JS LEWIS LTD

Energy and Sustainability Statement

20-24 Tolworth Broadway

Revision A

March 2024

Applicant:	
Date:	March 2024
Report:	Energy and Sustainability Statement – Tolworth Broadway
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EXECUTIVE SUMMARY

The Applicant is seeking planning permission for a new residential development at 20-24 Tolworth Broadway. The proposals are for 9 new apartments at first, second and third floor with supporting landscaping, access and infrastructure. This document, a combined energy and sustainability strategy, forms one of a suite of documents that form a planning application to be submitted to the Royal Borough of Kingston-upon-Thames ("the Council").

The scheme has to address national, regional and local planning policy on energy and sustainability. It also has to address the regulatory framework at the post-planning detailed design stage. This document sets out the energy strategy and the sustainability strategy as required by both the local and the regional planning policy. The strategy put in place makes key commitments to the headline standards.

It should be recognised that as schemes are developed post-planning, some of the details may change as the detailed design considerations are resolved in more depth. Accordingly, any related planning conditions should be worded to allow flexibility in how the details are resolved.

The first section of this report sets out the purpose and scope of the Energy and Sustainability Strategy, the context within which it sits, and the description of development. The second section sets out the planning policy and regulatory framework against which the development will be assessed. This covers national policy, local policy, emerging local policy, national building regulation and emerging national guidance that relates to property developments and policymaking. It identifies the London Plan CO2 reductions as the key headline policy for the development to address, including the need to use the updated SAP 10 CO2 factors. It also sets out the wider sustainability policy framework. Section 3 considers the energy hierarchy, the heating hierarchy, the cooling hierarchy, the energy demand assessment and the CO2 strategy. The CO2 emissions estimates are as follows:

	Regulated residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	1.6	19%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	4.9	60%
Cumulative on site savings	**6.4**	**79%**
Annual savings from off-set payment	1.7	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**51**	-
Cash in-lieu contribution (£)	**4,802**	

Figure 1 - Estimated CO2 Emissions Summary

It is estimated at the planning stage that the scheme achieves significantly higher savings than the required onsite CO2 reduction (35%) through a strategy that incorporates energy efficiency measures, solar PV to the roof, and air source heat pumps for heating and hot water. The exact specification and performance of the energy systems will evolve as the detailed servicing specification is determined at the building control stage. The energy hierarchy has been addressed as follows:

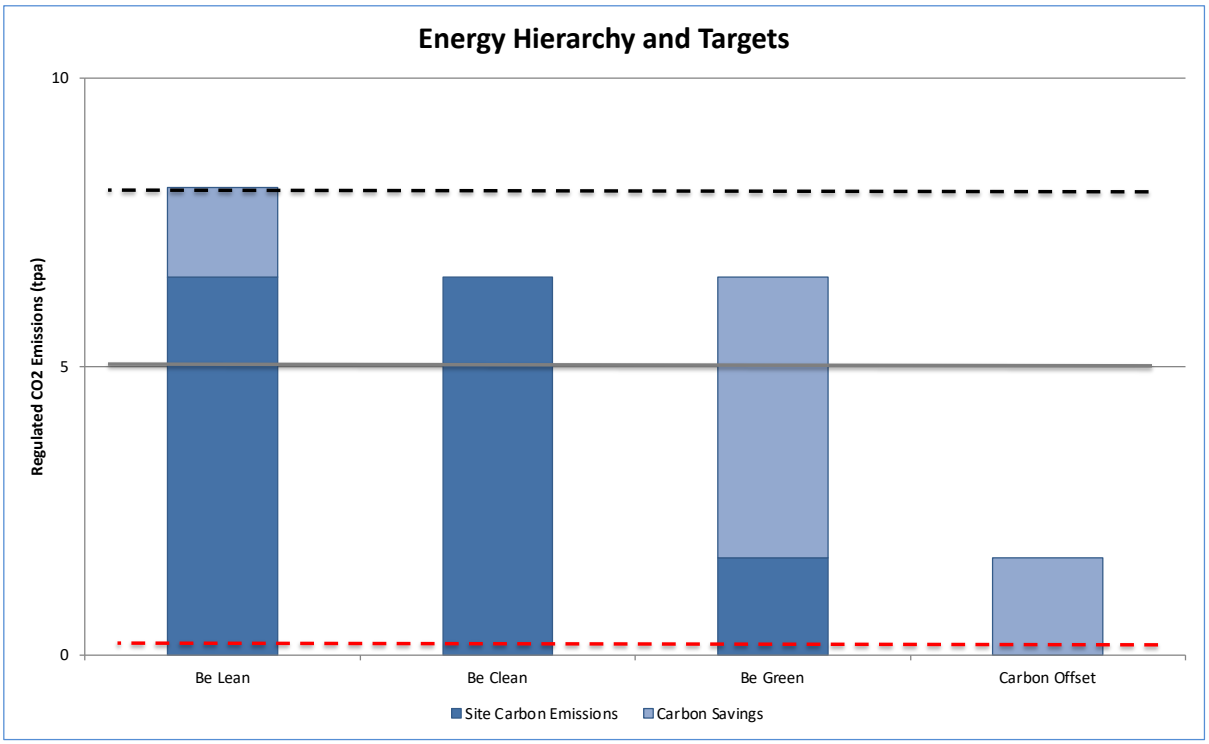

Figure 2 - Energy Hierarchy and Targets

Detailed Stage E engineering will review the options again for suitability. Any selected option will remain policy compliant on CO2 emissions.

The scheme also addresses the 'Be Seen' guidance and matters regarding peak demand and demand-side responses.

The fourth section considers the sustainability strategy for the development. Flood, water conservation, sustainable transport, materials and resource efficiency, waste and ecology are all considered.

The final section sets out the conclusions and recommended standards for the scheme. The client is aiming to deliver a sustainable development that addresses the environmental, social and economic issues in the round. National and local policy have been reviewed and analysed.

Through the provision of this strategy, the proposed development is considered to address the planning policy framework.

1 INTRODUCTION

1.1 Context

The Applicant is seeking planning permission for a new residential development at 20-24 Tolworth Broadway. The proposals are for 9 new apartments at first, second and third floor with supporting landscaping, access and infrastructure. This document, a combined energy and sustainability strategy, forms one of a suite of documents that form a planning application to be submitted to the Royal Borough of Kingston-upon-Thames ("the Council").

The scheme has to address national, regional and the Council's policy on energy and sustainability. It also has to address the regulatory framework at the post-planning detailed design stage. This document sets out the energy strategy and the sustainability strategy as required by both the local and the regional planning policy. The strategy put in place makes key commitments to the headline standards.

1.2 Location and Scheme Description

The proposed development site is 20-24 Tolworth Broadway, Tolworth, KT6 7HL. It sits to the West of the A240 (Tolworth Broadway) and forms part of the commercial area, with retail use already established and retained at ground floor. The proposals look to reconfigure and develop the first, second and third floors to create 9 apartments.

1.3 Report Limitations

It should be recognised that this is a strategic report undertaken at the planning stage. As schemes are developed post-planning, details will inevitably change as the detailed design considerations are resolved in more depth.

Accordingly, any related planning conditions should be worded to allow flexibility in how the details are resolved and should relate to the policy goals. For the reasons above, it is highly recommended that the energy calculations should be revisited post-planning to ensure compliance with the policy aims and with any regulatory requirements.

2 POLICY AND REGULATORY CONTEXT

2.1 National Policy

National Planning Policy Framework (December 2023)

The National Planning Policy Framework sets out a framework for positive growth, making progress in environmental, social and economic areas, and enhancing existing areas. It is a material consideration in planning decisions and reinforces the need for decisions to be determined in accordance with the local plan, unless material considerations indicate otherwise.

The policies throughout the NPPF constitute the government's view of what sustainable development is, and requires the planning process to perform a number of roles:

1. An economic role – building a strong economy, supporting growth and innovation;
2. A social role – supporting communities through providing housing supply, a high-quality built environment, and accessible local services;
3. An environmental role – contributing to natural and built environments, improving biodiversity, using resources prudently, minimizing waste and addressing climate change, including moving to a low carbon economy.

The 2023 National Planning Policy Framework retains a presumption in favour of sustainable development. Section 14 concerns itself with climate change:

158. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-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.

159. *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.

162. 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.

The NPPF sets out the importance of dealing with climate change, and the use renewable energy. Development should be in sustainable locations to reduce CO2 emissions. It notes the need to align local policies with the national timeline for low carbon buildings.

2.2 London Policy

The London Plan (2021)

Policy SI2 reflects the current adopted position on energy and CO2 savings:

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

   1. *Be lean: use less energy and manage demand during construction and operation.*
   2. *Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly. Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.*
   3. *Be green: generate, store and use renewable energy on-site.*
   4. *Be seen: monitor, verify and report on energy performance.*

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

C. *A minimum on-site reduction of at least 35 per cent beyond Building Regulations152 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 relevant 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 be ring-fenced to implement projects that deliver greenhouse gas reductions. The operation of offset funds should be monitored and reported on annually.*

Guidance on Preparation of Energy Strategies (2022)

The 2022 version of this document requires energy strategies to use the updated carbon factors in the new SAP. This means that the electricity aspect of regulated emissions, already small, has become even less substantial. In addition, the guidance clarifies the targets to be sought by all new major developments, summarized below:

- Commit to achieving compliance with Part L through efficiency measures only;
- Demonstrate how residential developments will achieve 35% saving onsite, with 10% from efficiency (noted as not always viable);
- Demonstrate how non-residential developments will achieve 35% saving onsite, with 15% from efficiency (noted as not always viable);
- For free-running buildings, include information regarding how overheating risk has been addressed;
- Demonstrate that connection to existing or planned networks have been prioritized;
- Investigate low carbon and renewable heating plant;
- Investigate low carbon and renewable technology onsite;

- Include information on post-occupancy energy performance monitoring;
- Align documents with the rest of the submission.

Be Seen Energy Monitoring Guidance (September 2021)

This document notes that static energy assessments based upon building regulations alone are not particularly accurate reflections of energy consumption of a building when in use. As a result, it recommends that actual energy use is monitored to help understand and bridge the gap between modelled energy use and actual. Applications are required to provide monitoring data for 'Reportable Units', which include individual buildings, heating and cooling systems and energy centres. At the planning stage, much of the energy demand and carbon emissions information is covered by the information in the GLA reporting spreadsheet. However, non-regulated energy uses should also be estimated applying the principles of CIBSE TM54 where applicable.

2.3 Local Policy - Royal Borough of Kingston-upon-Thames

The Kingston-upon-Thames Core Strategy was adopted in 2012. The key policies relating to Sustainable Development are DM1, DM2 and DM3, each set out below.

Core Strategy Policy DM1

Sustainable Design and Construction Standards

The Council will require all new residential developments to achieve successively higher levels of the Code for Sustainable Homes Level category for energy/CO2 in accordance with the following timeline:

- *Up to 2016: Code for Sustainable Homes Level 4*
- *From 2016: Code for Sustainable Homes Level 6*

Major developments should meet Code level 5 from 2013.

Residential developments are encouraged to meet the other Code for Sustainable Homes Level categories (water, materials, surface water run-off and waste) as well.

Where appropriate, other new build developments over 500m2 including conversions, refurbishments, extensions and changes of use are encouraged to achieve higher levels of the appropriate BREEAM standard in accordance with the following timeline:

- *Until 2013: BREEAM 'Excellent'*
- *From 2013 onwards: BREEAM Outstanding*

Buildings that are undergoing refurbishment or extension, but where the alterations are too small to be assessed under BREEAM are encouraged to comply with the policies for existing buildings set out in the Council's Sustainable Design and Construction SPD.

Where it is not possible to meet the standards, compelling reasons must demonstrate that achieving the sustainability standards outlined in policies DM1 to DM3 would not be technically feasible or economically viable, the Council will negotiate planning contributions with developers to fund other methods to offset the environmental impact of the development. Further guidance on the level of contributions expected will be outlined in the Council's Planning Obligations SPD, or Community Infrastructure Levy charge, in line with Policy IMP3.

New development should minimise air, noise and contaminated land impacts in line with industry best practice. Development proposals for contaminated land should include remediation measures.

Monitoring Emissions

The Council will promote good carbon management by monitoring CO2 emissions to ensure the development is operated within the CO2 emissions standards of the as-built specification and those outlined within the Council's Sustainable Design and Construction SPD. Measures to ensure these standards are maintained will be monitored by the Council.

Core Strategy Policy DM2

Low Carbon Development Independent Renewable Energy Generation

The Council will consider all applications for independent renewable energy installations favourably, subject to other Core Strategy policies.

The development of energy generating infrastructure will be fully encouraged by the Council providing that any opportunities for generating heat simultaneously with power are fully exploited.

District Heating Networks

The Council will seek to develop District Heating Networks in the following areas identified as being suitable for the establishment of a combined heat and power network as outlined in Figure 15:

- *The Hogsmill Valley Area*
- *Kingston Town Centre Tolworth Regeneration Area*

Where relevant, development proposals in these areas should undertake the following when a District Heating Network is:

Not in place – Major developments should undertake a detailed investigation into the feasibility of establishing a District Heating Network with the proposed development as an anchor heat load or contribute towards such feasibility work.

Planned – make all reasonable efforts to ensure the proposed development will be designed to connect to the planned District Heating Network without any major changes to the development. When the network is in place, the development should be connected, unless it can be demonstrated that there is insufficient heating demand for an efficient connection.

Present – connect to the District Heating Network and make all reasonable attempts to connect existing developments in the vicinity to the network, unless it can be demonstrated that connection of existing developments will not result in CO2 savings.

Core Strategy Policy DM3

Designing for Changing Climate

Design proposals should incorporate climate change adaptation measures based on the type and extent of the main changes expected in the local climate throughout the lifetime of the

development, this is likely to require a flexible design that can be adapted to accommodate the changing climate, e.g. provision of additional shading or cooling.

Where relevant, development proposals will need to take into consideration the requirements for climate change adaptation in the following ways:

- *design of streets and siting of buildings*
- *incorporation of green and blue infrastructure*
- *building density*
- *reduction of potable water consumption*

All developments should provide communal or private spaces for residents and the community that:

- *ameliorate the urban heat island effect*
- *provide flooding attenuation if required*
- *increase biodiversity*

Further details on adaptation measures will be provided in the Sustainable Design and Construction SPD.

2.4 Analysis and Interpretation

The scheme is a minor development of 9 residential units that is seeking to address energy and CO2 emissions. The policy body is largely aimed at major developments.

3 ENERGY ASSESSMENT

3.1 Methodology

This chapter explains the methodology for assessing energy demand and CO2 emissions profile and for undertaking options appraisal for low carbon and renewable energy solutions. It provides details of the process of identifying and assessing the likely significant environmental effects of the proposed development.

The content and conclusions of the strategy are based on an assessment of the proposed development identified in Section 1. The building was evaluated using Sap 10.2 software.

3.2 The Energy Hierarchy

The energy hierarchy is a widely accepted principle that provides a framework for energy policy making, helping to bring some logic to how solutions should be prioritised. For London developments it is stated as follows:

- Energy efficiency;
- Clean technology;
- Renewable energy.

3.3 Establishing CO2 Emissions (Business as Usual)

The scheme has been assessed using SAP for representative units for the residential. The baseline emissions are estimated to be as follows:

Table 2: The London Plan Energy Hierarchy		Regulated CO2 Emissions					
		Residential tCO2	Saving %	Non-Resi tCO2	Saving %	Total tCO2	Saving %
Baseline: Part L Compliant	A	8		-		8	

Figure 3 - Business as Usual Emissions Table

3.4 Demand Reduction (Be Lean)

The scheme is inherently energy efficient due to its scale and form, and although this is not recognised in Part L particularly well but is an important consideration. The proposed energy efficient specification for the apartments is as follows:

- Walls – 0.18W/m2K (Part L minimum of 0.3W/m2K)
- Floors – 0.13W/m2K (Part L minimum of 0.25W/m2K)
- Roofs – 0.10W/m2K (Part L minimum of 0.20W/m2K)
- Doors – 1.0W/m2K (Part L minimum of 2.0W/m2K)
- Glazing – 1.2W/m2K (Part L minimum of 2.0W/m2K)
- Air permeability – 3m3/m2/hr (Part L minimum of 10m3/m2/hr)
- LED lighting.

This efficient specification is sufficient for the scheme to exceed Part L and therefore meet the GLA's criteria of securing building control compliance through energy efficiency alone. Other energy saving measures are likely to include:

- Heating controls including:
  - Thermostatic heating controls;
  - Zone controls;

- Extract fans with low specific fan power;
- Energy usage displays;
- Internal clothes drying lines;
- Information on low energy white goods;
- Controlled flow showers and hot taps to reduce hot water consumption.

The emissions savings from energy efficiency are estimated at the planning stage to be:

Table 2: The London Plan Energy Hierarchy		Regulated CO2 Emissions					
		Residential tCO2	Saving %	Non-Resi tCO2	Saving %	Total tCO2	Saving %
Baseline: Part L Compliant	A	8		-		8	
After energy reduction (be lean)	B	7	19%	-	#DIV/0!	7	19%

Figure 4 - Be Lean Emissions Table

3.5 Cooling and Overheating

The cooling hierarchy is set out below together with the scheme responses to it:

- Reduce the amount of heat entering the building:
  - External shading has been incorporated;
  - Low g-value glazing employed to reduce unwanted solar gain.
- Minimize internal heat gain:
  - LED lighting throughout;
  - No communal heating pipe work with associated losses.
- Manage heat within the building:
  - Utilize opportunities for exposed thermal mass with new structure;
  - Night ventilation can be combined with any mechanical ventilation system which can include a summer bypass for free cooling.
- Passive ventilation:
  - Openable windows are provided, although their use is limited for some units in terms of purge ventilation due to the local environmental considerations.
- Mechanical ventilation:
  - This is a requirement for some units fronting the Broadway due to the local conditions;
  - Night ventilation can be combined through the mechanical ventilation system which will include a summer bypass for free cooling.
- Active cooling
  - This would be the last resort if required.

3.6 Heating Infrastructure (Be Clean)

The heating hierarchy is as follows:

1. Connection to an existing or planned heating network;
2. Communal heating system:
   a. Site-wide heat network;
   b. Building level heating system;
3. Individual heating system.

The site sits away from Kingston town centre where there is a planned district heat network that will feed the Cambridge Road Estate Regeneration project using waste heat from the Thames Water

Hogsmill RIver works. The proposed system is a significant distance from the development site, as are the proposed future district networks linking to the Hospital and the town centre. The site itself sits out with any heat priority area.[1]

The location of the development means that there is little value in a communal heating system for the foreseeable future. Therefore, the proposed approach is to provide independent solutions based on heat pumps.

3.7 Renewable Energy (Be Green) and Carbon Offsetting

3.7.1 Heat Pumps

The proposals include for hot water heat pumps throughout as follows:

- Fabric efficiency approach to minimise space heating;
- Air source heat pumps for heating and hot water.

3.7.2 Solar PV

Solar PV will be provided to the roof. The planning stage calculations have assumed 14kWp provision in total. The exact panels would be specified post-planning to ensure that tenders are competitive and that a range of suppliers can be used by the contractor, focusing on high efficiency panels. Further, there may be some refinement as to what proportion of savings is achieved from solar PV and what is achieved through energy efficiency as part of the optimization process.

The GLA table with the final carbon savings to be as follows:

Table 2: The London Plan Energy Hierarchy		Regulated CO2 Emissions					
		Residential tCO2	Saving %	Non-Resi tCO2	Saving %	Total tCO2	Saving %
Baseline: Part L Compliant	A	8		-		8	
After energy reduction (be lean)	B	7	19%	-	#DIV/0!	7	19%
After heat network (be clean)	C	7	0%	-	#DIV/0!	7	0%
After renewable energy (be green)	D	2	74%	-	#DIV/0!	2	74%

Figure 5 - Be Green Emissions Table

Table 3: The London Plan Energy Hierarchy SAP 10 factors		Regulated CO2 Emissions			
		Residential tCO2	Non-Resi tCO2	Total tCO2	(%)
Be lean: savings from energy demand reduction	A-B	2	-	2	19%
Be clean: savings from heat network	B-C	-	-	-	0%
Be green: savings from renewable energy	C-D	5	-	5	60%
Cumulative on-site savings	A-D =E	6	-	6	79%
Carbon shortfall	A-E = F	2	-	2	21%
Cumulative savings for offset payment		51	-	51	
Cash-in-lieu contribution (£95/tCO2)		£ 4,802	£ -	4,802	

Figure 6 - Emissions Summary and Carbon Offset Calculation

[1] https://maps.london.gov.uk/heatmap/

3.8 Other Renewable Energy Technologies

The London Plan sets a target of 20% renewable energy where feasible. This policy was originally the key energy policy in the London Plan in 2008 but has been increasingly ignored in favour of the overall CO2 targets set.

3.8.1 Biomass

Biomass and biomass CHP bring significant logistical issues in terms of fuel supply that are not compatible with the Site. There is a range of technical hurdles that the site would struggle to overcome. Neither are considered viable.

3.8.2 Solar Thermal

The scheme has limited roof space and PV is more effective in terms of CO2 per sqm saved. Solar thermal is not applicable.

3.8.3 Wind Power

Wind power is generally not suitable for the urban environment.

3.9 Energy Monitoring (Be Seen)

The 'Be Seen' planning stage inputs are provided separately in the required spreadsheet.

3.10 Peak Energy and Demand-Side Responses

Dialogue with the DNO will commence at Stage E when detailed design of the services systems commences. The opportunities for peak load management and flexibility available to these proposals are as follows:

1. Hot water storage through hot water cylinder capacity to each dwelling, allowing hot water demands to be managed;
2. Hot water from heat pumps which allows for switching down for short periods of time at peak demand;
3. The case for incorporating an onsite battery to provide grid services has been considered. At this stage, the density of development and competing demands for space render this as unlikely. This will be kept under review.
4. As a follow-up point to this, a micro-grid is less viable when not providing grid services. More realistic options for demand side response involve the promotion of smart utility offerings such as Octopus Energy's 'Agile' tariff.

3.11 Energy Strategy Summary

The proposed energy strategy comprises the following:

1. Energy efficiency measures for both fabric and fittings;
2. Solar control through layout/orientation;
3. Air source heat pumps for heating and hot water provision;
4. Solar PV integrated throughout.

4 ENVIRONMENTAL SUSTAINABILITY

4.1 Water

Water efficient specifications for internal water use are required by building regulations. All residential units are likely to incorporate measures to achieve a consumption of 105lpppd or less. This is likely to include measures such as efficient kitchen taps with hydro-brakes, ergonomic baths, shower flow rates of 8-9litres per minute. Rainwater is also to be harvested for irrigation of communal landscaping where appropriate. An exact specification will be required at the building control stage. At this stage an indicative specification that achieves 105lpppd would be as follows:

Installation Type	Average Capacity/Flow Rate	Litres/Person/Day
Single Flush WC's	0	0
Dual Flush WC's	3.06	13.53
All WC's	3.06	13.53
Kitchen/Utility Room Taps	4	12.12
Other Taps	4	7.9
Baths	140	15.4
Showers	9	39.33
Dishwashers	1.25	4.5
Washing Machines	8.17	17.16
Water Softener		
Waste Disposal Unit	Not Present	0
Total Water Use	109.94 Litres/Person/Day	
Contribution from Rain Water	0 Litres/Person/Day	
Contribution from Grey Water	0 Litres/Person/Day	
Normalisation Factor	0.91 Litres/Person/Day	

Code for Sustainable Homes - Consumptions & Credits	
Water Consumption (Code for Sustainable Homes)	100 Litres/Person/Day
Credits Scored	3

Building Regulations 2000 AD Part G (2010 Ed) - Consumption	
External Water Use	5 Litres/Person/Day
Water Consumption (Building Regulation 17 K)	105 Litres/Person/Day

4.2 Sustainable Transport

The Site is located with access to local facilities including bus stops, local shopping offerings, and good access to green amenity space. Cycle storage is provided at ground floor level for the apartments. The residential units will incorporate facilities for home office working. This will include appropriate services including phone line connections, broadband and power sockets.

4.3 Materials and Resource Efficiency

Materials resource efficiency will be achieved through the scale of development, which by its very nature should achieve high materials efficiencies and low waste volumes. Certified timber such as FSC and PEFC is widely available and commonly used throughout major development schemes.

4.4 Waste Strategy

A waste management plan will be put in place to reduce site waste generation typically using some or all of the following:

1. Identification of pre-requisites for waste contractors and sub-contractors;
2. Identification of key parties and individuals responsible for waste monitoring and management (main contractor, waste sub-contractors);

3. Identification of appropriate benchmarks for waste generation/recycling including the use of appropriate tools for generating suitable benchmarks for the development such as;
    a. WRAP Net Waste Tool;
    b. BRE SMART Waste;
4. Identification of processes for dealing with different waste streams;
5. Processes for monitoring total waste arisings, proportion reused onsite, proportion recycled offsite, proportion sent to landfill;
6. Reporting mechanisms to capture the waste management data.

During occupation, all units will be provided with waste segregation and recycling both internally and externally to the local authority standards. This will incorporate:

- Internal waste segregation into the waste streams collected locally;
- External segregation providing bin stores for the streams as above.

Residents will be provided with information on the local recycling collections.

4.5 Ecology and Biodiversity

The site is in a highly urban site, currently built upon and of limited ecological value. The proposals could incorporate limited areas of planting to improve the biodiversity and also to reduce run-off rates and albedo values. Micro habitats could also be incorporated into the build.

4.6 Urban Heat Island

The scheme will mitigate its impacts upon the urban heat island effect through the following measures:

- Use of heat pumps to extract heat from the local air to provide heating and hot water;
- An increased area of green and blue infrastructure provision;
- Light coloured finishes to increase albedo where appropriate.

4.7 Pollution

There is no gas boiler provision proposed, minimising NOx emissions. Light pollution will be designed out as far as possible. Noise and air quality are addressed in separate reports in support of the application.

5 CONCLUSION

5.1 Sustainable Development

The NPPF sets out clearly the three key elements to a sustainable development:

1. An economic role – building a strong economy, supporting growth and innovation;
2. A social role – supporting communities through providing housing supply, a high-quality built environment, and accessible local services;
3. An environmental role – contributing to natural and built environments, improving biodiversity, using resources prudently, minimizing waste and addressing climate change, including moving to a low carbon economy.

5.2 Social and Economic Sustainability

The proposals have the potential to bring significant economic and social benefits including the following:

1. Creation of 9 new energy efficient, low carbon dwellings;
2. Provision of construction jobs;
3. Provision of maintenance roles during operational phase;
4. Job creation for ongoing maintenance and management considerations;
5. Taxes derived from residential units.

5.3 Environmental Sustainability

The Site has been assessed at the planning stage, and with the proposed strategy is estimated to achieve the following:

- Energy and CO2
  - Energy efficiency savings;
  - Solar control through layout/orientation and fenestration;
  - Heat pumps for efficient heating and hot water provision;
  - Substantial CO2 savings onsite;
  - Substantial renewable electricity solar PV.
- Transport;
  - Provision of cycle storage ground floor;
  - Home working facilitated.
- Water
  - No impact on the flood plain;
  - Efficient water fittings to reduce demand for water.
- Waste and materials
  - Waste and recycling management procedures during construction;
  - Waste and recycling provision in line with local standards for operation;
  - Resource efficiency for the new building.
- Biodiversity
  - Planting areas incorporated;
  - Potential for micro-habitats.

It should be recognised that as schemes are developed post-planning, details will change as the detailed design considerations are resolved in more depth. Furthermore, at the point of publication there were various outstanding technical issues with the analysis software used for the assessment. Accordingly, any related planning conditions should be worded to allow flexibility in how the details are resolved and should relate to the policy ambitions rather than specific percentages set out in this report.

A summary of the energy and CO2 position is as follows:

Table 3: The London Plan Energy Hierarchy SAP 10 factors		Regulated CO2 Emissions			
		Residential tCO2	Non-Resi tCO2	Total tCO2	(%)
Be lean: savings from energy demand reduction	A-B	2	-	2	19%
Be clean: savings from heat network	B-C	-	-	-	0%
Be green: savings from renewable energy	C-D	5	-	5	60%
Cumulative on-site savings	A-D =E	6	-	6	79%
Carbon shortfall	A-E = F	2	-	2	21%
Cumulative savings for offset payment		51	-	51	
Cash-in-lieu contribution (£95/tCO2)		£ 4,802	£ -	4,802	

Figure 7 - Summary of CO2 Performance

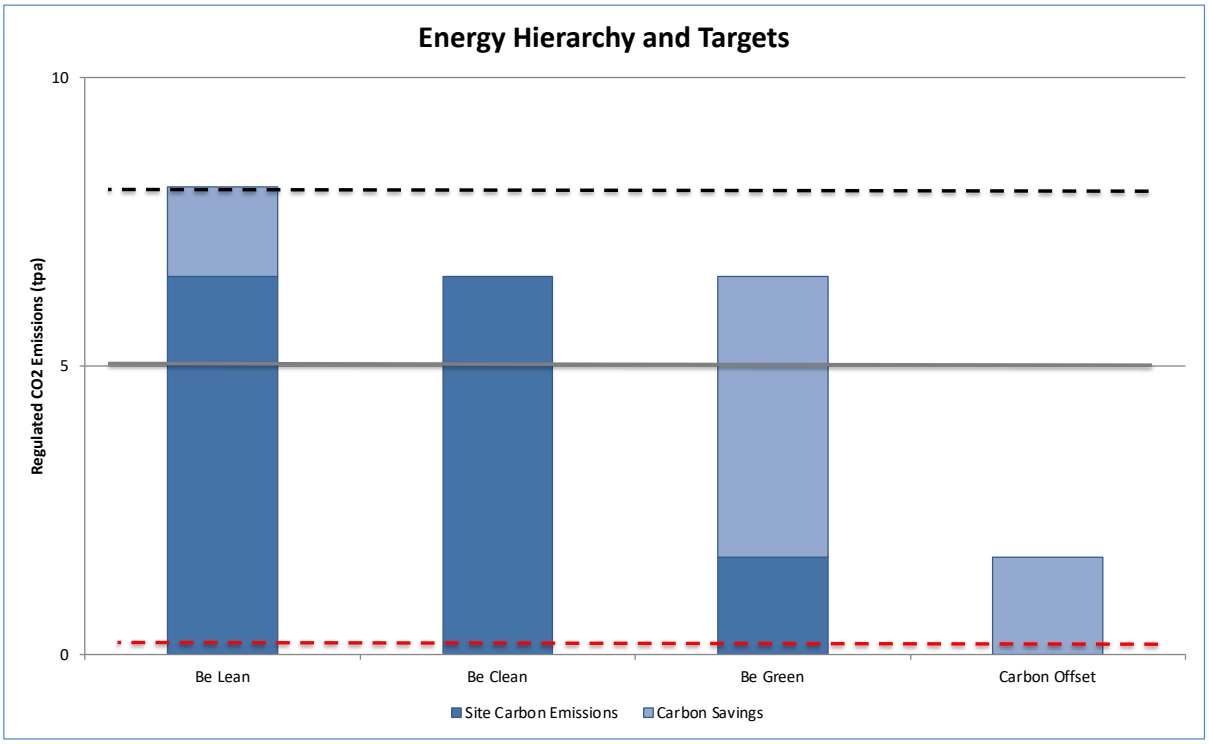

Figure 8 - Energy Hierarchy and Targets

5.4 Statement of Policy Compliance

In the development of the proposals, the design team has reviewed, interpreted and addressed the relevant planning policy on energy and CO2 emissions and sustainable development. The proposals have reviewed early-stage opportunities for efficiency and clean and renewable energy technology. It is compliant with the following documents:

The National Planning Policy Framework (Dec 2023)

The London Plan (2021)

The Mayor's Guidance on Preparing Energy Strategies (2022)

The Mayor's Guidance on 'Be Seen' (2022)

RBK Adopted Core Strategy (2012)

APPENDIX 1 - DER AND TER SHEETS

Full SAP Calculation Printout

Property Reference	Unit 03	**Issued on Date**	29/02/2024
Assessment Reference	Unit 03 Gas EE	**Prop Type Ref**	Unit 03
Property	Tolworth Broadway, 3		

SAP Rating	84 B	**DER**	13.49	**TER**	14.48
Environmental	90 B	**% DER < TER**			6.84
CO_2 Emissions (t/year)	0.71	**DFEE**	30.43	**TFEE**	33.60
Compliance Check	See BREL	**% DFEE < TFEE**			9.46
% DPER < TPER	-1.26	**DPER**	77.99	**TPER**	77.02

Assessor Details	Mr. Jonathan Lewis	**Assessor ID**	AZ32-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	57.0000	(1b)	x 2.5000	(2b) =	142.5000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.0000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		142.5000	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.2000 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

Effective ac	0.3117	0.3075	0.3033	0.2820	0.2777	0.2565	0.2565	0.2522	0.2650	0.2777	0.2863	0.2947	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			14.9000	1.1450	17.0611			(27)
Solid Door			2.1000	1.5000	3.1500			(26)
Heatloss Floor 1			57.0000	0.0600	3.4200			(28a)
External Wall 1	52.0000	14.9000	37.1000	0.1800	6.6780			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	0.1000		0.1000	0.1200	0.0120			(30)
Total net area of external elements Aum(A, m2)			119.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.7431			(33)
Party Ceiling 1			76.0000					(32b)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	7.0000	0.0410	0.2870
E3 Sill	7.0000	0.0460	0.3220

E4 Jamb	13.0000	0.0470	0.6110	
E5 Ground floor (normal)	0.0000	0.0710	0.0000	
E16 Corner (normal)	10.0000	0.0320	0.3200	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000	
E7 Party floor between dwellings (in blocks of flats)	34.0000	0.0490	1.6660	
E18 Party wall between dwellings	0.0000	0.0340	0.0000	
E14 Flat roof	0.0000	0.0400	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 3.2060 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 34.9491 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	14.6600	14.4602	14.2603	13.2611	13.0612	12.0619	12.0619	11.8621	12.4616	13.0612	13.4609	13.8606	(38)
Heat transfer coeff	49.6091	49.4093	49.2094	48.2101	48.0103	47.0110	47.0110	46.8111	47.4107	48.0103	48.4100	48.8097	(39)
Average = Sum(39)m / 12 =												48.1602	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8703	0.8668	0.8633	0.8458	0.8423	0.8248	0.8248	0.8212	0.8318	0.8423	0.8493	0.8563	(40)
HLP (average)												0.8449	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.8957 (42)
Hot water usage for mixer showers

63.0042	62.0574	60.6776	58.0378	56.0897	53.9171	52.6822	54.0515	55.5525	57.8852	60.5817	62.7628	(42a)

Hot water usage for baths

24.2067	23.8472	23.3409	22.4075	21.7085	20.9335	20.5149	21.0176	21.5649	22.3942	23.3469	24.1248	(42b)

Hot water usage for other uses

34.0436	32.8056	31.5677	30.3297	29.0918	27.8538	27.8538	29.0918	30.3297	31.5677	32.8056	34.0436	(42c)

Average daily hot water use (litres/day) 111.4798 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	121.2544	118.7101	115.5862	110.7750	106.8900	102.7044	101.0509	104.1609	107.4472	111.8471	116.7342	120.9312	(44)
Energy conte	192.0374	169.0417	177.6517	151.6454	143.8944	126.2871	122.2123	128.9729	132.4931	151.7754	166.3093	189.3490	(45)
Energy content (annual)										Total = Sum(45)m =		1851.6698	

Distribution loss (46)m = 0.15 x (45)m

28.8056	25.3562	26.6478	22.7468	21.5842	18.9431	18.3319	19.3459	19.8740	22.7663	24.9464	28.4024	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	25.5572	23.0721	25.5225	24.6584	25.4542	24.6075	25.4131	25.4273	24.6232	25.4741	24.6919	25.5520	(61)

Total heat required for water heating calculated for each month

217.5946	192.1138	203.1743	176.3038	169.3486	150.8946	147.6254	154.4002	157.1163	177.2495	191.0012	214.9010	(62)

WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

217.5946	192.1138	203.1743	176.3038	169.3486	150.8946	147.6254	154.4002	157.1163	177.2495	191.0012	214.9010	(64)
									Total per year (kWh/year) = Sum(64)m =		2151.7233	(64)
12Total per year (kWh/year)											2152	(64)

Electric shower(s)

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

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

Heat gains from water heating, kWh/month

70.2417	61.9744	65.4498	56.5867	54.2084	48.1423	46.9889	49.2403	50.2098	56.8338	61.4708	69.3466	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	83.3863	92.3205	83.3863	86.1658	83.3863	86.1658	83.3863	83.3863	86.1658	83.3863	86.1658	83.3863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	165.3227	167.0382	162.7151	153.5118	141.8942	130.9753	123.6809	121.9653	126.2884	135.4918	147.1093	158.0282	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	(71)
Water heating gains (Table 5)	94.4109	92.2238	87.9702	78.5926	72.8608	66.8643	63.1571	66.1832	69.7358	76.3896	85.3761	93.2077	(72)
Total internal gains	397.5550	406.0176	388.5067	372.7053	352.5764	335.4406	321.6593	322.9699	333.6251	349.7027	373.0864	389.0573	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6000	11.2829	0.6300	0.7000	0.7700	8.9654	(75)
South	9.7000	46.7521	0.6300	0.7000	0.7700	138.5940	(78)
Southwest	2.6000	36.7938	0.6300	0.7000	0.7700	29.2362	(79)

Solar gains	176.7955	295.0304	390.1516	465.2082	507.6773	498.9754	483.0956	451.6111	415.8780	322.1621	210.5800	152.0996	(83)
Total gains	574.3505	701.0480	778.6583	837.9135	860.2537	834.4160	804.7549	774.5811	749.5031	671.8649	583.6664	541.1569	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.9162	32.0453	32.1754	32.8423	32.9791	33.6801	33.6801	33.8239	33.3961	32.9791	32.7068	32.4389	
alpha	3.1277	3.1364	3.1450	3.1895	3.1986	3.2453	3.2453	3.2549	3.2264	3.1986	3.1805	3.1626	
util living area													
	0.8749	0.8038	0.7246	0.6108	0.4863	0.3520	0.2547	0.2749	0.4190	0.6395	0.8118	0.8890	(86)
MIT	20.3824	20.4760	20.5586	20.6393	20.6834	20.7085	20.7138	20.7141	20.7009	20.6419	20.5113	20.3709	(87)
Th 2	20.1928	20.1958	20.1988	20.2138	20.2168	20.2319	20.2319	20.2350	20.2259	20.2168	20.2108	20.2048	(88)
util rest of house													
	0.8618	0.7859	0.7016	0.5817	0.4512	0.3120	0.2111	0.2302	0.3762	0.6055	0.7916	0.8771	(89)
MIT 2	19.4416	19.5579	19.6597	19.7683	19.8201	19.8614	19.8660	19.8696	19.8480	19.7763	19.6175	19.4390	(90)
Living area fraction										fLA = Living area / (4) =		0.4737	(91)
MIT	19.8872	19.9928	20.0855	20.1809	20.2290	20.2627	20.2676	20.2696	20.2520	20.1863	20.0409	19.8804	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.7372	19.8428	19.9355	20.0309	20.0790	20.1127	20.1176	20.1196	20.1020	20.0363	19.8909	19.7304	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8537	0.7775	0.6935	0.5747	0.4448	0.3057	0.2045	0.2234	0.3691	0.5973	0.7828	0.8693	(94)
Useful gains	490.3428	545.0652	540.0220	481.5243	382.6402	255.1100	164.5900	173.0701	276.6684	401.3186	456.8781	470.4408	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	765.8279	738.3123	661.1506	536.6211	402.2793	259.1561	165.3641	174.1199	284.5583	453.0399	619.2056	758.0344	(97)
Space heating kWh													
	204.9609	129.8621	90.1196	39.6697	14.6115	0.0000	0.0000	0.0000	0.0000	38.4806	116.8758	213.9697	(98a)
Space heating requirement - total per year (kWh/year)												848.5500	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	204.9609	129.8621	90.1196	39.6697	14.6115	0.0000	0.0000	0.0000	0.0000	38.4806	116.8758	213.9697	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												848.5500	
Space heating per m2											(98c) / (4) =	14.8868	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	441.9032	347.8813	355.7645	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9521	0.9719	0.9672	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	420.7243	338.1050	344.0982	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	938.1075	905.4641	871.1891	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	372.5159	422.1152	392.1556	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.2456	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	116.0028	131.4481	122.1186	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												369.5695	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.2000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												4.0000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	204.9609	129.8621	90.1196	39.6697	14.6115	0.0000	0.0000	0.0000	0.0000	38.4806	116.8758	213.9697	(98)
Space heating efficiency (main heating system 1)													
	89.2000	89.2000	89.2000	89.2000	89.2000	0.0000	0.0000	0.0000	0.0000	89.2000	89.2000	89.2000	(210)
Space heating fuel (main heating system)													
	229.7768	145.5853	101.0310	44.4728	16.3806	0.0000	0.0000	0.0000	0.0000	43.1397	131.0267	239.8763	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	217.5946	192.1138	203.1743	176.3038	169.3486	150.8946	147.6254	154.4002	157.1163	177.2495	191.0012	214.9010	(64)
Efficiency of water heater												87.2000	(216)
(217)m	88.1588	87.9958	87.8049	87.5606	87.3556	87.2000	87.2000	87.2000	87.2000	87.5501	87.9486	88.1865	(217)
Fuel for water heating, kWh/month													
	246.8212	218.3216	231.3928	201.3506	193.8613	173.0442	169.2952	177.0645	180.1793	202.4548	217.1737	243.6893	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	29.0007	32.8620	30.5297	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	14.9378	13.4922	14.9378	14.4559	14.9378	14.4559	14.9378	14.9378	14.4559	14.9378	14.4559	14.9378	(231)
Lighting	16.1220	12.9336	11.6453	8.5319	6.5902	5.3843	6.0118	7.8144	10.1502	13.3176	15.0422	16.5700	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													

(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	951.2892	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.2000	
Water heating fuel used	2454.6485	(219)
Space cooling fuel	92.3924	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5170)		
mechanical ventilation fans (SFP = 0.5170)	89.8804	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	175.8804	(231)
Electricity for lighting (calculated in Appendix L)	130.1135	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3804.3240	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	951.2892	0.2100	199.7707	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2454.6485	0.2100	515.4762	(264)
Space and water heating			715.2469	(265)
Space cooling	92.3924	0.1142	10.5471	(266)
Pumps, fans and electric keep-hot	175.8804	0.1387	24.3968	(267)
Energy for lighting	130.1135	0.1443	18.7794	(268)
Total CO2, kg/year			768.9702	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.4900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	951.2892	1.1300	1074.9568	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2454.6485	1.1300	2773.7528	(278)
Space and water heating			3848.7096	(279)
Space cooling	92.3924	1.4207	131.2639	(280)
Pumps, fans and electric keep-hot	175.8804	1.5128	266.0719	(281)
Energy for lighting	130.1135	1.5338	199.5724	(282)
Total Primary energy kWh/year			4445.6178	(286)
Dwelling Primary energy Rate (DPER)			77.9900	(287)

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		57.0000 (1b)	x	2.5000 (2b)	=	142.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.5000	(5)

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2. Ventilation rate

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	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1404 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3904 (18)

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3318 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4230	0.4147	0.4065	0.3650	0.3567	0.3152	0.3152	0.3069	0.3318	0.3567	0.3733	0.3899	(22b)
Effective ac	0.5895	0.5860	0.5826	0.5666	0.5636	0.5497	0.5497	0.5471	0.5550	0.5636	0.5697	0.5760	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			12.1500	1.1450	13.9122			(27)
Heatloss Floor 1			57.0000	0.1300	7.4100			(28a)
External Wall 1	52.0000	12.1500	39.8500	0.1800	7.1730			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	0.1000		0.1000	0.1100	0.0110			(30)
Total net area of external elements Aum(A, m2)			119.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.0282			(33)

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

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	7.0000	0.0500	0.3500
E3	Sill	7.0000	0.0500	0.3500
E4	Jamb	13.0000	0.0500	0.6500
E5	Ground floor (normal)	0.0000	0.1600	0.0000
E16	Corner (normal)	10.0000	0.0900	0.9000
E17	Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000
E7	Party floor between dwellings (in blocks of flats)	34.0000	0.0700	2.3800
E18	Party wall between dwellings	0.0000	0.0600	0.0000
E14	Flat roof	0.0000	0.0800	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.6300 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 36.6582 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7204	27.5570	27.3969	26.6446	26.5038	25.8486	25.8486	25.7273	26.1010	26.5038	26.7886	27.0862	(38)
Heat transfer coeff	64.3786	64.2152	64.0551	63.3028	63.1620	62.5068	62.5068	62.3855	62.7592	63.1620	63.4468	63.7445	(39)
Average = Sum(39)m / 12 =												63.3021	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1294	1.1266	1.1238	1.1106	1.1081	1.0966	1.0966	1.0945	1.1010	1.1081	1.1131	1.1183	(40)
HLP (average)												1.1106	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.8957 (42)
Hot water usage for mixer showers

56.0037	55.1621	53.9357	51.5892	49.8575	47.9263	46.8287	48.0458	49.3800	51.4535	53.8504	55.7892	(42a)

Hot water usage for baths

24.2067	23.8472	23.3409	22.4075	21.7085	20.9335	20.5149	21.0176	21.5649	22.3942	23.3469	24.1248	(42b)

Hot water usage for other uses

34.0436	32.8056	31.5677	30.3297	29.0918	27.8538	27.8538	29.0918	30.3297	31.5677	32.8056	34.0436	(42c)

Average daily hot water use (litres/day) 105.0257 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.2540	111.8149	108.8443	104.3263	100.6578	96.7136	95.1973	98.1551	101.2747	105.4154	110.0029	113.9576	(44)
Energy conte	180.9503	159.2229	167.2896	142.8176	135.5047	118.9207	115.1329	121.5366	124.8818	143.0477	156.7193	178.4300	(45)
Energy content (annual)										Total = Sum(45)m =		1744.4541	
Distribution loss (46)m = 0.15 x (45)m	27.1426	23.8834	25.0934	21.4226	20.3257	17.8381	17.2699	18.2305	18.7323	21.4572	23.5079	26.7645	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	47.6944	48.5115	50.0188	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	231.9092	205.2503	218.2485	192.1326	186.4636	166.6151	163.6445	171.5554	174.1969	194.0066	206.0344	229.3889	(62)
WWHRS	-25.6026	-22.6431	-23.7106	-19.6333	-18.2975	-15.6573	-14.6762	-15.6067	-16.1997	-19.0976	-21.6353	-25.1284	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	206.3067	182.6072	194.5379	172.4993	168.1661	150.9578	148.9682	155.9486	157.9972	174.9090	184.3991	204.2604	(64)
										Total per year (kWh/year) = Sum(64)m =		2101.5576	(64)
12Total per year (kWh/year)												2102	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	72.9057	64.4485	68.3635	59.8156	57.7950	51.4647	50.4096	52.9156	53.8520	60.3031	64.4379	72.0677	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	(66)

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

	83.5347	92.4849	83.5347	86.3192	83.5347	86.3192	83.5347	83.5347	86.3192	83.5347	86.3192	83.5347	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	165.3227	167.0382	162.7151	153.5118	141.8942	130.9753	123.6809	121.9653	126.2884	135.4918	147.1093	158.0282	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	(71)
Water heating gains (Table 5)													
	97.9916	95.9055	91.8864	83.0772	77.6815	71.4788	67.7548	71.1231	74.7944	81.0525	89.4971	96.8652	(72)
Total internal gains													
	401.2840	409.8636	392.5713	377.3433	357.5455	340.2084	326.4055	328.0583	338.8371	354.5141	377.3607	392.8632	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1200	11.2829	0.6300	0.7000	0.7700	7.3102	(75)
South	7.9100	46.7521	0.6300	0.7000	0.7700	113.0184	(78)
Southwest	2.1200	36.7938	0.6300	0.7000	0.7700	23.8387	(79)

Solar gains	144.1673	240.5813	318.1466	379.3495	413.9792	406.8828	393.9341	368.2614	339.1244	262.7055	171.7167	124.0291	(83)
Total gains	545.4513	650.4449	710.7179	756.6928	771.5247	747.0913	720.3396	696.3197	677.9615	617.2196	549.0775	516.8923	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.5941	24.6567	24.7183	25.0121	25.0678	25.3306	25.3306	25.3798	25.2287	25.0678	24.9553	24.8388	
alpha	2.6396	2.6438	2.6479	2.6675	2.6712	2.6887	2.6887	2.6920	2.6819	2.6712	2.6637	2.6559	
util living area													
	0.9102	0.8664	0.8145	0.7317	0.6227	0.4839	0.3636	0.3890	0.5529	0.7499	0.8703	0.9197	(86)
MIT	18.9151	19.3036	19.7367	20.2301	20.6116	20.8597	20.9521	20.9412	20.7882	20.2955	19.5358	18.8457	(87)
Th 2	19.9769	19.9792	19.9815	19.9922	19.9942	20.0036	20.0036	20.0053	20.0000	19.9942	19.9901	19.9859	(88)
util rest of house													
	0.8987	0.8502	0.7922	0.6996	0.5769	0.4211	0.2874	0.3124	0.4913	0.7131	0.8519	0.9091	(89)
MIT 2	17.5768	18.0571	18.5893	19.1880	19.6270	19.8954	19.9769	19.9708	19.8263	19.2805	18.3622	17.4964	(90)
Living area fraction										fLA = Living area / (4) =		0.4737	(91)
MIT	18.2107	18.6475	19.1328	19.6817	20.0934	20.3522	20.4388	20.4304	20.2819	19.7613	18.9181	18.1356	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2107	18.6475	19.1328	19.6817	20.0934	20.3522	20.4388	20.4304	20.2819	19.7613	18.9181	18.1356	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8736	0.8252	0.7711	0.6888	0.5816	0.4438	0.3213	0.3459	0.5094	0.7037	0.8285	0.8848	(94)
Useful gains	476.5018	536.7329	548.0511	521.2291	448.7341	331.5585	231.4775	240.8429	345.3750	434.3568	454.9085	457.3715	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	895.5532	882.8005	809.1979	682.5087	530.1448	359.5494	239.9528	251.4411	387.9740	578.6465	749.8219	888.3162	(97)
Space heating kWh													
	311.7743	232.5575	194.2932	116.1213	60.5696	0.0000	0.0000	0.0000	0.0000	107.3515	212.3377	320.6228	(98a)
Space heating requirement - total per year (kWh/year)												1555.6278	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	311.7743	232.5575	194.2932	116.1213	60.5696	0.0000	0.0000	0.0000	0.0000	107.3515	212.3377	320.6228	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1555.6278	
Space heating per m2											(98c) / (4) =	27.2917	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	311.7743	232.5575	194.2932	116.1213	60.5696	0.0000	0.0000	0.0000	0.0000	107.3515	212.3377	320.6228	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	337.4181	251.6856	210.2740	125.6724	65.5515	0.0000	0.0000	0.0000	0.0000	116.1813	229.8027	346.9944	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	206.3067	182.6072	194.5379	172.4993	168.1661	150.9578	148.9682	155.9486	157.9972	174.9090	184.3991	204.2604	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.2637	84.9006	84.3787	83.5519	82.4111	80.3000	80.3000	80.3000	80.3000	83.3673	84.6846	85.3431	(217)
Fuel for water heating, kWh/month													
	241.9632	215.0834	230.5532	206.4577	204.0576	187.9923	185.5146	194.2075	196.7586	209.8053	217.7482	239.3403	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)

Lighting	17.3569	13.9243	12.5373	9.1854	7.0950	5.7967	6.4723	8.4130	10.9276	14.3377	16.1943	17.8393	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-15.3786	-22.8425	-34.5784	-41.0229	-46.1398	-43.7829	-43.2643	-39.9019	-34.2977	-27.0646	-17.3195	-13.1647	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.4862	-11.7999	-23.9376	-36.6686	-49.1834	-49.6591	-49.0599	-41.2060	-29.7786	-17.0916	-7.3951	-4.3183	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1683.5798	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2529.4821	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	140.0798	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-704.3420	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3734.7998	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1683.5798	0.2100	353.5518	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2529.4821	0.2100	531.1912	(264)
Space and water heating			884.7430	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	140.0798	0.1443	20.2178	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-378.7577	0.1335	-50.5602	
PV Unit electricity exported	-325.5842	0.1253	-40.8056	
Total			-91.3658	(269)
Total CO2, kg/year			825.5243	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.4800	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1683.5798	1.1300	1902.4452	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2529.4821	1.1300	2858.3148	(278)
Space and water heating			4760.7600	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	140.0798	1.5338	214.8591	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-378.7577	1.4933	-565.5961	
PV Unit electricity exported	-325.5842	0.4600	-149.7760	
Total			-715.3721	(283)
Total Primary energy kWh/year			4390.3479	(286)
Target Primary Energy Rate (TPER)			77.0200	(287)

Full SAP Calculation Printout

Property Reference	Unit 03	**Issued on Date**	29/02/2024
Assessment Reference	Unit 03	**Prop Type Ref**	Unit 03
Property	Tolworth Broadway, 3		

SAP Rating	89 B	**DER**	1.92	**TER**	14.26
Environmental	99 A	**% DER < TER**			86.54
CO_2 Emissions (t/year)	0.08	**DFEE**	30.43	**TFEE**	33.60
Compliance Check	See BREL	**% DFEE < TFEE**			9.46
% DPER < TPER	55.87	**DPER**	33.47	**TPER**	75.85

Assessor Details	Mr. Jonathan Lewis	**Assessor ID**	AZ32-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	57.0000	(1b)	x 2.5000	(2b) =	142.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		142.5000	(5)

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2. Ventilation rate

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3117	0.3075	0.3033	0.2820	0.2777	0.2565	0.2565	0.2522	0.2650	0.2777	0.2863	0.2947	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			14.9000	1.1450	17.0611			(27)
Solid Door			2.1000	1.5000	3.1500			(26)
Heatloss Floor 1			57.0000	0.0600	3.4200			(28a)
External Wall 1	52.0000	14.9000	37.1000	0.1800	6.6780			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	0.1000		0.1000	0.1200	0.0120			(30)
Total net area of external elements Aum(A, m2)			119.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.7431			(33)
Party Ceiling 1			76.0000					(32b)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	7.0000	0.0410	0.2870
E3 Sill	7.0000	0.0460	0.3220

E4 Jamb	13.0000	0.0470	0.6110	
E5 Ground floor (normal)	0.0000	0.0710	0.0000	
E16 Corner (normal)	10.0000	0.0320	0.3200	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000	
E7 Party floor between dwellings (in blocks of flats)	34.0000	0.0490	1.6660	
E18 Party wall between dwellings	0.0000	0.0340	0.0000	
E14 Flat roof	0.0000	0.0400	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 3.2060 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 34.9491 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	14.6600	14.4602	14.2603	13.2611	13.0612	12.0619	12.0619	11.8621	12.4616	13.0612	13.4609	13.8606	(38)
Heat transfer coeff	49.6091	49.4093	49.2094	48.2101	48.0103	47.0110	47.0110	46.8111	47.4107	48.0103	48.4100	48.8097	(39)
Average = Sum(39)m / 12 =												48.1602	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8703	0.8668	0.8633	0.8458	0.8423	0.8248	0.8248	0.8212	0.8318	0.8423	0.8493	0.8563	(40)
HLP (average)												0.8449	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.8957 (42)
Hot water usage for mixer showers

63.0042	62.0574	60.6776	58.0378	56.0897	53.9171	52.6822	54.0515	55.5525	57.8852	60.5817	62.7628	(42a)

Hot water usage for baths

24.2067	23.8472	23.3409	22.4075	21.7085	20.9335	20.5149	21.0176	21.5649	22.3942	23.3469	24.1248	(42b)

Hot water usage for other uses

34.0436	32.8056	31.5677	30.3297	29.0918	27.8538	27.8538	29.0918	30.3297	31.5677	32.8056	34.0436	(42c)

Average daily hot water use (litres/day) 111.4798 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	121.2544	118.7101	115.5862	110.7750	106.8900	102.7044	101.0509	104.1609	107.4472	111.8471	116.7342	120.9312	(44)
Energy conte	192.0374	169.0417	177.6517	151.6454	143.8944	126.2871	122.2123	128.9729	132.4931	151.7754	166.3093	189.3490	(45)
Energy content (annual)										Total = Sum(45)m =		1851.6698	
Distribution loss (46)m = 0.15 x (45)m	28.8056	25.3562	26.6478	22.7468	21.5842	18.9431	18.3319	19.3459	19.8740	22.7663	24.9464	28.4024	(46)

Water storage loss:
Store volume 201.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6100 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2558 (55)
Total storage loss

38.9298	35.1624	38.9298	37.6740	38.9298	37.6740	38.9298	38.9298	37.6740	38.9298	37.6740	38.9298	(56)

If cylinder contains dedicated solar storage

38.9298	35.1624	38.9298	37.6740	38.9298	37.6740	38.9298	38.9298	37.6740	38.9298	37.6740	38.9298	(57)
54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
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)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

285.8248	253.7529	271.4391	242.4074	237.6818	186.4731	184.4045	191.1651	192.6791	245.5628	257.0713	283.1364	(62)
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)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

285.8248	253.7529	271.4391	242.4074	237.6818	186.4731	184.4045	191.1651	192.6791	245.5628	257.0713	283.1364	(64)

Total per year (kWh/year) = Sum(64)m = 2831.5984 (64)
12Total per year (kWh/year) 2832 (64)
Electric shower(s)

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

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

138.8823	123.9753	134.0991	123.0317	122.8748	90.1393	90.3894	92.6373	92.2028	125.4952	127.9074	137.9885	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	83.3863	92.3205	83.3863	86.1658	83.3863	86.1658	83.3863	83.3863	86.1658	83.3863	86.1658	83.3863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	165.3227	167.0382	162.7151	153.5118	141.8942	130.9753	123.6809	121.9653	126.2884	135.4918	147.1093	158.0282	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	(71)
Water heating gains (Table 5)	186.6698	184.4871	180.2407	170.8774	165.1543	125.1934	121.4911	124.5124	128.0594	168.6764	177.6492	185.4684	(72)
Total internal gains	486.8139	495.2809	477.7772	461.9901	441.8699	393.7697	379.9933	381.2992	391.9487	438.9895	462.3595	478.3179	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6000	11.2829	0.6300	0.7000	0.7700	8.9654	(75)
South	9.7000	46.7521	0.6300	0.7000	0.7700	138.5940	(78)
Southwest	2.6000	36.7938	0.6300	0.7000	0.7700	29.2362	(79)

Solar gains	176.7955	295.0304	390.1516	465.2082	507.6773	498.9754	483.0956	451.6111	415.8780	322.1621	210.5800	152.0996	(83)
Total gains	663.6093	790.3113	867.9289	927.1982	949.5472	892.7451	863.0889	832.9103	807.8267	761.1517	672.9395	630.4175	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.9162	32.0453	32.1754	32.8423	32.9791	33.6801	33.6801	33.8239	33.3961	32.9791	32.7068	32.4389	
alpha	3.1277	3.1364	3.1450	3.1895	3.1986	3.2453	3.2453	3.2549	3.2264	3.1986	3.1805	3.1626	
util living area	0.8343	0.7607	0.6801	0.5670	0.4469	0.3304	0.2379	0.2562	0.3916	0.5854	0.7608	0.8487	(86)
Living	20.4330	20.5133	20.5844	20.6532	20.6895	20.7097	20.7141	20.7145	20.7032	20.6578	20.5493	20.4246	
Non living	19.5029	19.6021	19.6891	19.7832	19.8260	19.8624	19.8662	19.8699	19.8500	19.7930	19.6619	19.5043	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.7100	20.5133	20.5844	20.6532	20.6895	20.7097	20.7141	20.7145	20.7032	20.6578	20.5493	20.5051	(87)
Th 2	20.1928	20.1958	20.1988	20.2138	20.2168	20.2319	20.2319	20.2350	20.2259	20.2168	20.2108	20.2048	(88)
util rest of house	0.8186	0.7410	0.6560	0.5383	0.4136	0.2925	0.1970	0.2144	0.3509	0.5516	0.7381	0.8341	(89)
MIT 2	19.9178	19.6021	19.6891	19.7832	19.8260	19.8624	19.8662	19.8699	19.8500	19.7930	19.6619	19.6306	(90)
Living area fraction										fLA = Living area / (4) =		0.4737	(91)
MIT	20.2930	20.0337	20.1132	20.1953	20.2350	20.2638	20.2678	20.2700	20.2542	20.2027	20.0822	20.0448	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2930	20.0337	20.1132	20.1953	20.2350	20.2638	20.2678	20.2700	20.2542	20.2027	20.0822	20.0448	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8206	0.7369	0.6533	0.5376	0.4144	0.2941	0.1989	0.2163	0.3524	0.5510	0.7342	0.8310	(94)
Useful gains	544.5787	582.3449	567.0554	498.4299	393.4466	262.5536	171.6870	180.1691	284.7033	419.3873	494.0533	523.8474	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	793.3991	747.7458	669.8961	544.5493	409.7678	266.2593	172.4289	181.1593	291.7726	461.0263	628.4697	773.3810	(97)
Space heating kWh	185.1224	111.1494	76.5134	33.2059	12.1430	0.0000	0.0000	0.0000	0.0000	30.9794	96.7798	185.6530	(98a)
Space heating requirement - total per year (kWh/year)												731.5462	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	185.1224	111.1494	76.5134	33.2059	12.1430	0.0000	0.0000	0.0000	0.0000	30.9794	96.7798	185.6530	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												731.5462	
Space heating per m2											(98c) / (4) =	12.8341	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	441.9032	347.8813	355.7645	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9589	0.9763	0.9724	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	423.7570	339.6303	345.9612	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	996.4366	963.7981	929.5183	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	412.3293	464.3808	434.1665	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.2456	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	128.4008	144.6098	135.2010	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												408.2116	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	193.0122	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	185.1224	111.1494	76.5134	33.2059	12.1430	0.0000	0.0000	0.0000	0.0000	30.9794	96.7798	185.6530	(98)
Space heating efficiency (main heating system 1)	193.0122	193.0122	193.0122	193.0122	193.0122	0.0000	0.0000	0.0000	0.0000	193.0122	193.0122	193.0122	(210)
Space heating fuel (main heating system)	95.9122	57.5867	39.6417	17.2041	6.2913	0.0000	0.0000	0.0000	0.0000	16.0505	50.1418	96.1872	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	285.8248	253.7529	271.4391	242.4074	237.6818	186.4731	184.4045	191.1651	192.6791	245.5628	257.0713	283.1364	(64)
Efficiency of water heater												175.0484	(216)
(217)m	175.0484	175.0484	175.0484	175.0484	175.0484	175.0484	175.0484	175.0484	175.0484	175.0484	175.0484	175.0484	(217)
Fuel for water heating, kWh/month	163.2832	144.9615	155.0652	138.4802	135.7806	106.5266	105.3449	109.2070	110.0719	140.2828	146.8572	161.7475	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	32.1002	36.1525	33.8002	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.6337	6.8949	7.6337	7.3874	7.6337	7.3874	7.6337	7.6337	7.3874	7.6337	7.3874	7.6337	(231)
Lighting	16.1220	12.9336	11.6453	8.5319	6.5902	5.3843	6.0118	7.8144	10.1502	13.3176	15.0422	16.5700	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-33.9494	-50.7552	-77.3451	-90.6053	-100.6385	-91.9328	-90.6975	-84.4756	-72.6219	-59.0656	-37.9535	-28.9100	(233a)

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

(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m	-12.3361	-28.5922	-62.4844	-102.1144	-140.9704	-146.7761	-144.3831	-118.7808	-83.0103	-43.7340	-17.3857	-9.5156 (233b)

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

(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	379.0155	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	175.0484	
Water heating fuel used	1617.6085	(219)
Space cooling fuel	102.0529	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5170)		
mechanical ventilation fans (SFP = 0.5170)	89.8804	(230a)
Total electricity for the above, kWh/year	89.8804	(231)
Electricity for lighting (calculated in Appendix L)	130.1135	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1729.0337	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	589.6372	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	379.0155	0.1573	59.6362	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1617.6085	0.1416	229.0148	(264)
Space and water heating			288.6510	(265)
Space cooling	102.0529	0.1142	11.6506	(266)
Pumps, fans and electric keep-hot	89.8804	0.1387	12.4675	(267)
Energy for lighting	130.1135	0.1443	18.7794	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-818.9503	0.1339	-109.6259	
PV Unit electricity exported	-910.0834	0.1236	-112.4612	
Total			-222.0871	(269)
Total CO2, kg/year			109.4614	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.9200	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	379.0155	1.5824	599.7677	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1617.6085	1.5235	2464.5026	(278)
Space and water heating			3064.2703	(279)
Space cooling	102.0529	1.4207	144.9911	(280)
Pumps, fans and electric keep-hot	89.8804	1.5128	135.9711	(281)
Energy for lighting	130.1135	1.5338	199.5724	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-818.9503	1.4947	-1224.0821	
PV Unit electricity exported	-910.0834	0.4535	-412.7053	
Total			-1636.7874	(283)
Total Primary energy kWh/year			1908.0176	(286)
Dwelling Primary energy Rate (DPER)			33.4700	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	57.0000	(1b)	x 2.5000	(2b) =	142.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		142.5000	(5)

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2. Ventilation rate

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m3 per hour

Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1404	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3904	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3318	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4230	0.4147	0.4065	0.3650	0.3567	0.3152	0.3152	0.3069	0.3318	0.3567	0.3733	0.3899	(22b)
Effective ac	0.5895	0.5860	0.5826	0.5666	0.5636	0.5497	0.5497	0.5471	0.5550	0.5636	0.5697	0.5760	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			12.1500	1.1450	13.9122			(27)
Heatloss Floor 1			57.0000	0.1300	7.4100			(28a)
External Wall 1	52.0000	12.1500	39.8500	0.1800	7.1730			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	0.1000		0.1000	0.1100	0.0110			(30)
Total net area of external elements Aum(A, m2)			119.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.0282			(33)

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

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	7.0000	0.0500	0.3500
E3	Sill	7.0000	0.0500	0.3500
E4	Jamb	13.0000	0.0500	0.6500
E5	Ground floor (normal)	0.0000	0.1600	0.0000
E16	Corner (normal)	10.0000	0.0900	0.9000
E17	Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000
E7	Party floor between dwellings (in blocks of flats)	34.0000	0.0700	2.3800
E18	Party wall between dwellings	0.0000	0.0600	0.0000
E14	Flat roof	0.0000	0.0800	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.6300	(36)	
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	36.6582	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7204	27.5570	27.3969	26.6446	26.5038	25.8486	25.8486	25.7273	26.1010	26.5038	26.7886	27.0862	(38)
Heat transfer coeff	64.3786	64.2152	64.0551	63.3028	63.1620	62.5068	62.5068	62.3855	62.7592	63.1620	63.4468	63.7445	(39)
Average = Sum(39)m / 12 =												63.3021	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1294	1.1266	1.1238	1.1106	1.1081	1.0966	1.0966	1.0945	1.1010	1.1081	1.1131	1.1183	(40)
HLP (average)												1.1106	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8957	(42)

Hot water usage for mixer showers

56.0037	55.1621	53.9357	51.5892	49.8575	47.9263	46.8287	48.0458	49.3800	51.4535	53.8504	55.7892	(42a)

Hot water usage for baths

24.2067	23.8472	23.3409	22.4075	21.7085	20.9335	20.5149	21.0176	21.5649	22.3942	23.3469	24.1248	(42b)

Hot water usage for other uses

34.0436	32.8056	31.5677	30.3297	29.0918	27.8538	27.8538	29.0918	30.3297	31.5677	32.8056	34.0436	(42c)

Average daily hot water use (litres/day)	105.0257	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.2540	111.8149	108.8443	104.3263	100.6578	96.7136	95.1973	98.1551	101.2747	105.4154	110.0029	113.9576	(44)
Energy conte	180.9503	159.2229	167.2896	142.8176	135.5047	118.9207	115.1329	121.5366	124.8818	143.0477	156.7193	178.4300	(45)
Energy content (annual)											Total = Sum(45)m =	1744.4541	
Distribution loss (46)m = 0.15 x (45)m	27.1426	23.8834	25.0934	21.4226	20.3257	17.8381	17.2699	18.2305	18.7323	21.4572	23.5079	26.7645	(46)

Water storage loss:		
Store volume	201.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6575	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.8950	(55)

Total storage loss

27.7463	25.0612	27.7463	26.8513	27.7463	26.8513	27.7463	27.7463	26.8513	27.7463	26.8513	27.7463	(56)

If cylinder contains dedicated solar storage

27.7463	25.0612	27.7463	26.8513	27.7463	26.8513	27.7463	27.7463	26.8513	27.7463	26.8513	27.7463	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

231.9591	205.2953	218.2983	192.1808	186.5134	168.2840	166.1417	172.5453	174.2451	194.0564	206.0826	229.4387	(62)
WWHRS -25.6026	-22.6431	-23.7106	-19.6333	-18.2975	-15.6573	-14.6762	-15.6067	-16.1997	-19.0976	-21.6353	-25.1284	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)

Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	206.3565	182.6522	194.5877	172.5476	168.2159	152.6267	151.4654	156.9386	158.0454	174.9588	184.4473	204.3103	(64)
											Total per year (kWh/year) = Sum(64)m =	2107.1524	(64)
12Total per year (kWh/year)												2107	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month													
	100.9730	89.7995	96.4308	86.9775	85.8623	79.0318	79.0887	81.2179	81.0138	88.3703	91.5998	100.1350	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	94.7836	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	83.5347	92.4849	83.5347	86.3192	83.5347	86.3192	83.5347	83.5347	86.3192	83.5347	86.3192	83.5347	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	165.3227	167.0382	162.7151	153.5118	141.8942	130.9753	123.6809	121.9653	126.2884	135.4918	147.1093	158.0282	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	32.4784	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	-75.8269	(71)
Water heating gains (Table 5)													
	135.7164	133.6303	129.6112	120.8020	115.4063	109.7663	106.3020	109.1638	112.5192	118.7773	127.2220	134.5900	(72)
Total internal gains													
	439.0088	447.5884	430.2961	415.0681	395.2703	378.4960	364.9527	366.0990	376.5619	392.2389	415.0856	430.5880	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1200	11.2829	0.6300	0.7000	0.7700	7.3102	(75)
South	7.9100	46.7521	0.6300	0.7000	0.7700	113.0184	(78)
Southwest	2.1200	36.7938	0.6300	0.7000	0.7700	23.8387	(79)

Solar gains	144.1673	240.5813	318.1466	379.3495	413.9792	406.8828	393.9341	368.2614	339.1244	262.7055	171.7167	124.0291	(83)
Total gains	583.1761	688.1697	748.4427	794.4176	809.2495	785.3788	758.8867	734.3604	715.6864	654.9444	586.8023	554.6171	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.5941	24.6567	24.7183	25.0121	25.0678	25.3306	25.3306	25.3798	25.2287	25.0678	24.9553	24.8388	
alpha	2.6396	2.6438	2.6479	2.6675	2.6712	2.6887	2.6887	2.6920	2.6819	2.6712	2.6637	2.6559	
util living area													
	0.8979	0.8525	0.7989	0.7139	0.6036	0.4649	0.3470	0.3712	0.5314	0.7287	0.8542	0.9077	(86)
MIT	19.0130	19.3871	19.8053	20.2789	20.6408	20.8728	20.9573	20.9475	20.8080	20.3479	19.6204	18.9472	(87)
Th 2	19.9769	19.9792	19.9815	19.9922	19.9942	20.0036	20.0036	20.0053	20.0000	19.9942	19.9901	19.9859	(88)
util rest of house													
	0.8851	0.8353	0.7755	0.6811	0.5578	0.4035	0.2737	0.2974	0.4706	0.6908	0.8342	0.8960	(89)
MIT 2	17.6971	18.1579	18.6699	19.2423	19.6564	19.9061	19.9799	19.9747	19.8436	19.3377	18.4633	17.6217	(90)
Living area fraction										fLA = Living area / (4) =		0.4737	(91)
MIT	18.3204	18.7401	19.2077	19.7333	20.1227	20.3640	20.4429	20.4355	20.3005	19.8162	19.0114	18.2496	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3204	18.7401	19.2077	19.7333	20.1227	20.3640	20.4429	20.4355	20.3005	19.8162	19.0114	18.2496	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8597	0.8107	0.7556	0.6719	0.5639	0.4264	0.3066	0.3300	0.4896	0.6835	0.8114	0.8710	(94)
Useful gains	501.3274	557.8887	565.5171	533.8022	456.3339	334.8602	232.6497	242.3072	350.3797	447.6232	476.1536	483.0694	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	902.6156	888.7483	813.9934	685.7807	531.9950	360.2910	240.2064	251.7591	389.1364	582.1133	755.7430	895.5834	(97)
Space heating kWh													
	298.5584	222.3377	184.8664	109.4245	56.2919	0.0000	0.0000	0.0000	0.0000	100.0606	201.3043	306.9104	(98a)
Space heating requirement - total per year (kWh/year)												1479.7543	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	298.5584	222.3377	184.8664	109.4245	56.2919	0.0000	0.0000	0.0000	0.0000	100.0606	201.3043	306.9104	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1479.7543	
Space heating per m2											(98c) / (4) =	25.9606	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	298.5584	222.3377	184.8664	109.4245	56.2919	0.0000	0.0000	0.0000	0.0000	100.0606	201.3043	306.9104	(98)

Space heating efficiency (main heating system 1)

92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)

Space heating fuel (main heating system)

323.4652	240.8859	200.2886	118.5531	60.9880	0.0000	0.0000	0.0000	0.0000	108.4081	218.0979	332.5140	(211)

Space heating efficiency (main heating system 2)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)

Space heating fuel (main heating system 2)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)

Space heating fuel (secondary)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement

206.3565	182.6522	194.5877	172.5476	168.2159	152.6267	151.4654	156.9386	158.0454	174.9588	184.4473	204.3103	(64)

Efficiency of water heater 79.8000 (216)

(217)m 84.8873	84.5018	83.9450	83.0671	81.8808	79.8000	79.8000	79.8000	79.8000	82.8553	84.2563	84.9701	(217)

Fuel for water heating, kWh/month

243.0948	216.1518	231.8039	207.7206	205.4401	191.2615	189.8063	196.6649	198.0519	211.1619	218.9121	240.4496	(219)

Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa 7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting 17.3569	13.9243	12.5373	9.1854	7.0950	5.7967	6.4723	8.4130	10.9276	14.3377	16.1943	17.8393	(232)

Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m -15.3786	-22.8425	-34.5784	-41.0229	-46.1398	-43.7829	-43.2643	-39.9019	-34.2977	-27.0646	-17.3195	-13.1647	(233a)

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

(234a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235c)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m -5.4862	-11.7999	-23.9376	-36.6686	-49.1834	-49.6591	-49.0599	-41.2060	-29.7786	-17.0916	-7.3951	-4.3183	(233b)

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

(234b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	1603.2008	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2550.5195	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	140.0798	(232)

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

PV generation	-704.3420	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3675.4581	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1603.2008	0.2100	336.6722	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2550.5195	0.2100	535.6091	(264)
Space and water heating			872.2812	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	140.0798	0.1443	20.2178	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-378.7577	0.1335	-50.5602	
PV Unit electricity exported	-325.5842	0.1253	-40.8056	
Total			-91.3658	(269)
Total CO2, kg/year			813.0625	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.2600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1603.2008	1.1300	1811.6169	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2550.5195	1.1300	2882.0870	(278)
Space and water heating			4693.7039	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	140.0798	1.5338	214.8591	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-378.7577	1.4933	-565.5961	
PV Unit electricity exported	-325.5842	0.4600	-149.7760	
Total			-715.3721	(283)
Total Primary energy kWh/year			4323.2917	(286)
Target Primary Energy Rate (TPER)			75.8500	(287)

Full SAP Calculation Printout

Property Reference	Unit 06	**Issued on Date**	29/02/2024
Assessment Reference	06 Gas EE	**Prop Type Ref**	06
Property	Tolworth Broadway, 06		

SAP Rating	86 B	**DER**	11.16	**TER**	11.14
Environmental	91 B	**% DER < TER**			-0.18
CO_2 Emissions (t/year)	0.81	**DFEE**	27.13	**TFEE**	27.15
Compliance Check	See BREL	**% DFEE < TFEE**			0.10
% DPER < TPER	-9.92	**DPER**	64.62	**TPER**	58.79

Assessor Details	Mr. Jonathan Lewis	**Assessor ID**	AZ32-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	80.0000	(1b)	x 2.5000	(2b) =	200.0000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		200.0000	(5)

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2. Ventilation rate

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		81.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3117	0.3075	0.3033	0.2820	0.2777	0.2565	0.2565	0.2522	0.2650	0.2777	0.2863	0.2947	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			20.3000	1.1450	23.2443			(27)
Solid Door			2.1000	1.5000	3.1500			(26)
Heatloss Floor 1			0.1000	0.1200	0.0120			(28a)
External Wall 1	38.5000	20.3000	18.2000	0.1800	3.2760			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	12.0000		12.0000	0.1200	1.4400			(30)
Total net area of external elements Aum(A, m2)			60.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.5443			(33)
Party Ceiling 1			76.0000					(32b)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.0000	0.0410	0.4510
E3 Sill	11.0000	0.0460	0.5060

E4 Jamb	41.0000	0.0470	1.9270	
E5 Ground floor (normal)	0.0000	0.0710	0.0000	
E16 Corner (normal)	5.0000	0.0320	0.1600	
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0310	-0.0775	
E7 Party floor between dwellings (in blocks of flats)	26.0000	0.0490	1.2740	
E18 Party wall between dwellings	5.0000	0.0340	0.1700	
E14 Flat roof	10.0000	0.0400	0.4000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.8105 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.3548 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	20.5755	20.2950	20.0145	18.6120	18.3315	16.9290	16.9290	16.6485	17.4900	18.3315	18.8925	19.4535	(38)
Heat transfer coeff	57.9303	57.6498	57.3693	55.9668	55.6863	54.2838	54.2838	54.0033	54.8448	55.6863	56.2473	56.8083	(39)
Average = Sum(39)m / 12 =												55.8966	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7241	0.7206	0.7171	0.6996	0.6961	0.6785	0.6785	0.6750	0.6856	0.6961	0.7031	0.7101	(40)
HLP (average)												0.6987	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4629 (42)
Hot water usage for mixer showers

73.7030	72.5954	70.9814	67.8933	65.6143	63.0729	61.6283	63.2301	64.9859	67.7147	70.8692	73.4206	(42a)

Hot water usage for baths

28.2963	27.8761	27.2843	26.1931	25.3761	24.4701	23.9808	24.5684	25.2083	26.1777	27.2913	28.2006	(42b)

Hot water usage for other uses

39.8522	38.4030	36.9538	35.5047	34.0555	32.6063	32.6063	34.0555	35.5047	36.9538	38.4030	39.8522	(42c)

Average daily hot water use (litres/day) 130.4161 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.8515	138.8745	135.2195	129.5911	125.0459	120.1493	118.2154	121.8540	125.6989	130.8462	136.5634	141.4734	(44)
Energy conte	224.6581	197.7554	207.8273	177.4037	168.3358	147.7376	142.9712	150.8807	154.9993	177.5571	194.5596	221.5132	(45)
Energy content (annual)										Total = Sum(45)m =		2166.1989	
Distribution loss (46)m = 0.15 x (45)m	33.6987	29.6633	31.1741	26.6106	25.2504	22.1606	21.4457	22.6321	23.2499	26.6336	29.1839	33.2270	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	25.6593	23.1604	25.6133	24.7331	25.5231	24.6660	25.4689	25.4877	24.6869	25.5495	24.7775	25.6524	(61)
Total heat required for water heating calculated for each month	250.3174	220.9157	233.4406	202.1368	193.8589	172.4036	168.4402	176.3684	179.6862	203.1065	219.3371	247.1656	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	250.3174	220.9157	233.4406	202.1368	193.8589	172.4036	168.4402	176.3684	179.6862	203.1065	219.3371	247.1656	(64)
										Total per year (kWh/year) = Sum(64)m =		2467.1770	(64)
12Total per year (kWh/year)												2467	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	81.1136	71.5437	75.5059	65.1700	62.3524	55.2892	53.9052	56.5398	57.7090	65.4251	70.8855	80.0662	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	110.6826	122.5414	110.6826	114.3720	110.6826	114.3720	110.6826	110.6826	114.3720	110.6826	114.3720	110.6826	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)	109.0237	106.4639	101.4864	90.5139	83.8070	76.7906	72.4532	75.9943	80.1514	87.9370	98.4520	107.6159	(72)
Total internal gains	502.0897	513.6659	491.0913	471.5922	445.7754	424.9552	407.2461	408.5101	422.0948	441.4070	471.0320	490.9996	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.8000	11.2829	0.6300	0.7000	0.7700	30.3443	(75)
Southeast	5.3000	36.7938	0.6300	0.7000	0.7700	59.5968	(77)
Southwest	6.2000	36.7938	0.6300	0.7000	0.7700	69.7170	(79)

Solar gains	159.6580	282.0358	412.6657	556.1868	663.9345	677.1497	645.3469	562.2080	461.9340	318.9281	193.0690	135.4463	(83)
Total gains	661.7477	795.7017	903.7570	1027.7790	1109.7098	1102.1049	1052.5930	970.7181	884.0288	760.3351	664.1010	626.4459	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.3603	38.5469	38.7354	39.7061	39.9061	40.9371	40.9371	41.1498	40.5184	39.9061	39.5081	39.1179	
alpha	3.5574	3.5698	3.5824	3.6471	3.6604	3.7291	3.7291	3.7433	3.7012	3.6604	3.6339	3.6079	
util living area													
	0.9005	0.8370	0.7483	0.6016	0.4509	0.3123	0.2262	0.2547	0.4173	0.6685	0.8432	0.9121	(86)
MIT	20.4624	20.5448	20.6253	20.7019	20.7341	20.7495	20.7514	20.7520	20.7428	20.6937	20.5782	20.4558	(87)
Th 2	20.3196	20.3227	20.3257	20.3412	20.3443	20.3598	20.3598	20.3629	20.3536	20.3443	20.3381	20.3319	(88)
util rest of house													
	0.8904	0.8223	0.7282	0.5760	0.4220	0.2818	0.1936	0.2199	0.3807	0.6386	0.8266	0.9030	(89)
MIT 2	19.6611	19.7648	19.8646	19.9690	20.0074	20.0395	20.0411	20.0452	20.0267	19.9647	19.8223	19.6647	(90)
Living area fraction										fLA = Living area / (4) =		0.3500	(91)
MIT	19.9416	20.0378	20.1309	20.2255	20.2618	20.2880	20.2897	20.2926	20.2773	20.2199	20.0869	19.9416	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9416	20.0378	20.1309	20.2255	20.2618	20.2880	20.2897	20.2926	20.2773	20.2199	20.0869	19.9416	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8842	0.8157	0.7221	0.5714	0.4183	0.2784	0.1900	0.2160	0.3764	0.6327	0.8199	0.8971	(94)
Useful gains	585.1037	649.0806	652.5765	587.2396	464.1825	306.8276	199.9582	209.6755	332.7249	481.0964	544.4920	561.9988	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	906.1211	872.6911	781.9934	633.8532	476.7723	308.7650	200.2916	210.2122	338.7949	535.6962	730.4761	894.2514	(97)
Space heating kWh													
	238.8370	150.2663	96.2862	33.5618	9.3668	0.0000	0.0000	0.0000	0.0000	40.6222	133.9085	247.1959	(98a)
Space heating requirement - total per year (kWh/year)												950.0446	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	238.8370	150.2663	96.2862	33.5618	9.3668	0.0000	0.0000	0.0000	0.0000	40.6222	133.9085	247.1959	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												950.0446	
Space heating per m2											(98c) / (4) =	11.8756	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	510.2675	401.6999	410.4249	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9781	0.9881	0.9836	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	499.0837	396.9377	403.7134	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1237.6760	1182.3948	1088.0954	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	531.7864	584.3801	509.1802	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	0.8875	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	117.9901	129.6593	112.9744	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												360.6238	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												84.2000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												4.0000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	238.8370	150.2663	96.2862	33.5618	9.3668	0.0000	0.0000	0.0000	0.0000	40.6222	133.9085	247.1959	(98)
Space heating efficiency (main heating system 1)													
	84.2000	84.2000	84.2000	84.2000	84.2000	0.0000	0.0000	0.0000	0.0000	84.2000	84.2000	84.2000	(210)
Space heating fuel (main heating system)													
	283.6543	178.4635	114.3541	39.8596	11.1245	0.0000	0.0000	0.0000	0.0000	48.2449	159.0362	293.5818	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	250.3174	220.9157	233.4406	202.1368	193.8589	172.4036	168.4402	176.3684	179.6862	203.1065	219.3371	247.1656	(64)
Efficiency of water heater												87.2000	(216)
(217)m	88.1652	87.9988	87.7747	87.4793	87.2902	87.2000	87.2000	87.2000	87.2000	87.5271	87.9475	88.1887	(217)
Fuel for water heating, kWh/month													
	283.9185	251.0441	265.9543	231.0682	222.0855	197.7105	193.1654	202.2573	206.0621	232.0499	249.3955	280.2690	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	29.4975	32.4148	28.2436	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	18.0180	16.2744	18.0180	17.4368	18.0180	17.4368	18.0180	18.0180	17.4368	18.0180	17.4368	18.0180	(231)
Lighting	21.3994	17.1674	15.4574	11.3247	8.7475	7.1468	7.9798	10.3725	13.4728	17.6770	19.9662	21.9942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													

(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1128.3190	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.2000	
Water heating fuel used	2814.9803	(219)
Space cooling fuel	90.1560	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5170)		
mechanical ventilation fans (SFP = 0.5170)	126.1480	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	212.1480	(231)
Electricity for lighting (calculated in Appendix L)	172.7058	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4418.3090	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1128.3190	0.2100	236.9470	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2814.9803	0.2100	591.1459	(264)
Space and water heating			828.0929	(265)
Space cooling	90.1560	0.1143	10.3010	(266)
Pumps, fans and electric keep-hot	212.1480	0.1387	29.4275	(267)
Energy for lighting	172.7058	0.1443	24.9268	(268)
Total CO2, kg/year			892.7482	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.1600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1128.3190	1.1300	1275.0005	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2814.9803	1.1300	3180.9278	(278)
Space and water heating			4455.9282	(279)
Space cooling	90.1560	1.4211	128.1190	(280)
Pumps, fans and electric keep-hot	212.1480	1.5128	320.9375	(281)
Energy for lighting	172.7058	1.5338	264.9019	(282)
Total Primary energy kWh/year			5169.8866	(286)
Dwelling Primary energy Rate (DPER)			64.6200	(287)

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		80.0000 (1b)	x	2.5000 (2b)	=	200.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.0000	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1500	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4000	(18)

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3400 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4335	0.4250	0.4165	0.3740	0.3655	0.3230	0.3230	0.3145	0.3400	0.3655	0.3825	0.3995	(22b)
Effective ac	0.5940	0.5903	0.5867	0.5699	0.5668	0.5522	0.5522	0.5495	0.5578	0.5668	0.5732	0.5798	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			17.9000	1.1450	20.4962			(27)
Heatloss Floor 1			0.1000	0.1300	0.0130			(28a)
External Wall 1	38.5000	17.9000	20.6000	0.1800	3.7080			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	12.0000		12.0000	0.1100	1.3200			(30)
Total net area of external elements Aum(A, m2)			60.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.0592			(33)

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

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	11.0000	0.0500	0.5500
E3	Sill	11.0000	0.0500	0.5500
E4	Jamb	41.0000	0.0500	2.0500
E5	Ground floor (normal)	0.0000	0.1600	0.0000
E16	Corner (normal)	5.0000	0.0900	0.4500
E17	Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E7	Party floor between dwellings (in blocks of flats)	26.0000	0.0700	1.8200
E18	Party wall between dwellings	5.0000	0.0600	0.3000
E14	Flat roof	10.0000	0.0800	0.8000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.2950 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.3542 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.2014	38.9606	38.7246	37.6159	37.4085	36.4429	36.4429	36.2640	36.8148	37.4085	37.8281	38.2668	(38)
Heat transfer coeff	74.5556	74.3148	74.0788	72.9701	72.7627	71.7970	71.7970	71.6182	72.1690	72.7627	73.1823	73.6210	(39)
Average = Sum(39)m / 12 =												72.9691	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9319	0.9289	0.9260	0.9121	0.9095	0.8975	0.8975	0.8952	0.9021	0.9095	0.9148	0.9203	(40)
HLP (average)												0.9121	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4629 (42)
Hot water usage for mixer showers

65.5138	64.5292	63.0946	60.3496	58.3238	56.0648	54.7807	56.2045	57.7653	60.1909	62.9948	65.2628	(42a)

Hot water usage for baths

28.2963	27.8761	27.2843	26.1931	25.3761	24.4701	23.9808	24.5684	25.2083	26.1777	27.2913	28.2006	(42b)

Hot water usage for other uses

39.8522	38.4030	36.9538	35.5047	34.0555	32.6063	32.6063	34.0555	35.5047	36.9538	38.4030	39.8522	(42c)

Average daily hot water use (litres/day) 122.8659 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.6623	130.8083	127.3327	122.0474	117.7554	113.1412	111.3678	114.8284	118.4782	123.3223	128.6891	133.3156	(44)
Energy conte	211.6883	186.2693	195.7056	167.0767	158.5214	139.1203	134.6897	142.1816	146.0955	167.3473	183.3412	208.7400	(45)
Energy content (annual)										Total = Sum(45)m =		2040.7768	
Distribution loss (46)m = 0.15 x (45)m	31.7533	27.9404	29.3558	25.0615	23.7782	20.8680	20.2035	21.3272	21.9143	25.1021	27.5012	31.3110	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	262.6472	232.2967	246.6645	216.3918	209.4803	188.4354	185.6486	193.1405	195.4105	218.3062	232.6563	259.6989	(62)
WWHRS	-29.9502	-26.4882	-27.7369	-22.9672	-21.4046	-18.3161	-17.1684	-18.2569	-18.9505	-22.3406	-25.3092	-29.3955	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	232.6971	205.8085	218.9276	193.4246	188.0757	170.1193	168.4802	174.8836	176.4600	195.9656	207.3471	230.3033	(64)
										Total per year (kWh/year) = Sum(64)m =		2362.4923	(64)
12Total per year (kWh/year)												2362	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	83.1261	73.4414	77.8118	67.8818	65.4481	58.5863	57.5240	60.0151	60.9055	68.3827	73.2897	82.1458	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)

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

	110.6754	122.5335	110.6754	114.3646	110.6754	114.3646	110.6754	110.6754	114.3646	110.6754	114.3646	110.6754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)													
	111.7286	109.2878	104.5858	94.2803	87.9679	81.3698	77.3173	80.6655	84.5910	91.9122	101.7913	110.4110	(72)
Total internal gains													
	504.7875	516.4819	494.1836	475.3512	449.9291	429.5271	412.1031	413.1741	426.5271	445.3752	474.3639	493.7876	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.7600	11.2829	0.6300	0.7000	0.7700	26.7581	(75)
Southeast	4.6700	36.7938	0.6300	0.7000	0.7700	52.5126	(77)
Southwest	5.4700	36.7938	0.6300	0.7000	0.7700	61.5084	(79)

Solar gains	140.7791	248.6869	363.8723	490.4261	585.4364	597.0901	569.0470	495.7362	407.3160	281.2173	170.2395	119.4302	(83)
Total gains	645.5666	765.1688	858.0559	965.7773	1035.3655	1026.6172	981.1501	908.9103	833.8430	726.5925	644.6034	613.2178	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8062	29.9028	29.9981	30.4539	30.5407	30.9514	30.9514	31.0287	30.7919	30.5407	30.3656	30.1846	
alpha	2.9871	2.9935	2.9999	3.0303	3.0360	3.0634	3.0634	3.0686	3.0528	3.0360	3.0244	3.0123	
util living area													
	0.9270	0.8864	0.8270	0.7172	0.5777	0.4257	0.3151	0.3520	0.5403	0.7673	0.8903	0.9352	(86)
MIT	19.2170	19.5694	19.9926	20.4714	20.7815	20.9372	20.9812	20.9735	20.8677	20.4460	19.7697	19.1629	(87)
Th 2	20.1404	20.1430	20.1455	20.1572	20.1594	20.1697	20.1697	20.1716	20.1657	20.1594	20.1550	20.1503	(88)
util rest of house													
	0.9180	0.8733	0.8077	0.6881	0.5378	0.3760	0.2580	0.2921	0.4873	0.7356	0.8755	0.9271	(89)
MIT 2	18.0587	18.4974	19.0186	19.5980	19.9501	20.1199	20.1585	20.1550	20.0534	19.5846	18.7624	17.9976	(90)
Living area fraction									fLA = Living area / (4) =			0.3500	(91)
MIT	18.4641	18.8726	19.3595	19.9037	20.2411	20.4059	20.4465	20.4415	20.3384	19.8861	19.1149	18.4055	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4641	18.8726	19.3595	19.9037	20.2411	20.4059	20.4465	20.4415	20.3384	19.8861	19.1149	18.4055	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8960	0.8503	0.7877	0.6788	0.5419	0.3904	0.2773	0.3119	0.4987	0.7243	0.8537	0.9061	(94)
Useful gains	578.4410	650.6047	675.9152	655.5449	561.0194	400.7822	272.0572	283.4962	415.8305	526.2522	550.2948	555.6583	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1056.0110	1038.3701	952.6162	802.9426	621.4724	416.8483	276.1640	289.4426	450.2193	675.6808	879.2807	1045.8200	(97)
Space heating kWh	355.3121	260.5783	205.8655	106.1263	44.9770	0.0000	0.0000	0.0000	0.0000	111.1749	236.8698	364.6803	(98a)
Space heating requirement - total per year (kWh/year)												1685.5843	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	355.3121	260.5783	205.8655	106.1263	44.9770	0.0000	0.0000	0.0000	0.0000	111.1749	236.8698	364.6803	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1685.5843	
Space heating per m2											(98c) / (4) =	21.0698	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	355.3121	260.5783	205.8655	106.1263	44.9770	0.0000	0.0000	0.0000	0.0000	111.1749	236.8698	364.6803	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	384.5369	282.0112	222.7982	114.8553	48.6764	0.0000	0.0000	0.0000	0.0000	120.3192	256.3526	394.6756	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	232.6971	205.8085	218.9276	193.4246	188.0757	170.1193	168.4802	174.8836	176.4600	195.9656	207.3471	230.3033	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.2854	84.8881	84.2498	83.1498	81.8277	80.3000	80.3000	80.3000	80.3000	83.2138	84.6674	85.3613	(217)
Fuel for water heating, kWh/month	272.8452	242.4467	259.8554	232.6219	229.8436	211.8546	209.8134	217.7878	219.7509	235.4964	244.8958	269.7982	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)

Lighting	22.9962	18.4484	16.6107	12.1697	9.4002	7.6801	8.5752	11.1464	14.4781	18.9960	21.4559	23.6353	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-21.3196	-31.5249	-47.5009	-56.0679	-62.7867	-59.4496	-58.7152	-54.2685	-46.8411	-37.2010	-23.9513	-18.2641	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-7.9643	-17.0960	-34.6269	-52.9727	-71.0002	-71.6970	-70.8626	-59.5671	-43.0906	-24.7725	-10.7359	-6.2735	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1824.2254	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2847.0100	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	185.5923	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-988.5501	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3954.2775	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1824.2254	0.2100	383.0873	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2847.0100	0.2100	597.8721	(264)
Space and water heating			980.9594	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	185.5923	0.1443	26.7867	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-517.8909	0.1336	-69.1893	
PV Unit electricity exported	-470.6592	0.1254	-59.0006	
Total			-128.1899	(269)
Total CO2, kg/year			891.4855	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1824.2254	1.1300	2061.3747	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2847.0100	1.1300	3217.1213	(278)
Space and water heating			5278.4960	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	185.5923	1.5338	284.6676	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-517.8909	1.4937	-773.5739	
PV Unit electricity exported	-470.6592	0.4601	-216.5605	
Total			-990.1344	(283)
Total Primary energy kWh/year			4703.1300	(286)
Target Primary Energy Rate (TPER)			58.7900	(287)

Full SAP Calculation Printout

Property Reference	Unit 06	**Issued on Date**	29/02/2024
Assessment Reference	06 RE	**Prop Type Ref**	06
Property	Tolworth Broadway, 06		

SAP Rating	86 B	**DER**	3.08	**TER**	10.97
Environmental	97 A	**% DER < TER**			71.92
CO_2 Emissions (t/year)	0.22	**DFEE**	27.13	**TFEE**	27.15
Compliance Check	See BREL	**% DFEE < TFEE**			0.10
% DPER < TPER	36.73	**DPER**	36.59	**TPER**	57.84

Assessor Details	Mr. Jonathan Lewis	**Assessor ID**	AZ32-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	80.0000	(1b)	x 2.5000	(2b) =	200.0000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		200.0000	(5)

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2. Ventilation rate

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		81.0000 (23c)

Effective ac	0.3117	0.3075	0.3033	0.2820	0.2777	0.2565	0.2565	0.2522	0.2650	0.2777	0.2863	0.2947	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			20.3000	1.1450	23.2443			(27)
Solid Door			2.1000	1.5000	3.1500			(26)
Heatloss Floor 1			0.1000	0.1200	0.0120			(28a)
External Wall 1	38.5000	20.3000	18.2000	0.1800	3.2760			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	12.0000		12.0000	0.1200	1.4400			(30)
Total net area of external elements Aum(A, m2)			60.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.5443			(33)
Party Ceiling 1			76.0000					(32b)

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

List of Thermal Bridges

		Length	Psi-value	Total	
K1	Element				
E2	Other lintels (including other steel lintels)	11.0000	0.0410	0.4510	
E3	Sill	11.0000	0.0460	0.5060	

E4 Jamb	41.0000	0.0470	1.9270	
E5 Ground floor (normal)	0.0000	0.0710	0.0000	
E16 Corner (normal)	5.0000	0.0320	0.1600	
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0310	-0.0775	
E7 Party floor between dwellings (in blocks of flats)	26.0000	0.0490	1.2740	
E18 Party wall between dwellings	5.0000	0.0340	0.1700	
E14 Flat roof	10.0000	0.0400	0.4000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.8105 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.3548 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	20.5755	20.2950	20.0145	18.6120	18.3315	16.9290	16.9290	16.6485	17.4900	18.3315	18.8925	19.4535	(38)
Heat transfer coeff	57.9303	57.6498	57.3693	55.9668	55.6863	54.2838	54.2838	54.0033	54.8448	55.6863	56.2473	56.8083	(39)
Average = Sum(39)m / 12 =												55.8966	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7241	0.7206	0.7171	0.6996	0.6961	0.6785	0.6785	0.6750	0.6856	0.6961	0.7031	0.7101	(40)
HLP (average)												0.6987	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4629 (42)
Hot water usage for mixer showers

73.7030	72.5954	70.9814	67.8933	65.6143	63.0729	61.6283	63.2301	64.9859	67.7147	70.8692	73.4206	(42a)

Hot water usage for baths

28.2963	27.8761	27.2843	26.1931	25.3761	24.4701	23.9808	24.5684	25.2083	26.1777	27.2913	28.2006	(42b)

Hot water usage for other uses

39.8522	38.4030	36.9538	35.5047	34.0555	32.6063	32.6063	34.0555	35.5047	36.9538	38.4030	39.8522	(42c)

Average daily hot water use (litres/day) 130.4161 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.8515	138.8745	135.2195	129.5911	125.0459	120.1493	118.2154	121.8540	125.6989	130.8462	136.5634	141.4734	(44)
Energy conte	224.6581	197.7554	207.8273	177.4037	168.3358	147.7376	142.9712	150.8807	154.9993	177.5571	194.5596	221.5132	(45)
Energy content (annual)										Total = Sum(45)m =		2166.1989	
Distribution loss (46)m = 0.15 x (45)m	33.6987	29.6633	31.1741	26.6106	25.2504	22.1606	21.4457	22.6321	23.2499	26.6336	29.1839	33.2270	(46)

Water storage loss:
Store volume 201.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6100 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2558 (55)
Total storage loss

38.9298	35.1624	38.9298	37.6740	38.9298	37.6740	38.9298	38.9298	37.6740	38.9298	37.6740	38.9298	(56)

If cylinder contains dedicated solar storage

38.9298	35.1624	38.9298	37.6740	38.9298	37.6740	38.9298	38.9298	37.6740	38.9298	37.6740	38.9298	(57)
54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
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)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

318.4455	282.4666	301.6147	268.1657	262.1232	207.9236	205.1634	213.0729	215.1853	271.3445	285.3216	315.3006	(62)
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)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

318.4455	282.4666	301.6147	268.1657	262.1232	207.9236	205.1634	213.0729	215.1853	271.3445	285.3216	315.3006	(64)

Total per year (kWh/year) = Sum(64)m = 3146.1275 (64)
12Total per year (kWh/year) 3146 (64)
Electric shower(s)

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

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

149.7287	133.5226	144.1325	131.5963	131.0016	97.2715	97.2917	99.9216	99.6861	134.0676	137.3007	148.6831	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	110.6826	122.5414	110.6826	114.3720	110.6826	114.3720	110.6826	110.6826	114.3720	110.6826	114.3720	110.6826	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)	201.2483	198.6944	193.7265	182.7727	176.0774	135.0994	130.7684	134.3032	138.4529	180.1984	190.6954	199.8428	(72)
Total internal gains	591.3143	602.8963	580.3314	560.8510	535.0457	483.2640	465.5613	466.8190	480.3963	530.6685	560.2754	580.2265	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.8000	11.2829	0.6300	0.7000	0.7700	30.3443	(75)
Southeast	5.3000	36.7938	0.6300	0.7000	0.7700	59.5968	(77)
Southwest	6.2000	36.7938	0.6300	0.7000	0.7700	69.7170	(79)

Solar gains	159.6580	282.0358	412.6657	556.1868	663.9345	677.1497	645.3469	562.2080	461.9340	318.9281	193.0690	135.4463	(83)
Total gains	750.9723	884.9322	992.9971	1117.0378	1198.9802	1160.4137	1110.9083	1029.0270	942.3303	849.5966	753.3444	715.6728	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.3603	38.5469	38.7354	39.7061	39.9061	40.9371	40.9371	41.1498	40.5184	39.9061	39.5081	39.1179	
alpha	3.5574	3.5698	3.5824	3.6471	3.6604	3.7291	3.7291	3.7433	3.7012	3.6604	3.6339	3.6079	
util living area	0.8673	0.7994	0.7080	0.5636	0.4203	0.2970	0.2145	0.2405	0.3933	0.6175	0.7985	0.8795	(86)
Living	20.5038	20.5758	20.6454	20.7105	20.7368	20.7498	20.7515	20.7521	20.7441	20.7062	20.6096	20.4994	
Non living	19.7117	19.8019	19.8878	19.9782	20.0100	20.0398	20.0412	20.0453	20.0278	19.9780	19.8594	19.7182	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.7462	20.5758	20.6454	20.7105	20.7368	20.7498	20.7515	20.7521	20.7441	20.7062	20.6096	20.5694	(87)
Th 2	20.3196	20.3227	20.3257	20.3412	20.3443	20.3598	20.3598	20.3629	20.3536	20.3443	20.3381	20.3319	(88)
util rest of house	0.8548	0.7830	0.6870	0.5385	0.3928	0.2680	0.1835	0.2075	0.3584	0.5877	0.7796	0.8680	(89)
MIT 2	20.0772	19.8019	19.8878	19.9782	20.0100	20.0398	20.0412	20.0453	20.0278	19.9780	19.8594	19.8288	(90)
Living area fraction										fLA = Living area / (4) =		0.3500	(91)
MIT	20.3114	20.0728	20.1530	20.2345	20.2644	20.2883	20.2898	20.2927	20.2785	20.2329	20.1220	20.0880	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3114	20.0728	20.1530	20.2345	20.2644	20.2883	20.2898	20.2927	20.2785	20.2329	20.1220	20.0880	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8547	0.7766	0.6814	0.5343	0.3895	0.2647	0.1801	0.2039	0.3543	0.5824	0.7730	0.8635	(94)
Useful gains	641.8376	687.2468	676.5795	596.8390	466.9517	307.1541	200.0195	209.7806	333.8940	494.8037	582.3618	617.9669	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	927.5432	874.7060	783.2599	634.3552	476.9209	308.7835	200.2955	210.2188	338.8601	536.4187	732.4496	902.5718	(97)
Space heating kWh	212.5650	125.9726	79.3702	27.0117	7.4171	0.0000	0.0000	0.0000	0.0000	30.9616	108.0632	211.7461	(98a)
Space heating requirement - total per year (kWh/year)												803.1074	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	212.5650	125.9726	79.3702	27.0117	7.4171	0.0000	0.0000	0.0000	0.0000	30.9616	108.0632	211.7461	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												803.1074	
Space heating per m2											(98c) / (4) =	10.0388	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	510.2675	401.6999	410.4249	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9810	0.9899	0.9862	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	500.5798	397.6291	404.7470	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1295.9847	1240.7100	1146.4043	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	572.6916	627.2522	551.7930	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.8875	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	127.0659	139.1716	122.4291	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												388.6666	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	193.7122	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	212.5650	125.9726	79.3702	27.0117	7.4171	0.0000	0.0000	0.0000	0.0000	30.9616	108.0632	211.7461	(98)
Space heating efficiency (main heating system 1)	193.7122	193.7122	193.7122	193.7122	193.7122	0.0000	0.0000	0.0000	0.0000	193.7122	193.7122	193.7122	(210)
Space heating fuel (main heating system)	109.7324	65.0308	40.9733	13.9442	3.8289	0.0000	0.0000	0.0000	0.0000	15.9833	55.7854	109.3096	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	318.4455	282.4666	301.6147	268.1657	262.1232	207.9236	205.1634	213.0729	215.1853	271.3445	285.3216	315.3006	(64)
Efficiency of water heater												175.0243	(216)
(217)m	175.0243	175.0243	175.0243	175.0243	175.0243	175.0243	175.0243	175.0243	175.0243	175.0243	175.0243	175.0243	(217)
Fuel for water heating, kWh/month	181.9436	161.3870	172.3273	153.2162	149.7639	118.7970	117.2200	121.7390	122.9459	155.0324	163.0183	180.1467	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	31.7665	34.7929	30.6073	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	10.7139	9.6771	10.7139	10.3683	10.7139	10.3683	10.7139	10.7139	10.3683	10.7139	10.3683	10.7139	(231)
Lighting	21.3994	17.1674	15.4574	11.3247	8.7475	7.1468	7.9798	10.3725	13.4728	17.6770	19.9662	21.9942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-21.4157	-33.4587	-53.3619	-65.7824	-76.0267	-71.6404	-70.6078	-64.1804	-53.1580	-40.2744	-24.4563	-18.0846	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.0332	-11.8826	-26.5407	-44.3431	-62.0356	-64.7647	-63.7239	-51.9661	-35.7747	-18.4682	-7.1661	-3.8729	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	414.5879	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	175.0243	
Water heating fuel used	1797.5374	(219)
Space cooling fuel	97.1667	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5170)		
mechanical ventilation fans (SFP = 0.5170)	126.1480	(230a)
Total electricity for the above, kWh/year	126.1480	(231)
Electricity for lighting (calculated in Appendix L)	172.7058	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-988.0192	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	1620.1265	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	414.5879	0.1579	65.4745	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1797.5374	0.1416	254.4889	(264)
Space and water heating			319.9633	(265)
Space cooling	97.1667	0.1143	11.1020	(266)
Pumps, fans and electric keep-hot	126.1480	0.1387	17.4983	(267)
Energy for lighting	172.7058	0.1443	24.9268	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-592.4475	0.1328	-78.6768	
PV Unit electricity exported	-395.5718	0.1231	-48.6943	
Total			-127.3710	(269)
Total CO2, kg/year			246.1194	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0800	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	414.5879	1.5846	656.9449	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1797.5374	1.5235	2738.6313	(278)
Space and water heating			3395.5762	(279)
Space cooling	97.1667	1.4211	138.0816	(280)
Pumps, fans and electric keep-hot	126.1480	1.5128	190.8367	(281)
Energy for lighting	172.7058	1.5338	264.9019	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-592.4475	1.4907	-883.1651	
PV Unit electricity exported	-395.5718	0.4517	-178.6863	
Total			-1061.8514	(283)
Total Primary energy kWh/year			2927.5448	(286)
Dwelling Primary energy Rate (DPER)			36.5900	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	80.0000	(1b)	x 2.5000	(2b) =	200.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		200.0000	(5)

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2. Ventilation rate

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m3 per hour

Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1500	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4335	0.4250	0.4165	0.3740	0.3655	0.3230	0.3230	0.3145	0.3400	0.3655	0.3825	0.3995	(22b)
Effective ac	0.5940	0.5903	0.5867	0.5699	0.5668	0.5522	0.5522	0.5495	0.5578	0.5668	0.5732	0.5798	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			17.9000	1.1450	20.4962			(27)
Heatloss Floor 1			0.1000	0.1300	0.0130			(28a)
External Wall 1	38.5000	17.9000	20.6000	0.1800	3.7080			(29a)
Communal Wall	10.0000	2.1000	7.9000	0.1800	1.4220			(29a)
External Roof 1	12.0000		12.0000	0.1100	1.3200			(30)
Total net area of external elements Aum(A, m2)			60.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.0592			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000	(35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	11.0000	0.0500	0.5500
E3 Sill	11.0000	0.0500	0.5500
E4 Jamb	41.0000	0.0500	2.0500
E5 Ground floor (normal)	0.0000	0.1600	0.0000
E16 Corner (normal)	5.0000	0.0900	0.4500
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E7 Party floor between dwellings (in blocks of flats)	26.0000	0.0700	1.8200
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E14 Flat roof	10.0000	0.0800	0.8000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2950	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	35.3542	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.2014	38.9606	38.7246	37.6159	37.4085	36.4429	36.4429	36.2640	36.8148	37.4085	37.8281	38.2668	(38)
Heat transfer coeff	74.5556	74.3148	74.0788	72.9701	72.7627	71.7970	71.7970	71.6182	72.1690	72.7627	73.1823	73.6210	(39)
Average = Sum(39)m / 12 =												72.9691	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9319	0.9289	0.9260	0.9121	0.9095	0.8975	0.8975	0.8952	0.9021	0.9095	0.9148	0.9203	(40)
HLP (average)												0.9121	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4629	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
65.5138	64.5292	63.0946	60.3496	58.3238	56.0648	54.7807	56.2045	57.7653	60.1909	62.9948	65.2628	(42a)

Hot water usage for baths

28.2963	27.8761	27.2843	26.1931	25.3761	24.4701	23.9808	24.5684	25.2083	26.1777	27.2913	28.2006	(42b)

Hot water usage for other uses

39.8522	38.4030	36.9538	35.5047	34.0555	32.6063	32.6063	34.0555	35.5047	36.9538	38.4030	39.8522	(42c)

Average daily hot water use (litres/day)		122.8659	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	133.6623	130.8083	127.3327	122.0474	117.7554	113.1412	111.3678	114.8284	118.4782	123.3223	128.6891	133.3156	(44)
Energy conte	211.6883	186.2693	195.7056	167.0767	158.5214	139.1203	134.6897	142.1816	146.0955	167.3473	183.3412	208.7400	(45)
Energy content (annual)										Total = Sum(45)m =		2040.7768	
Distribution loss (46)m = 0.15 x (45)m	31.7533	27.9404	29.3558	25.0615	23.7782	20.8680	20.2035	21.3272	21.9143	25.1021	27.5012	31.3110	(46)
Water storage loss:													
Store volume												201.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6575	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8950	(55)
Total storage loss	27.7463	25.0612	27.7463	26.8513	27.7463	26.8513	27.7463	27.7463	26.8513	27.7463	26.8513	27.7463	(56)
If cylinder contains dedicated solar storage	27.7463	25.0612	27.7463	26.8513	27.7463	26.8513	27.7463	27.7463	26.8513	27.7463	26.8513	27.7463	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	262.6971	232.3417	246.7143	216.4400	209.5302	188.4836	185.6984	193.1903	195.4587	218.3560	232.7045	259.7487	(62)
WWHRS	-29.9502	-26.4882	-27.7369	-22.9672	-21.4046	-18.3161	-17.1684	-18.2569	-18.9505	-22.3406	-25.3092	-29.3955	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)

Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	232.7469	205.8535	218.9774	193.4728	188.1255	170.1675	168.5300	174.9334	176.5082	196.0154	207.3953	230.3532	(64)
Total per year (kWh/year) = Sum(64)m =												2363.0790	(64)
12Total per year (kWh/year)												2363	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	111.1934	98.7925	105.8791	95.0436	93.5154	85.7481	85.5913	88.0824	88.0674	96.4499	100.4516	110.2130	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	110.6754	122.5335	110.6754	114.3646	110.6754	114.3646	110.6754	110.6754	114.3646	110.6754	114.3646	110.6754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)	149.4534	147.0126	142.3106	132.0051	125.6927	119.0946	115.0421	118.3903	122.3158	129.6370	139.5161	148.1358	(72)
Total internal gains	542.5123	554.2067	531.9084	513.0760	487.6539	467.2519	449.8279	450.8989	464.2519	483.1000	512.0887	531.5124	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.7600	11.2829	0.6300	0.7000	0.7700	26.7581	(75)
Southeast	4.6700	36.7938	0.6300	0.7000	0.7700	52.5126	(77)
Southwest	5.4700	36.7938	0.6300	0.7000	0.7700	61.5084	(79)

Solar gains	140.7791	248.6869	363.8723	490.4261	585.4364	597.0901	569.0470	495.7362	407.3160	281.2173	170.2395	119.4302	(83)
Total gains	683.2915	802.8936	895.7807	1003.5021	1073.0903	1064.3420	1018.8749	946.6352	871.5679	764.3173	682.3283	650.9426	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8062	29.9028	29.9981	30.4539	30.5407	30.9514	30.9514	31.0287	30.7919	30.5407	30.3656	30.1846	
alpha	2.9871	2.9935	2.9999	3.0303	3.0360	3.0634	3.0634	3.0686	3.0528	3.0360	3.0244	3.0123	
util living area	0.9173	0.8749	0.8135	0.7019	0.5626	0.4124	0.3041	0.3390	0.5219	0.7485	0.8769	0.9258	(86)
MIT	19.2951	19.6363	20.0453	20.5039	20.7970	20.9425	20.9830	20.9761	20.8798	20.4865	19.8375	19.2437	(87)
Th 2	20.1404	20.1430	20.1455	20.1572	20.1594	20.1697	20.1697	20.1716	20.1657	20.1594	20.1550	20.1503	(88)
util rest of house	0.9073	0.8609	0.7933	0.6724	0.5230	0.3638	0.2488	0.2810	0.4697	0.7157	0.8608	0.9168	(89)
MIT 2	18.1555	18.5788	19.0810	19.6342	19.9656	20.1242	20.1596	20.1567	20.0642	19.6295	18.8444	18.0981	(90)
Living area fraction									fLA = Living area / (4) =			0.3500	(91)
MIT	18.5543	18.9489	19.4185	19.9386	20.2566	20.4106	20.4478	20.4435	20.3497	19.9294	19.1920	18.4991	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5543	18.9489	19.4185	19.9386	20.2566	20.4106	20.4478	20.4435	20.3497	19.9294	19.1920	18.4991	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8848	0.8380	0.7742	0.6642	0.5277	0.3781	0.2675	0.3003	0.4816	0.7060	0.8392	0.8950	(94)
Useful gains	604.5423	672.8464	693.5174	666.5363	566.2873	402.4615	272.5464	284.2400	419.7354	539.6048	572.6436	582.6235	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1062.7409	1044.0441	956.9854	805.4845	622.6003	417.1833	276.2598	289.5885	451.0320	678.8335	884.9179	1052.7125	(97)
Space heating kWh	340.8998	249.4448	196.0202	100.0427	41.8969	0.0000	0.0000	0.0000	0.0000	103.5862	224.8375	349.7462	(98a)
Space heating requirement - total per year (kWh/year)												1606.4742	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	340.8998	249.4448	196.0202	100.0427	41.8969	0.0000	0.0000	0.0000	0.0000	103.5862	224.8375	349.7462	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1606.4742	
Space heating per m2											(98c) / (4) =	20.0809	(99)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	340.8998	249.4448	196.0202	100.0427	41.8969	0.0000	0.0000	0.0000	0.0000	103.5862	224.8375	349.7462	(98)

Space heating efficiency (main heating system 1)

92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)

Space heating fuel (main heating system)

369.3389	270.2544	212.3729	108.3886	45.3921	0.0000	0.0000	0.0000	0.0000	112.2277	243.5943	378.9233	(211)

Space heating efficiency (main heating system 2)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)

Space heating fuel (main heating system 2)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)

Space heating fuel (secondary)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement

232.7469	205.8535	218.9774	193.4728	188.1255	170.1675	168.5300	174.9334	176.5082	196.0154	207.3953	230.3532	(64)

Efficiency of water heater 79.8000 (216)

(217)m 84.9144	84.4916	83.8123	82.6553	81.3008	79.8000	79.8000	79.8000	79.8000	82.6979	84.2413	84.9936	(217)

Fuel for water heating, kWh/month

274.0960	243.6378	261.2712	234.0718	231.3943	213.2425	211.1905	219.2148	221.1882	237.0259	246.1921	271.0242	(219)

Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa 7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting 22.9962	18.4484	16.6107	12.1697	9.4002	7.6801	8.5752	11.1464	14.4781	18.9960	21.4559	23.6353	(232)

Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m -21.3196	-31.5249	-47.5009	-56.0679	-62.7867	-59.4496	-58.7152	-54.2685	-46.8411	-37.2010	-23.9513	-18.2641	(233a)

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

(234a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235c)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m -7.9643	-17.0960	-34.6269	-52.9727	-71.0002	-71.6970	-70.8626	-59.5671	-43.0906	-24.7725	-10.7359	-6.2735	(233b)

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

(234b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	1740.4921	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2863.5491	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	185.5923	(232)

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

PV generation	-988.5501	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3887.0834	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1740.4921	0.2100	365.5033	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2863.5491	0.2100	601.3453	(264)
Space and water heating			966.8487	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	185.5923	0.1443	26.7867	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-517.8909	0.1336	-69.1893	
PV Unit electricity exported	-470.6592	0.1254	-59.0006	
Total			-128.1899	(269)
Total CO2, kg/year			877.3747	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.9700	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1740.4921	1.1300	1966.7561	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2863.5491	1.1300	3235.8105	(278)
Space and water heating			5202.5666	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	185.5923	1.5338	284.6676	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-517.8909	1.4937	-773.5739	
PV Unit electricity exported	-470.6592	0.4601	-216.5605	
Total			-990.1344	(283)
Total Primary energy kWh/year			4627.2006	(286)
Target Primary Energy Rate (TPER)			57.8400	(287)

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