.7463	781.5459 1345.2284 Aug 110.8417 8.3894	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024	fact Table 0.77 0.77 349.6573 973.3573	188.5865 857.0436 Nov 107.4286 8.1619	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072	(83) (84) (85)
North East Solar gains Total gains 7. Mean interr Temperature dutilisation fatual pha util living and mit the control of the c	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329	m2 .800 .000 .747.7346 .1406.5563 	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620 8.2175 0.5292	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563	Jul 110.4033 8.3602 0.2577	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247	fact Table 0.77 0.77 349.6573 973.3573 Oct 108.2620 8.2175 0.8725	188.5865 857.0436 Nov 107.4286 8.1619	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967	(76) (83) (84) (85) (86) (87)
North East Solar gains Total gains 7. Mean interr Temperature duutilisation fatau alpha util living an	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923	22.1 15.9 491.1774 1190.7130 in the liviting area, Mar 105.7997 8.0533 0.9329 20.8129	m2 .800 .000 .747.7346 .1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9a, Table 9a) May 108.2620 8.2175 0.5292 20.9982	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999	944.9185 1504.7463 Jul 110.4033 8.3602 0.2577 21.0000	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988	fact Table 0.77 0.77 349.6573 973.3573 Oct 108.2620 8.2175 0.8725 20.9281	Nov 107.4286 8.1619 0.9857 20.6513	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082	(85) (86) (87) (88)
North East Solar gains Total gains 7. Mean interr Temperature ductilisation for the second	877.3335 mal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009	1016.6173 ture (heati	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597	m2 .800 .000	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 m Table 9a) Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885	Jul 110.4033 8.3602 0.2577 21.0000 20.2885	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770	(85) (86) (87) (88) (89) (90)
North East	877.3335 mal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146	m2 .800 .000 .747.7346 .1406.5563 	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 0.2160	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911 0.2539	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826	fact Table 0.77 0.77 349.6573 973.3573 Oct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956	(85) (86) (87) (88) (89) (90) (91)
North East	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022 20.1823	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696	m2 .800 .000 .747.7346 .1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167 20.2884 20.6307	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911 0.2539 20.2911 20.6321	Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000	(85) (85) (86) (87) (88) (89) (90) (91) (92)
North East	877.3335 nnal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696	m2 .800 .000 .747.7346 1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167 20.2884	Jul 110.4033 8.3602 0.2577 21.0000 20.2885	Aug 110.8417 8.3894 0.3001 21.0000 20.2911 0.2539 20.2911	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA =	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 19.8889 at / (4) =	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768	(85) (85) (86) (87) (88) (89) (90) (91) (92)
North East	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022 20.1823	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696	m2 .800 .000 .747.7346 .1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167 20.2884 20.6307	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911 0.2539 20.2911 20.6321	Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000	(85) (85) (86) (87) (88) (89) (90) (91) (92)
North East	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022 20.1823 20.1823	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271 20.4271	m2 .800 .000 .747.7346 1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167 20.2884 20.6307 20.6307	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 0.2160 20.2885 20.6307	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911 0.2539 20.2911 20.6321 20.6321	Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000	(85) (85) (86) (87) (88) (89) (90) (91) (92)
North East	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022 20.1823 20.1823	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271	m2 .800 .000	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224 20.6224	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167 20.2884 20.6307	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307	Aug 110.8417 8.3894 0.3001 21.0000 20.2911 20.6321 20.6321	Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000	(85) (85) (86) (87) (88) (89) (90) (91) (92)
North East Solar gains Total gains 7. Mean intern Temperature dutilisation fatual living and will living and will rest of be will rest of be will remperature acadjusted MIT 8. Space heat:	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022 20.1823 20.1823	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271 20.4271	m2 .800 .000 .747.7346 .1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9, Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224 20.6224	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167 20.2884 20.6307	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307 20.6307	Aug 110.8417 8.3894 0.3001 21.0000 20.2911 20.6321 20.6321	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575 20.5575	Nov 188.5865 857.0436 Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 19.20.2556 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000 19.9768	(85) (85) (86) (87) (88) (89) (90) (91) (92)
North East Solar gains Total gains 7. Mean interr Temperature dutilisation fatual living and util living and util rest of MIT 2 Living area find MIT Temperature acadjusted MIT 8. Space heat:	877.3335 mal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016	ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022 20.1823 20.1823	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271 20.4271	m2 .800 .000 .747.7346 1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 m Table 9a, Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224 May May	Speci or	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307 Jul	Aug 110.8417 8.3894 0.3001 21.0000 20.2911 20.6321 20.6321	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575	Nov 188.5865 857.0436 Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9881 19.8889 20.2556 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000 19.9768	(83) (84) (85) (86) (87) (88) (89) (91) (91) (92) (93)
North East Solar gains Total gains 7. Mean intern Temperature dutilisation fatual living and will living and will rest of be will rest of be will remperature acadjusted MIT 8. Space heat:	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016	1016.6173 ture (heati	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271 20.4271	m2 .800 .000 .747.7346 .1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224 20.6224 May 0.5080 800.2220	Speci or 1002.0301 1582.7690 Th1 (C) Jun 110.4033 8.3602 0.3563 20.9999 20.2885 0.3167 20.2884 20.6307	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307 20.6307	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911 20.6321 20.6321	data le 6c .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575 20.5575	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 20.2556 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North East Solar gains Total gains 7. Mean interr Temperature dubilisation fatau alpha util living and util living area for MIT Temperature adjusted MIT 8. Space heat: Utilisation Useful gains Ext temp.	877.3335 mal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016 ing require Jan 0.9930 871.1744 4.3000	1016.6173 ture (heati ng periods ains for li Feb 105.4001 8.0267 0.9845 20.5923 20.2571 0.9793 19.8022 20.1823 20.1823	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271 20.4271	m2 .800 .000 .747.7346 1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 m Table 9a, Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224 May 0.5080	Speci or	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307 Jul 10.2360	781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911 20.6321 20.6321	data le 6c .0000	fact Table 0.77 0.77 349.6573 973.3573 Oct 108.2620 8.2175 0.8725 20.2754 0.8349 20.2140 Living are 20.5575 20.5575	Nov 10.8556 857.0436 Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 10.2556 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000 19.9768	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North East Solar gains Total gains 7. Mean interm Temperature dutilisation for the second of the s	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016 ing require Jan 0.9930 871.1744 4.3000 e W 1454.7047	1016.6173 ture (heati	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271 20.4271	m2 .800 .000 .747.7346 1406.5563	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 om Table 9a) May 108.2620 8.2175 0.5292 20.9982 20.2754 0.4885 20.2742 20.6224 20.6224 May 0.5080 800.2220	Speci or	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307 Jul 0.2360 355.1692	781.5459 1345.2284 781.5459 1345.2284 Aug 110.8417 8.3894 0.3001 21.0000 20.2911 20.6321 20.6321 20.6321 Aug 0.2761 371.4329	data le 6c .0000 .0000 .0000 579.5994 1165.3439 Sep 109.5367 8.3024 0.5247 20.9988 20.2832 0.4708 20.2826 fLA = 20.6271 20.6271	fact Table 0.77 0.77 349.6573 973.3573 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575 20.5575	Nov 107.4286 8.1619 0.9857 20.6513 20.2701 0.9801 19.8889 20.2556 20.2556	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.4082 20.2649 0.9956 19.5770 0.4810 19.9768	(85) (86) (87) (88) (89) (90) (91) (92) (93)
North East Solar gains Total gains 7. Mean interr Temperature dubilisation fatau alpha util living and util living area for MIT Temperature adjusted MIT 8. Space heat: Utilisation Useful gains Ext temp.	877.3335 anal tempera uring heati actor for g Jan 105.0036 8.0002 rea 0.9953 20.4339 20.2545 house 0.9937 19.6009 raction 20.0016 djustment 20.0016 ing require Jan 0.9930 871.1744 4.3000 e W 1454.7047	1016.6173 ture (heati ng periods ains for li Feb 0.5923 20.2571 0.9793 19.8022 20.1823 20.1823 ment Feb 0.9787 995.0005 4.9000	22.1 15.9 491.1774 1190.7130 in the livi ving area, Mar 105.7997 8.0533 0.9329 20.8129 20.2597 0.9146 20.0696 20.4271 20.4271	m2 .800 .000	Table 6a W/m2 10.6334 19.6403 957.8282 1575.1913 m Table 9a, Table 9a, Table 9a, Table 9a, 20.2754 0.4885 20.2742 20.6224 May 0.5080 800.2220 11.7000	Speci or	Jul 110.4033 8.3602 0.2577 21.0000 20.2885 20.6307 20.6307	Aug 110.8417 8.3894 0.3001 21.0000 20.2911 20.6321 20.6321 Aug 0.2761 371.4329 16.4000	data le 6c .0000	fact Table 0.77 0.77 349.6573 973.3573 0ct 108.2620 8.2175 0.8725 20.9281 20.2754 0.8349 20.2140 Living are 20.5575 20.5575	Nov 19.8889 20.2556 Nov 0.9799 839.8438 7.1000	W 65.3772 86.5641 125.6878 832.6708 21.0000 Dec 106.6079 8.1072 0.9967 20.2649 0.9956 19.5770 0.4810 19.9768 0.0000 19.9768	(85) (86) (87) (88) (89) (90) (91) (92) (93)

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Space heating requirement - total per year (kWh/year) Solar heating kWh					1630.1384	
0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0 0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	(98b)
434.1466 279.2331 138.5833 19.4012 1.1415 0.0000 0.000 Space heating requirement after solar contribution - total per year (kWh/year) Space heating per m2	0.0000	0.0000	49.8563 (98c)	253.0579 / (4) =	454.7186 1630.1384 14.0529	
9b. Energy requirements						
Fraction of space heat from secondary/supplementary system (Table 11) Fraction of space heat from community system Fraction of heat from community Heat pump-Space and Water Factor for control and charging method (Table 4c(3)) for space heating Factor for charging method (Table 4c(3)) for water heating Distribution loss factor (Table 12c) for community heating system Efficiency of secondary/supplementary heating system, % Space heating:					0.0000 1.0000 1.0000 1.0000 1.0000 1.5000 0.0000	(302) (303a) (305) (305a) (306)
Space heating requirement 434.1466 279.2331 138.5833 19.4012 1.1415 0.0000 0.000	0 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 0.000		0.0000	74.7845	379.5869	682.0779	(50)
Space heating requirement 651.2199 418.8497 207.8749 29.1017 1.7122 0.0000 0.000		0.0000	74.7845	379.5869	682.0779	(307)
Efficiency of secondary/supplementary heating system in $\%$ (from Table 4a or Appendix E) 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 185.496	2 192.6582	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 278.244		291.8004	324.5792	344.1152	382.7470	(0.)
Water heating fuel 386.8281 342.1236 363.7469 320.7452 311.5015 281.3447 278.244		291.8004	324.5792	344.1152	382.7470	(310)
Cooling System Energy Efficiency Ratio Space coolin	0 0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	1 1
Pumps and Fa 35.4951 32.0601 35.4951 34.3501 35.4951 34.3501 35.4951 Lighting 39.0575 31.3334 28.2122 20.6695 15.9657 13.0441 14.564		34.3501 24.5901	35.4951 32.2635	34.3501 36.4415	35.4951 40.1430	1 1
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	
Electricity generated by wind turbines (Appendix M) (negative quantity)		0.0000	0.0000		0.0000	, ,
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)				0.0000		
(335a)m 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000		0.0000	0.0000	0.0000	0.0000	, ,
(333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by wind turbines (Appendix M) (negative quantity)		0.0000	0.0000	0.0000	0.0000	, ,
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by hydro-electric generators (Appendix M) (negative quantity)		0.0000	0.0000	0.0000	0.0000	
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Annual totals kWh/year	0.0000	0.0000	0.0000	0.0000	0.0000	, ,
Space heating fuel - community heating Space heating fuel - secondary					2445.2076 0.0000	
Water heating fuel - community heating Efficiency of water heater					3916.7634 0.0000	
Electricity used for heat distribution Space cooling fuel					24.4521 0.0000	
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 Electricity for lighting (calculated in Appendix L)					417.9262 315.2165	
Energy saving/generation technologies (Appendices M ,N and Q)						. ,
PV generation Wind generation					0.0000 0.0000	
Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)					0.0000 0.0000	
Appendix Q - special features Energy saved or generated					-0.0000	
Energy used Total delivered energy for all uses					0.0000 7095.1137	(337)
						/
10b. Fuel costs - using Table 12 prices			Fuel and		Fue?	
	Fuel kWh/year		Fuel price p/kWh		Fuel cost £/year	
Space heating from Heat pump Space heating total	2445.2076		4.4400		108.5672 108.5672	(340)
Total CO2 associated with community systems Space heating - secondary	0.0000		0.0000		0.0000 0.0000	1 1
Water heating from Heat pump Water heating total	3916.7634		4.4400		173.9043 173.9043	
Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot	0.0000 417.9262		16.4900 16.4900		0.0000 68.9160	(347a)
Energy for lighting	315.2165		16.4900		51.9792	

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Additional standing charges Total energy cost				92.0000 (351) 495.3667 (355)
11b. SAP rating - Community heating scheme Energy cost deflator (Table 12):				0.3600 (356)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band	[]	(255) x (256)] / [(4) + 49	5.0] =	1.1077 (357) 82.0450 82 (358) B
12b. Carbon dioxide emissions - Community heating scheme				
	Energy kWh/year	Emission factor kg CO2/kWh		Emissions CO2/year
Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems	544.1677 24.4521	0.1587 0.0000		412.0000 (367) 94.1806 (367) 9.3956 (372) 0.0373 (386) 237.4441 (373)
	417.9262 315.2165	0.1387 0.1443		237.4441 (376) 57.9715 (378) 45.4955 (379) 340.9111 (383) 2.9400 (384) 97.1626 (384a) 97 (385) A
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING				
1. Overall dwelling characteristics				
	Area (m2)	Storey height (m)		Volume (m3)
Ground floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) Dwelling volume	116.0000	(1b) x 3.1500 (2l 3a)+(3b)+(3c)+(3d)+(3e)		365.4000 (1b) - (4) 365.4000 (5)
2. Ventilation rate				
		_		per hour
Number of open chimneys Number of open flues Number of chimneys / flues attached to closed fire Number of flues attached to solid fuel boiler Number of flues attached to other heater Number of blocked chimneys Number of intermittent extract fans Number of passive vents Number of flueless gas fires		0 0 0 0 0 0	* 80 = * 20 = * 10 = * 20 = * 35 = * 20 = * 10 = * 40 =	0.0000 (6a) 0.0000 (6b) 0.0000 (6c) 0.0000 (6d) 0.0000 (6e) 0.0000 (7a) 0.0000 (7b) 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b) Pressure test Pressure Test Method Measured/design AP50 Infiltration rate Number of sides sheltered)+(7c) =	A: 0.0000 /	` '	per hour 0.0000 (8) Yes ower Door 2.5000 (17) 0.1250 (18) 1 (19)
Shelter factor Infiltration rate adjusted to include shelter factor		$(20) = 1 - [0.075 \times (21) = (18) \times (21)]$		0.9250 (20) 0.1156 (21)
Jan Feb Mar Apr May Jun Jul Wind speed 4.2000 4.0000 4.0000 3.7000 3.7000 3.3000 3.4000 Wind factor 1.0500 1.0000 1.0000 0.9250 0.9250 0.8250 0.8500 Adj infilt rate 0.1214 0.1156 0.1156 0.1070 0.1070 0.0954 0.0983 Balanced mechanical ventilation with heat recovery	Aug 3.2000 0.8000 0.0925	Sep Oct 3.3000 3.5000 0.8250 0.8750 0.0954 0.1012	Nov 3.5000 0.8750 0.1012	Dec 3.8000 (22) 0.9500 (22a) 0.1098 (22b)

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If mechanical v If exhaust air If balanced wit	heat pump	using Appen)			0.5000 0.5000 76.5000	(23b
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													
Element					Ononings	No:	tArea	U-value	Α×U		<-value	Α×Κ	
Opening Type 1	(Uw = 1.20))		Gross m2	Openings m2	38	m2 .0800	W/m2K 1.1450	W/K 43.6031		kJ/m2K	kJ/K	(27
Door External Wall 1 sheltered wall				.17.5900 9.3400	40.2800	77 9	.2000 .3100 .3400	1.3000 0.1800 0.1700	2.8600 13.9158 1.5878	19	90.0000 90.0000	14688.9000 1774.6000	(29
Total net area Fabric heat los Party Wall 1 Party Floor 1 Party Ceiling 1 Internal Wall 1	ss, W/K = S L		Aum(A, m2)			46 116 116	.9300 (26)(3 .4000 .0000 .0000 .9100	30) + (32) = 0.0000	61.9667 0.0000	18	30.0000 40.0000 40.0000 9.0000	8352.0000 4640.0000 4640.0000 926.1900	(32) (32)
Heat capacity C Thermal mass pa			FA) in kJ/n	12K				(28)	.(30) + (32)	+ (32a).	(32e) =	35021.6900 301.9111	
E17 Cor E2 Othe E3 Sill E4 Jamb E7 Part E18 Par P3 Part	ment oner (norma oner (inver er lintels l o ty floor be ty wall be ty wall - I ermediate f s (Sum(L x oridges	rtéd - inter (including etween dwell etween dwell intermediate Floor within	other steel ings (in bl ings floor betw a dwelling	lintels) ocks of flage	ngs (in bloc	·	5)	25. 22. 14. 14. 37. 74. 6.	2000 0500 1800 1800 8000 6600 3000 4600 9600	i-value 0.0320 -0.1170 0.0020 0.0130 0.0080 0.0000 -0.0010 0.0000	To 0.8i -2.5 0.0 0.1i 0.3i 0.0i -0.0i 0.0i 0.0i (36a) = + (36a) =	799 284 843 024 000 063 000	
/entilation hea		culated mon	thly (38)m Mar	= 0.33 x (2	25)m x (5) May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	(37)
(38)m Heat transfer c	28.8078	28.1107 88.8127	28.1107	27.0650 87.7670	27.0650 87.7670	25.6708 86.3728	26.0193 86.7213	25.3222	25.6708 86.3728	26.3679 87.0699	26.3679 87.0699	27.4136	` '
Average = Sum(3	39)m / 12 =		Mar				Jul			0ct	Nov	87.5346 Dec	
HLP HLP (average) Days in mont	Jan 0.7716 31	0.7656 28	0.7656 31	Apr 0.7566 30	May 0.7566 31	Jun 0.7446 30	0.7476 31	Aug 0.7416 31	Sep 0.7446 30	0.7506	0.7506 30	0.7596 0.7546	
. Water heatin													
Assumed occupan	ncy											2.8464	(42
lot water usage Hot water usage	0.0000 for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	•
lot water usage	43.7804	42.1884	80.0205	76.8203 39.0043	74.4241 37.4123	71.7670 35.8203	70.3318 35.8203	72.0553 37.4123	73.9318	76.7750 40.5964	80.0410 42.1884		(42
verage daily h	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	116.7438 Dec	(43
nergy conte nergy content	126.7689 200.7710 (annual)	123.9444 176.4952	120.6168 185.3835	115.8246 158.5581	111.8364 150.5533	107.5873 132.2912	106.1521 128.3818	109.4676 135.5438	139.2616	117.3713 159.2718 Total = 9	122.2294 174.1382 Sum(45)m =	126.4884 198.0503 1938.6996	(45
Distribution lo Water storage l	30.1157	= 0.15 x (4 26.4743	5)m 27.8075	23.7837	22.5830	19.8437	19.2573	20.3316	20.8892	23.8908	26.1207	29.7075	(46
tore volume) If manufact Temperature f nter (49) or (otal storage l	factor from (54) in (55	Table 2b	ctor is kno	own (kWh/da	ay):							180.0000 1.4000 0.7800 1.0920	(48 (49
f cylinder con	33.8520	30.5760 cated solar 30.5760	33.8520 storage 33.8520	32.7600 32.7600	33.8520 33.8520	32.7600 32.7600	33.8520 33.8520	33.8520 33.8520	32.7600 32.7600	33.8520	32.7600	33.8520	
rimary loss ombi loss otal heat requ	23.2624 0.0000 uired for w	21.0112 0.0000 water heatin	23.2624 0.0000 g calculate	22.5120 0.0000 ed for each	23.2624 0.0000 month	22.5120 0.0000	23.2624 0.0000	23.2624 0.0000	22.5120 0.0000	33.8520 23.2624 0.0000	32.7600 22.5120 0.0000	33.8520 23.2624 0.0000	(59 (61
WHRS PV diverter Solar input EGHRS	257.8854 0.0000 0.0000 0.0000 0.0000	228.0824 0.0000 0.0000 0.0000 0.0000	242.4979 0.0000 0.0000 0.0000 0.0000	213.8301 0.0000 0.0000 0.0000 0.0000	207.6677 0.0000 0.0000 0.0000 0.0000	187.5632 0.0000 0.0000 0.0000 0.0000	185.4962 0.0000 0.0000 0.0000 0.0000	192.6582 0.0000 0.0000 0.0000 0.0000	194.5336 0.0000 0.0000 0.0000 0.0000	216.3862 0.0000 0.0000 0.0000 0.0000	229.4102 0.0000 0.0000 0.0000 0.0000	255.1647 0.0000 0.0000 0.0000 0.0000	(63 (63 (63
Output from w/h		228.0824	242.4979	213.8301	207.6677	187.5632	185.4962	192.6582		216.3862	229.4102		

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Exercise 10 10 10 10 10 10 10 1	Flactric shower(s)					Total p				2611.1756	
	· ·	0.0000 0.0000	0.0000	0.0000	0.0000						(64a)
S. Teternal gains (sale 5 and 5) **Retablic gains (lable 5) artists** **Retablic gains (lable 5) artists**	Heat gains from water heating, kWh/mont	th	al Energy u	sed by inst	antaneous e	lectric sho	wer(s) (kWh	/year) = Su	m(64a)m =	0.0000	(64a)
Petabolic gains (Table 2) Marce Nov.	112.4479 99.9544 16	07.3315 96.9382	95.7505	88.2044	88.3785	90.7598	90.5221	98.6494	102.1185	111.5432	(65)
No. Part P											
Column Table Tab	5. Internal gains (see Table 5 and 5a)										
(ac) 19. 78.78 319.7865 719.7865 719.7865 719.7865 219.7865 719.	• , , , ,			_			_			_	
March Marc	(66)m 170.7863 170.7863 17	70.7863 170.7863	170.7863	170.7863							(66)
March Marc	44.6222 39.6330 3	32.2317 24.4015	18.2404	15.3993		21.6287	29.0299	36.8602	43.0213	45.8623	(67)
March Marc	417.7766 422.1118 41	11.1872 387.9300	358.5720	330.9796	312.5462	308.2110	319.1356	342.3928	371.7508	399.3431	(68)
Lasses e.g. e.g. e.g. port Lasses e.g. e.g. e.g. port Lasses e.g. e.g. Lasses e.g. e.g. Lasses e.g. e.g. Lasses e.g.	54.9251 54.9251 5	54.9251 54.9251	54.9251	54.9251	54.9251						1 1
March Posting gains (1916) S) 101,136 142,7417 144,2628 134,6364 128,6969 122,1962 118,7887 121,3990 125,7251 132,5932 141,8312 149,9237 (7)	Losses e.g. evaporation (negative value	es) (Table 5)									
Total gains 172,093 300,0973 097,950 781,850 094,425 1099,531 170,631 180,031	Water heating gains (Table 5)										
Companies Comp	Total internal gains										
Same Campaign Ca											` ,
Salar Flow Rate Salar Flow Specific data Specific da											
Rational Control Rational Co	6. Solar gains										
North 22.1888 11.9814 0.3668 0.9668 0.9668 0.7786 0.7887 0.7887 0.7887 0.7887 0.7887 0.7887 0.7888 0.7887 0.78888 0.7888 0.7888 0.78888 0.78888 0.78888 0.7888 0.78888 0.7888 0.7888 0.78	[Jan]										
Solar gains 172.0903 308.0973 497.9669 781.8968 974.4253 1089.7924 1017.6605 861.4874 637.3668 382.4465 219.6645 140.8221 (83) 70.14 gains 897.4825 1223.3376 1197.5825 1446.6277 1591.7885 1670.5313 1576.8881 1425.1699 1223.1652 1096.1466 887.5216 847.8651 (84)		m2								W	
Solar gains 172.0903 300.9973 497.9669 781.8060 974.4253 1089.7924 1017.6065 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. Hean Internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (C) Temperature during heating periods in the living area from Table 9, Th1 (C) The period of the living area, fil., (see Table 9) That a 108.6836 109.5367 109.5367 110.8417 110.8417 112.6309 112.1782 113.0873 112.6309 111.7292 111.7292 114.033 110.000 111.000 11							.0000	0.77			
Total gains 897.4825 1023.376 1197.5025 1440.6277 1591.7885 1670.5313 1576.8883 1425.1699 1223.1852 1006.1466 887.5216 847.8051 (84) 7. Mean intermal temperature (heating season) 7. Mean intermal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (C) 18	North										
7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Thi (C) Tulifisation factor for gains for living area, nil,m (see Table 9a) Tul Aug Sop Oct Nov Dec 111.792 111.793 110.793 112.7	North					0		0.77	00	98.4248	(76)
Propertion Pro	North East 	15.9000 97.9669 781.8060	22.3313 974.4253	1089.7924	0.3600 1017.0605	861.4874	637.3608	382.4465	219.0645	140.8221	(83)
Propertion Pro	North East 	15.9000 97.9669 781.8060	22.3313 974.4253	1089.7924	0.3600 1017.0605	861.4874	637.3608	382.4465	219.0645	140.8221	(83)
Statistication factor for gains for living area, nil,m (see Table 9a) Nar	North East 	15.9000 97.9669 781.8060	22.3313 974.4253	1089.7924	0.3600 1017.0605	861.4874	637.3608	382.4465	219.0645	140.8221	(83)
tau 188.6836 169.5367 109.5367 110.5417 110.5417 112.6369 112.1782 113.6873 112.6369 111.7292 111.7292 111.4933 alpha 8.2456 8.3024 8.3024 8.3024 8.3084 8.3084 8.5087 8.44785 8.5032 8.5087 8.4486 8.4486 8.4062 util living area	North East	15.9000 	22.3313 974.4253 1591.7885	1089.7924 1670.5313	0.3600 1017.0605	861.4874	637.3608	382.4465	219.0645	140.8221	(83)
## Billiving area fraction ## Billiving area fra	North East Solar gains 172.0903 300.9973 49 Total gains 897.4825 1023.3376 119 7. Mean internal temperature (heating s	15.9000 97.9669 781.8060 97.5025 1440.6277 	22.3313 974.4253 1591.7885	1089.7924 1670.5313	0.3600 1017.0605	861.4874	637.3608	382.4465	219.0645	140.8221 847.8051	(83) (84)
MIT 20.561 20.6881 20.8864 20.9897 20.9997 21.0000 21.0000 20.0000 20.9999 20.9737 20.7700 20.5280 (87) Th 2 20.2780 20.2832 20.2832 20.2911 20.2911 20.2911 20.3016 20.2990 20.3042 20.3016 20.2963 20.2963 20.2963 20.2885 (88) util rest of house 0.9886	North East Solar gains 172.0903 300.9973 45 Total gains 897.4825 1023.3376 115 7. Mean internal temperature (heating solutions) Temperature during heating periods in to Utilisation factor for gains for living Jan Feb	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see	22.3313 974.4253 1591.7885 mm Table 9, Table 9a) May 110.8417	1089.7924 1670.5313 Th1 (C)	0.3600 	861.4874 1425.1699	.0000 637.3608 1223.1052 Sep	382.4465 1006.1466	219.0645 887.5216	140.8221 847.8051 21.0000 Dec	(83) (84)
The 2 02.7898 20.2832 20.2832 20.2911 20.2911 20.2916 20.3016 20.2999 20.3042 20.3016 20.2963 20.2963 20.2963 20.2885 (88) util rest of house util rest of house 0.9886 0.9679 0.8711 0.6280 0.4019 0.2224 0.1319 0.1512 0.3602 0.7365 0.9766 0.9578 0.9918 (89) MIT 2 19.7677 19.9433 20.1737 20.2831 20.2999 20.3016 20.2999 20.3016 20.3906 20.3016 20.2766 20.6766 20.6577 19.7488 (99) Living area fraction 1.0000	North East Solar gains 172.0903 300.9973 49 Total gains 897.4825 1023.3376 119 7. Mean internal temperature (heating solutions) Temperature during heating periods in the Utilisation factor for gains for living Jan Feb tau 108.6836 109.5367 100 alpha 8.2456 8.3024 util living area	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087	0.3600 	861.4874 1425.1699	.0000 637.3608 1223.1052 Sep 112.6309 8.5087	382.4465 1006.1466 Oct 111.7292 8.4486	219.0645 887.5216 Nov 111.7292 8.4486	140.8221 847.8051 21.0000 Dec 110.4033 8.3602	(83) (84)
Note	North East Solar gains 172.0903 300.9973 49 Total gains 897.4825 1023.3376 119 7. Mean internal temperature (heating solutions) Temperature during heating periods in tour for gains for living Jan Feb tau 108.6836 109.5367 16 alpha 8.2456 8.3024 util living area 0.9916 0.9757	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, ni1,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705	861.4874 1425.1699 Aug 113.0873 8.5392 0.1932	Sep 112.6309 8.5087 0.4095	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825	219.0645 887.5216 Nov 111.7292 8.4486 0.9693	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940	(83) (84) (85)
Living area fraction 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	North East Solar gains 172.0903 300.9973 45 Total gains 897.4825 1023.3376 115 7. Mean internal temperature (heating solution factor for gains for living Jan Feb tau 108.6836 109.5367 161 alpha 8.2456 8.3024 util living area 0.9916 0.9757 MIT 20.5501 20.6881 2 Th 2 20.2780 20.2832 2	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000	861.4874 1425.1699	.0000 637.3608 1223.1052 Sep 112.6309 8.5087 0.4095 20.9999	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280	(83) (84) (85) (86) (87)
Temperature adjustment adjustment adjustment adjustment 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	North East Solar gains 172.0903 300.9973 49 Total gains 897.4825 1023.3376 119 7. Mean internal temperature (heating solutions) Temperature during heating periods in tour for gains for living Jan Feb tau 108.6836 109.5367 100 alpha 8.2456 8.3024 util living area 0.9916 0.9757 MIT 20.5501 20.6881 20 Th 2 20.2780 20.2832 20 util rest of house 0.9886 0.9679	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, ni1,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319	Aug 113. 0873 8.5392 0.1932 21.0000 20.3042 0.1512	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918	(83) (84) (85) (86) (87) (88) (89)
8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	North East Solar gains 172.0903 300.9973 45 Total gains 897.4825 1023.3376 115 7. Mean internal temperature (heating serious in the serious for living Jan Feb tau 108.6836 109.5367 16 alpha 8.2456 8.3024 util living area 0.9916 0.9757 MIT 20.5501 20.6881 2 10.2501 20.6881 2 10.2501 20.2780 20.2832 2 10.2780 20.283	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831	22.3313 974.4253 1591.7885 0	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 fLA =	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) =	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810	(83) (84) (85) (86) (87) (88) (89) (90) (91)
8. Space heating requirement 3an Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	North East	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, ni1,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 fLA = 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119	Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
8. Space heating requirement 3an Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	North East	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, ni1,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 fLA = 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119	Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
Dan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	North East	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230 20.5165 20.6230	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362 20.6362	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 fLA = 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119	Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
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 761.239 851.7408 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) Solar heating contribution - total per year (kWh/year) Solar heating contribution - total per year (kWh/year) Space heating kWh 342.1734 211.6836 82.8606 6.7263 0.2026 0.0000 0.000	North East	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 209.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362 20.6362	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 fLA = 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119	Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
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) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Solar heating contribution - total per year (kWh/year) Space heating requirement after solar contribution - total per year (kWh/year) Space heating requirement after solar contribution - total per year (kWh/year) Space heating requirement after solar contribution - total per year (kWh/year) Space heating requirement after solar contribution - total per year (kWh/year)	North East Solar gains 172.0903 300.9973 45 Total gains 897.4825 1023.3376 115 7. Mean internal temperature (heating solutions) Temperature during heating periods in touring for gains for living Jan Feb tau 108.6836 109.5367 108 alpha 8.2456 8.3024 util living area 0.9916 0.9757 MIT 20.5501 20.6881 2 Th 2 20.2780 20.2832 22 util rest of house 0.9886 0.9679 MIT 2 19.7677 19.9433 2 Living area fraction MIT 20.1441 20.3016 2 Temperature adjustment adjusted MIT 20.1441 20.3016 2	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230 20.5165 20.6230	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362 20.6362	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 fLA = 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 20.6119	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
Space heating kWh 342.1734 211.6836 82.8606 6.7263 0.2026 0.0000 0.0	North East	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230 Mar Apr 0.8798 0.6468	22.3313 974.4253 1591.7885 mm Table 9, Table 9a) May 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362 20.6362	Aug 113. 0873 8.5392 0.1932 21. 0000 20. 3042 0.1512 20. 3042 20. 6389 20. 6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 fLA = 20.6375 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 20.6119	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000 20.1236	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
342.1734 211.6836 82.8606 6.7263 0.2026 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	North East Solar gains 172.0903 300.9973 45 Total gains 897.4825 1023.3376 115 7. Mean internal temperature (heating serious in Utilisation factor for gains for living Jan Feb tau 108.6836 109.5367 16 alpha 8.2456 8.3024 util living area 0.9916 0.9757 MIT 20.5501 20.6881 2 Th 2 20.2780 20.2832 2 util rest of house 0.9886 0.9679 MIT 2 19.7677 19.9433 2 Living area fraction MIT 20.1441 20.3016 2 Temperature adjustment adjusted MIT 20.1441 20.3016 2 8. Space heating requirement Utilisation 0.9880 0.9681 Useful gains 886.6802 990.6847 105 Ext temp. 5.1000 5.6000	15.9000	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362 20.6362	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 fLA = 20.6375 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 20.6119	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000 20.1236	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
Solar heating kWh	North East	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230 Mar Apr 0.8798 0.6468 53.5413 931.7862 7.4000 9.9000	22.3313 974.4253 1591.7885 mm Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376 Jun 0.2398 400.5571 16.0000	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 20.6362 20.6362 Jul 0.1505 237.2863 17.9000	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.6389 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 fLA = 20.6375 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 20.6119	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998 Nov 0.9597 851.7408 8.0000	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000 20.1236	(83) (84) (85) (86) (87) (88) (89) (91) (92) (93) (94) (95) (96)
Space heating kWh 342.1734 211.6836 82.8606 6.7263 0.2026 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	North East Solar gains 172.0903 300.9973 45 Total gains 897.4825 1023.3376 115 7. Mean internal temperature (heating serious in the literature of the literature of the literature of the literature of literature	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230 Mar Apr 0.8798 0.6468 53.5413 931.7862 7.4000 9.9000 64.9130 941.1284	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318 20.6318	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 20.6376 20.6376 20.6376	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 20.6362 20.6362 20.6362 Jul 0.1505 237.2863 17.9000 237.2864	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042 20.6389 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 fLA = 20.6375 20.6375 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 20.6119 Oct 0.7566 761.2939 11.6000 784.6645	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998 20.3998	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000 20.1236	(83) (84) (85) (86) (87) (88) (89) (91) (92) (93) (94) (95) (96) (97)
342.1734 211.6836 82.8606 6.7263 0.2026 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	North East	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, ni1,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230 20.5165 20.6230 Mar Apr 0.8798 0.6468 53.5413 931.7862 7.4000 9.9000 64.9130 941.1284 82.8606 6.7263 year (kWh/year)	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318 May 0.4206 669.5507 13.0000 669.8231 0.2026	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376 20.6376 Jun 0.2398 400.5571 16.0000 400.5587 0.0000	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362 20.6362 Jul 0.1505 237.2863 17.9000 237.2864 0.0000	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042 20.6389 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 fLA = 20.6375 20.6375 Sep 0.3839 469.5655 15.2000 469.6495 0.0000	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 20.6119 Oct 0.7566 761.2939 11.6000 784.6645 17.3877	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998 Nov 0.9597 851.7408 8.0000 1079.6480 164.0932	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000 20.1236 0.0000 20.1236 123.8136 359.7023 1184.8298	(83) (84) (85) (86) (87) (88) (89) (91) (92) (93) (93) (94) (95) (96) (97) (98a)
Space heating per m2 $(98c) / (4) = 10.2141 (99)$	North East Solar gains 172.0903 300.9973 45 Total gains 897.4825 1023.3376 115 1	15.9000 97.9669 781.8060 97.5025 1440.6277 season) the living area frog area, nil,m (see Mar Apr 09.5367 110.8417 8.3024 8.3894 0.8963 0.6678 20.8864 20.9897 20.2832 20.2911 0.8711 0.6280 20.1737 20.2831 20.5165 20.6230 20.5165 20.6230 20.5165 20.6230 Mar Apr 0.8798 0.6468 53.5413 931.7862 7.4000 9.9000 64.9130 941.1284 82.8606 6.7263 year (kWh/year) 0.0000 0.0000	22.3313 974.4253 1591.7885 om Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318 May 0.4206 669.5507 13.0000 669.8231 0.2026	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 0.2224 20.3016 20.6376 20.6376 Jun 0.2398 400.5571 16.0000 400.5587 0.0000	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 0.1319 20.2990 20.6362 20.6362 Jul 0.1505 237.2863 17.9000 237.2864 0.0000	Aug 113.0873 8.5392 0.1932 21.0000 20.3042 0.1512 20.3042 20.6389 20.6389 20.6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 fLA = 20.6375 20.6375 Sep 0.3839 469.5655 15.2000 469.6495 0.0000	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 20.6119 Oct 0.7566 761.2939 11.6000 784.6645 17.3877	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998 Nov 0.9597 851.7408 8.0000 1079.6480 164.0932	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000 20.1236 Dec 0.9912 840.3427 5.1000 1323.8136 359.7023 1184.8298	(83) (84) (85) (86) (87) (88) (89) (91) (92) (93) (93) (94) (95) (96) (97) (98a)
	Solar gains	15.9000	22.3313 974.4253 1591.7885 m Table 9, Table 9a) May 110.8417 8.3894 0.4408 20.9997 20.2911 0.4019 20.2909 20.6318 20.6318 20.6318 May 0.4206 669.5507 13.0000 669.8231 0.2026 0.0000	1089.7924 1670.5313 Th1 (C) Jun 112.6309 8.5087 0.2585 21.0000 20.3016 20.6376 20.6376 20.6376 Jun 0.2398 400.5571 16.0000 400.5587 0.00000	0.3600 1017.0605 1576.8883 Jul 112.1782 8.4785 0.1705 21.0000 20.2990 20.6362 20.6362 Jul 0.1505 237.2863 17.9000 237.2864 0.0000 0.0000	Aug 113. 0873 8.5392 0.1932 21. 0000 20. 3042 20. 6389 20. 6389 20. 6389 20. 6389 20. 6389	Sep 112.6309 8.5087 0.4095 20.9999 20.3016 0.3602 20.3016 20.6375 20.6375 20.6375	382.4465 1006.1466 Oct 111.7292 8.4486 0.7825 20.9737 20.2963 0.7345 20.2766 Living are 20.6119 Oct 0.7566 761.2939 11.6000 784.6645 17.3877 0.0000	219.0645 887.5216 Nov 111.7292 8.4486 0.9693 20.7700 20.2963 0.9578 20.0567 a / (4) = 20.3998 20.3998 Nov 0.9597 851.7408 8.0000 1079.6480 164.0932 0.0000	140.8221 847.8051 21.0000 Dec 110.4033 8.3602 0.9940 20.5280 20.2885 0.9918 19.7488 0.4810 20.1236 0.0000 20.1236 Dec 0.9912 840.3427 5.1000 1323.8136 359.7023 1184.8298 0.0000 0.0000	(83) (84) (85) (86) (87) (88) (89) (91) (92) (93) (94) (95) (96) (97) (98a) (98b)

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9b. Energy requirements		
Fraction of space heat from secondary/supplementary system (Table 11) Fraction of space heat from community system Fraction of heat from community Heat pump-Space and Water Factor for control and charging method (Table 4c(3)) for space heating Factor for charging method (Table 4c(3)) for water heating Distribution loss factor (Table 12c) for community heating system Efficiency of secondary/supplementary heating system, % Space heating:	-	0.0000 (301) 1.0000 (302) 1.0000 (303a) 1.0000 (305) 1.0000 (305a) 1.5000 (306) 0.0000 (208)
Space heating requirement 342.1734 211.6836 82.8606 6.7263 0.2026 0.0000 0.0000 0.0000 Space heat from Heat pump = $(98) \times 1.00 \times 1.00 \times 1.50$	0.0000 17.3877	164.0932 359.7023 (98)
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 Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) Space heating fuel for secondary/supplementary system	0.0000 26.0816	246.1398 539.5535 (307) 0.0000 (308)
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 Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50		229.4102 255.1647 (64)
310a 386.8281 342.1236 363.7469 320.7452 311.5015 281.3447 278.2443 288.9872 Water heating fuel		344.1152 382.7470
386.8281 342.1236 363.7469 320.7452 311.5015 281.3447 278.2443 288.9872 Cooling System Energy Efficiency Ratio		344.1152 382.7470 (310) 0.0000 (314)
Space coolin 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000		0.0000 0.0000 (315) 34.3501 35.4951 (331)
Lighting 39.0575 31.3334 28.2122 20.6695 15.9657 13.0441 14.5645 18.9314		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 Space heating fuel - secondary Water heating fuel - community heating Efficiency of water heater Electricity used for heat distribution Space cooling fuel		1777.2447 (307) 0.0000 (309) 3916.7634 (310) 0.0000 (311) 17.7724 (313) 0.0000 (321)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375) mechanical ventilation fans (SFP = 0.9375) Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)		417.9262 (330a) 417.9262 (331) 315.2165 (332)
Energy saving/generation technologies (Appendices M ,N and Q) PV generation Wind generation Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)		0.0000 (333) 0.0000 (334) 0.0000 (335a) 0.0000 (335)
Appendix Q - special features Energy saved or generated Energy used Total delivered energy for all uses		-0.0000 (336) 0.0000 (337) 6427.1509 (338)
10b. Fuel costs - using BEDF prices (528)	-	
Fuel	r	Fuel cost
Space heating from Heat pump 1777.2447 Space heating total		£/year 85.3077 (340a) 85.3077 (340)
Total CO2 associated with community systems Space heating - secondary 0.0000	0.0000	0.0000 (473) 0.0000 (341)
Water heating from Heat pump 3916.7634 Water heating total	4.8000	188.0046 (342a) 188.0046 (342)
Energy for instantaneous electric shower(s) 0.0000		0.0000 (347a)
Pumps, fans and electric keep-hot 417.9262 Energy for lighting 315.2165		89.8959 (349) 67.8031 (350)
Additional standing charges Total energy cost		98.0000 (351) 529.0114 (355)
12b. Carbon dioxide emissions - Community heating scheme		
Energy kWh/year Efficiency of heat source Heat pump	y Emission factor	Emissions kg CO2/year 412.0000 (367)

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Space and Water heating from Heat pump Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total CO2, kg/year	1382.0408 17.7724 417.9262 315.2165	0.1596 0.0000 0.1387 0.1443	68.8413 (367) 8.3516 (372) 0.0371 (386) 211.0608 (373) 211.0608 (376) 57.9715 (378) 45.4955 (379) 314.5278 (383)
13b. Primary energy - Community heating scheme			
		ry energy factor	Primary energy
Efficiency of heat source Heat pump	kWh/year	kg CO2/kWh	kWh/year 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	417.9262	1.5128	2219.6560 (476)
Pumps, fans and electric keep-hot Energy for lighting	315.2165	1.5128	632.2388 (478) 483.4895 (479)
Total Primary energy kWh/year	313.2103	1.5556	3335.3844 (483)

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Ravenscourt Park Hospital Energy Statement Issued



APPENDIX H DHN CORRESPONDENCE

Revision: 001

Ref: 6391-CBC-HR-RP-S-003-P01

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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

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

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 The company accepts no liability for the content of this email or for the consequences of any actions taken based on the information provided

From: Asagba-Power Roy: H&F < Roy. Asagba-Power@lbhf.gov.uk >

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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>

unless that information is subsequently confirmed in writing. If you are not the intended recipient, you are notified that disclosing, copying,

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

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

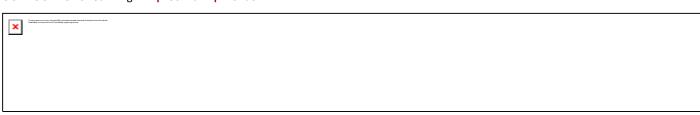
Kind regards

Hasnaat Mahmood | Sustainability Engineer

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

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

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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

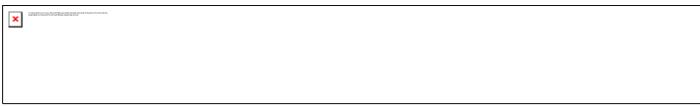
Hasnaat Mahmood | Sustainability Engineer

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' < Subject: Ravenscourt Park Hospital - District Heating Network">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

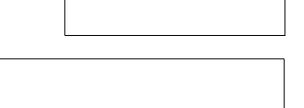
Kind regards

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



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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 <u>pre-application</u> 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

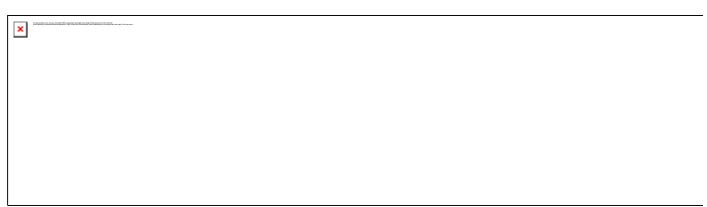
Kind regards

Mandy

Mandy Burke
Resident Access Adviser
Environment Department
Hammersmith & Fulham Council
Email: mandy.burke@lbhf.gov.uk

Tel no: 07825935342





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

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Ravenscourt Park Hospital Energy Statement Issued



APPENDIX I ASHP DETAILS

Revision: 001

Ref: 6391-CBC-HR-RP-S-003-P01

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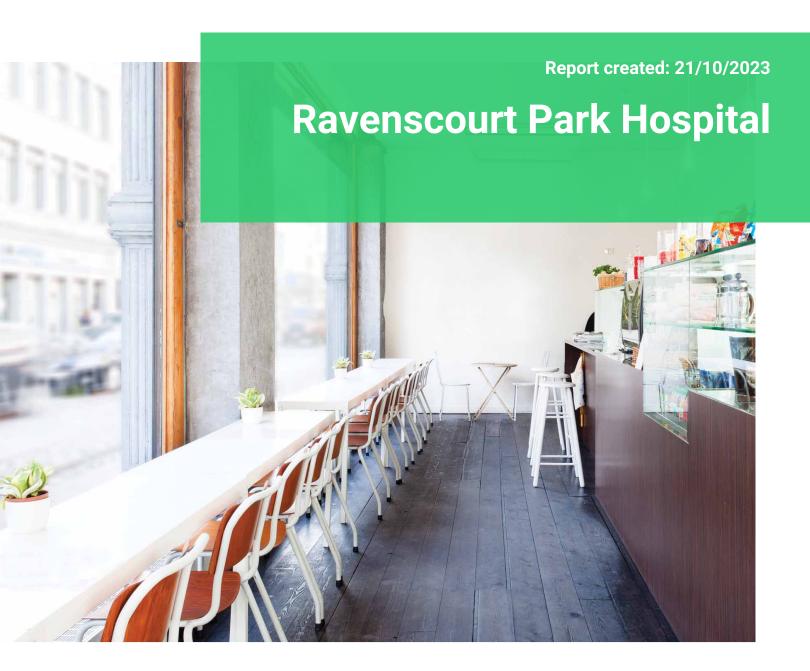
SOUND LEVEL**							
Sound Power - Cooling	dB(A)	76	76	78	79	80	80
Sound Pressure level @1m distance - Cooling	dB(A)	59.7	59.7	61.7	62.2	63.2	62.8
REFRIGERANT CIRCUIT							
Refrigerant type		R32	R32	R32	R32	R32	R32
Refrigerant charge	kg	3	5	5	6.5	6.7	10.2
N. of circuits	No.	1	1	1	1	1	2
PIPING CONNECTIONS							
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-	EWYT064CZP-	EWYT090CZP-
COOLING PERFORMANCE		A2	A2	A2
Capacity - Cooling	kW	51.11	64.41	88.77
	KVV	Inverter	Inverter	Inverter
Capacity control - Type		Controlled	Controlled	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	ı	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
		Black closed-	Black closed-	Black closed-
Insulation material *		cell flexible	cell flexible	cell flexible
		elastomeric foam	elastom eric foam	elastomeric foam
AIR HEAT EXCHANGER				
		Al Fins&Cu	Al Fins&Cu	Al Fins&Cu
Type *		Tubes	Tubes	Tubes
Type *		Axial	Axial	Axial
Drive *	1/0	VFD 7049	VFD	VFD
Nominal air flow	l/s °C	7048 35	8967 35	13402 35
Air Temperature Quantity	No.	2	3	35 4
Speed	rpm	900	800	900
Motor input	kW	1.1	1.2	2.3
CASING		2.12		1.5
Colour *		IW	IW	IW
Material *		GPSS	GPSS	GPSS
Haterial		0133	0, 33	01.33

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				
Туре		Scroll	Scroll	Scroll
Oil charge	1	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)







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.





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- 1. Project Summary
- 2. Energy Efficiency
- 3. DELC Calculation (BREEAM Pol 01)
- 4. TM65 Embodied Carbons
- 5. BES6001 Product Declaration
- 6. Loop by Daikin
- 7. Reclaim with Confidence







PROJECT SUMMARY

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

All information in this report is based on our best understanding of the appropriate legislation at the time of origination. We endeavour to keep this tool in line with current legislative practices. However, we cannot be held responsible for any errors or omissions caused by the use of the information contained within this document.





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.

Ravenscourt Park Hospital Energy Statement Issued

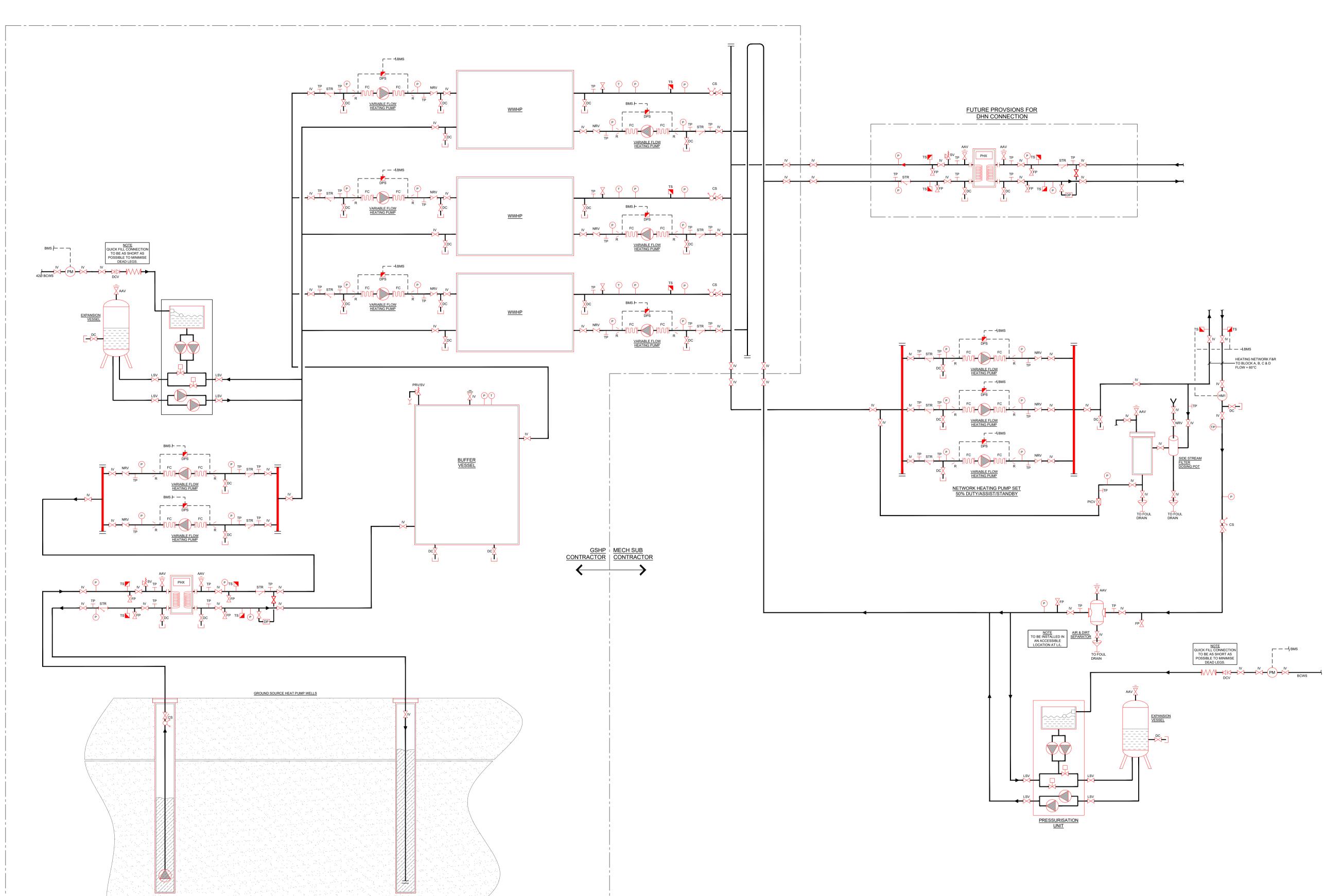


APPENDIX K HEATING SCHEMATIC

Revision: 001

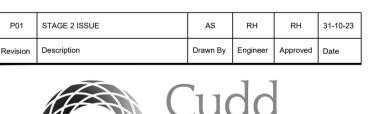
Ref: 6391-CBC-HR-RP-S-003-P01

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NOTES

- THE HEATING SYSTEM DESIGN AND SPECIFICATION SHALL TAKE INTO CONSIDERATION THE FOLLOWING TO INCREASE SYSTEM EFFICIENCIES, REDUCE SYSTEM CAPACITY AND MINIMISE SYSTEM
 CONSTRUCTION.
- 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
- 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.



Consulting

(t) 01344 62 8821 (t) 0121 711 4343 (t) 0203 393 6446 (e) info@cuddbentley.co.uk (e) info@cuddbentley.co.uk (e) info@cuddbentley.co.uk

STAGE 2

TELEREAL TRILLIUM

RAVENSCOURT PARK HOSPITAL HAMMERSMITH

PLANTROOM HEATING SCHEMATIC

Scale	Size	Drawn By	Engineer	Approved	Date			
NTS	A1	AS	RH	RH	OCT'23			
Drawing Referen	nce				Revision			
6391-C	BC-ZZ-	-XX-DR-I	И-50001		P01			

Ravenscourt Park Hospital Energy Statement Issued



APPENDIX L GSHP DETAILS

Revision: 001

Ref: 6391-CBC-HR-RP-S-003-P01

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DYNACIATPOWER TM

Water cooled water chillers

High energy efficiency

Compact and quiet

Scroll compressors

High-efficiency brazed-plate

heat exchangers

CIAT self-adjusting

electronic control





only











Cooling capacity: 200 to 700 kW Heating capacity: 230 to 800 kW

USE

The new generation of DYNACIATPOWER 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

DYNACIATPOWER LG series

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

The design of the DYNACIATPOWER LGP series heat pump range is identical to that of the DYNACIATPOWER 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



DYNACIATPOWER TM

Water cooled water chillers

DESCRIPTION

The DYNACIATPOWER 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.

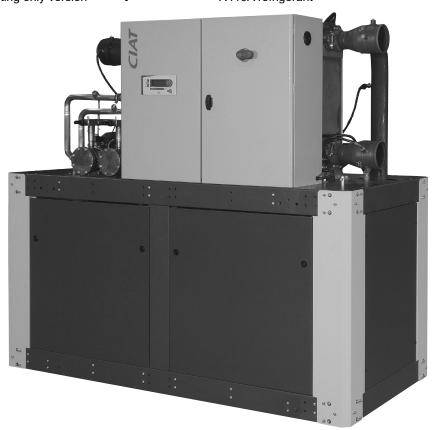
The entire DYNACIATPOWER range complies with the following EC directives and standards:

- 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



DYNACIATPOWER ™

Water cooled water chillers

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 DYNACIATPOWER 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.



DYNACIATPOWER TM

Water cooled water chillers

DESCRIPTION OF THE MAIN COMPONENTS

NBOUND

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

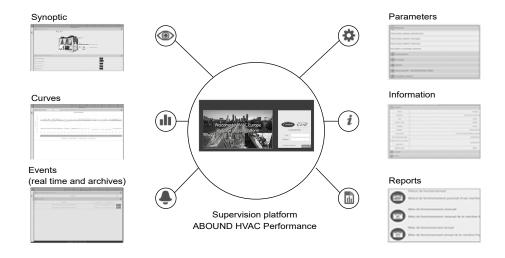


Contents of the box (avalable in 230v and 400v)

- 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)	A
Low Noise version (compressor casing)	A
Xtra Low Noise version (compressor casing with acoustic insulation)	A
Compressor intake shut-off valves	A
Soft start	A
Electrical energy meter	A
Water filter on evaporator and condenser	ı
Phase controller (reversal, loss, asymmetry)	ı
Anti-vibration mounts	1
Flanged connections	ı
Flexible hydraulic couplings on evaporator and condenser	ı
Relay board with dry contacts	ı
LONWORKS/BACNET gateway	1
Outdoor temperature sensor	ı

- 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	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
efficiency**	P _{rated}	kW	246	293	335	384	419	463	530	593	687	795	876
Cooling	,												
Standard unit	Net cooling capacity	kW	203	242	278	320	348	382	439	495	574	651	703
Full load CA1 performances*	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 ₂ Eq	57,42	63,68	68,49	71,41	82,27	88,95	88,74	93,96	129,46	139,9	141,98
Compressor						_							
Туре						Her	metic S	CROLL	- 2900	rpm			
Number			4 6										
Start-up mode							Direct	in line ir	series				
		Number of stages	6	4	6	4	6	4	6	4	6	8	6
Capacity control		%	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				Polyole	ster PO	E 160S	Z (32cP)	Poly	olester	POE 3	MAF (32	2cst)
Oil capacity per circuit		I	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						Braz	zed-plat	e heat e	xchang	er/ 1			
Water capacity		1	20	23	26	29	32	37	50	57	64		7
Hydraulic connection		Ø	VICTA	AULIC E	N100		VICTA	AULIC E	N125		VICT	AULIC E	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 $Cooling\ mode\ conditions:\ evaporator\ water\ inlet/outlet\ temperature\ 12\ ^{\circ}C/7\ ^{\circ}C,\ outdoor\ air\ temperature\ 35\ ^{\circ}C,\ evaporator\ fouling\ mode\ conditions:\ evaporator\ fouling\ mode\ con$

factor 0 m2. k/W

 $\eta s \; heat \; _{30/35^{\circ}C} \; \& \; SCOP \; _{30/35^{\circ}C}$ SEER 12/7°C Values in bold comply with Ecodesign Regulation (EU) No. 813/2013 for Heating applications. Values calculated according to EN14825:2022.

Values in bold comply with Ecodesign Regulation (EU) No. 2015/1095 for Process application

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



SEPR _{-2/-8°C}

Eurovent certified values





TECHNICAL SPECIFICATIONS

DYNACIATPOWER LG		700V	800V	900V	1000V	1100V	1200V	1400V	1600V	1800V	2100V	2400V
Water condenser												
Type/ Number					Braz	ed-plate	e heat e	xchang	er/ 1			
Water capacity	ı	23	26	29	32	37	40	55	61	73	77	77
Hydraulic connection	Ø	VICTA	AULIC E	N100		VICTA	AULIC E	N125		VICTA	AULIC E	N150
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			20	99			24	99		3350	
Width	mm						996					
Height	mm			18	69			18	87		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

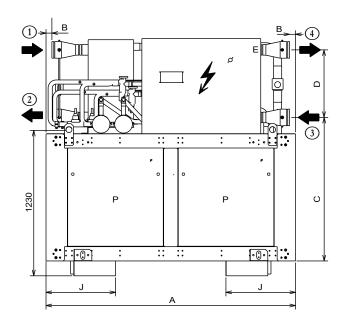
DYNACIATPOWER LG	700V	800V	900V	1000V	1100V	1200V	1400V	1600V	1800V	2100V	2400V		
COMPRESSOR													
Voltage	V		400V - 3Ph - 50Hz (+10/- 10%)										
Maximum nominal current	Α	140	160	182	205	218	232	266	295	356	399	443	
Starting current (1)	Α	316	334	391	414	480	494	586	615	607	720	763	
Starting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

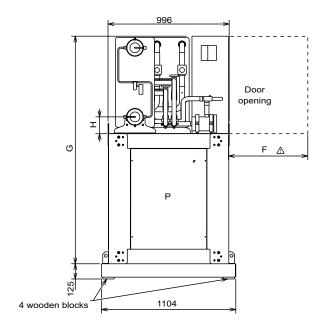
⁽¹⁾ Starting current of largest compressor + maximum current of other compressors under full load Cable selection nominal current = sum of maximum nominal currents in above tables

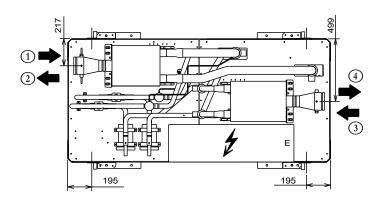


DIMENSIONS

700V to 1600V models







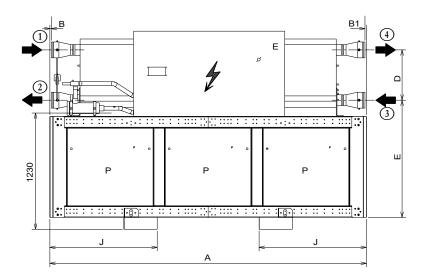
- E Electrical connection on the side
- P Noise insulation panels option

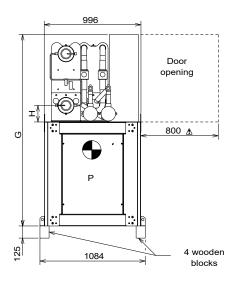
			[Dimensio	ons (mm	Chilled water		Hot water		Weight (kg)							
Models	Α	В	С	D	F	G	н	J	Input 1	Outlet 2	Input 3	Outlet 4	empty	in operation			
700V									\	VICTAULIC DN 100						1044	1088
800V		99 49										VICTAULIC DN 100		1156	1205		
900V	2099		1207	568	1000	1869	137	585		100	Div	100	1189	1246			
1000V	2099		1207	300	1000	1009	137	365					1312	1378			
1100V																1363	1436
1200V										AULIC 125		AULIC 125	1425	1510			
1400V	2499	60	1240	532	600	1887	170	715		517 125		1613		1713			
1600V	2499	- 60	1240	332	000	1007	170	7 15									1708

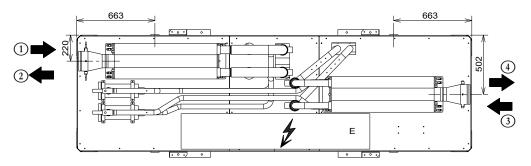


DIMENSIONS

■ 1800V to 2400V models







- E Electrical connection on the side
- P Noise insulation panels option

			ī	Dimensio	ons (mm)	Chilled water		Hot water		Weight (kg)			
Models	A	В	B1	С	D	G	н	J	Input 1	Outlet 2	Input 1	Outlet 2	empty	in operation
1800V		159	63										2284	2472
2100V	3350	3350	15	1240	532	1970	170	1135		AULIC 150	_	AULIC 150	2376	2588
2400V		15	15						511 100				2418	2637