WEBB YATES ENGINEERS

Sustainability, Energy & Overheating Report

J5106 Maresfield Gardens

Ref: J5106-E-RP-0001
Revision: 02
Status: S3

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REVISION HISTORY

Revision	Status	Date	Author	Reviewer	Approver
00	S3	13/06/2023	AE	ES	ES
01	S3	10/07/2023	RG	ES	ES
02	S3	10/07/2023	RG	ES	ES

1. INTRODUCTION

This report sets out the energy strategy for the proposed development and gives guidance on what fabric performance needs to be achieved in order to meet Building Regulations Part L compliance, along with measures in order to mitigate the risk of summertime overheating. In developing this strategy local and regional planning policies have been addressed.

Maresfield Gardens is a development which consists of the refurbishment of an existing house along with the construction of a basement and kitchen extension of a four-bedroom house, spread over four storeys located in London.

The energy consumption of the development has been assessed in line with the Local policy and the CO_2 emission savings have been estimated using SAP software.

This report identifies the proposed energy strategy to meet Building Regulations Part L requirements.

2. SUSTAINABILITY STRATEGY

With the existing extension being constructed in 2007, the current fabric quality is poorer than what is currently required from Building Regulations. New works would see a significant improvement to U-value of external walls if compared to limits set for retained and refurbished elements. The demolition of and replacement of extension would see an improvement to if the extension was retained and refurbished. This would lead to large savings in CO_2 emissions over a 60-year lifespan.

With the extension being replaced, it is also proposed to replace the existing boiler system providing heating and hot water to the whole house. Taking this under consideration, the proposed extension would lead to a significant improvement in energy consumption and savings for the whole development.

2.1. Primary Sustainable options

2.1.1. MVHR (Mechanical Ventilation with Heat Recovery)

The basement will be mechanically ventilated by supply and extract mechanical ventilation heat recovery MVHR systems. MVHRs are an extremely energy efficient way of ventilating spaces while recovering some of the heat out of the rooms extract air into the supply via heat transfer. The heat recovery process takes away almost all the ventilation heat losses which improves the efficiency of the internal space heating loads. The unit fan pulls in fresh air from outside, through the heat recovery element within the unit and supplies the internal space. The extract fan reverses the process and takes the air from the internal supply, through the heat recovery element and exhausts to outside. Whilst the supply and extract air cross over through the unit, the temperature from the extract mixes with the supply without coming in contact, via a heat exchanger. Efficient MVHR units typically heat from 0°C to 18°C through heat transfer when the extract air is 20 °C.

The supply flow rate is matched to the extract flow rates and are sized by using Building Regulations Part F. The units will be SAP Appendix Q compliant and have a specific fan power of 0.9W/l/s or less and a heat exchanger efficiency of at least 88%, as certified by the BRE.

2.1.2. ASHP (Air Source Heat Pumps)

The buildings hot water and heating will be primarily produced via ASHPs located on the ground floor external plant space. The ASHPs will heat the water up to 55 °C and will be stored in hot water storage cylinders located in the basement plant room.

An air source heat pump extracts heat energy from the air which is used to heat up the buildings water supply/storage for hot water. This is achieved by using a compressor and refrigerant cycle to reach an efficient water temperature that can be used to provide heating or hot water. A well-designed heat pump system transfers around three to four times more energy into heat then it uses to extract it. As a result, heat pumps are incredibly efficient.

The end-users will be supplied with regular information to control and operate the system e.g. at point of occupancy and maintenance visits.

The performance of the heat pump system will need to be monitored postconstruction to ensure it is achieving the expected performance approved during planning as specified in the mechanical design documentation.

2.1.3. Fabric Upgrades

Fabric upgrades will be made to the building to reduce heat and cooling loads. The reduction in heating and cooling loads will result in the building being more energy efficient as it will keep the temperature of the building at more of a constant and will reduce the requirements to use the cooling or heating systems for longer, saving energy. It will also decrease loss of heat energy from internal to external.

3. ENERGY ASSESSMENT

An energy assessment has been carried out to demonstrate how the targets for regulated CO_2 emissions reduction over and above 2021 Building Regulations will be met. The energy assessment has also been carried in order to provide guidance on what minimum fabric performance needs to be achieved in order to meet Building Regulations Part L compliance.

As part of planning policy, the following criteria apply:

- The development should minimise carbon emissions to as high a degree possible

For the purpose of the energy assessment, the energy demand has been calculated using the approved SAP software.

See Appendix A for full SAP results.

3.1. Part L Requirements

As an existing building with no change of use, the refurbishment of existing building has different Part L requirements than the new portions of the development. As part of proposed improvements, any retained thermal elements will need to be upgraded to the following minimum performance if current U-values exceed the threshold values wherever possible. Improvement to wall and roof constructions are proposed. As more than 25% of the external envelope will undergo renovation, the development is classified as a major renovation and needs to comply with paragraph L1 of Schedule 1.

Table 4.3 Limiting U-values for existing elements in existing dwellings

Element	U-value[1] W/(m²·K)	
	(a) Threshold	(b) Improved
Roof[2][3][4]	0.35	0.16
Wall – cavity insulation[2][5]	0.70	0.55
Wall – internal or external insulation[2][6]	0.70	0.30
Floor[7][8]	0.70	0.25

For the basement and kitchen extension, the proposed constructions will need to achieve the following minimum U-values.

Table 4.2 Limiting U-values for new fabric elements in existing dwellings

Element type	Maximum U-value[1] W/(m²·K)
Roof[2]	0.15
Wall[2][3]	0.18
Floor[4][5]	0.18
Swimming pool basin[6]	0.25
Window[7][8][9]	1.4 or Window Energy Rating[10] Band B minimum
Rooflight[11][12]	2.2
Doors with >60% of internal face glazed[13]	1.4 or Doorset Energy Rating[10] Band C minimum
Other doors[13][14]	1.4 or Doorset Energy Rating[10] Band B minimum

Compliance at the design stage is demonstrated by calculating the CO_2 emissions rate for the proposed development, known as the Building Emissions Rate (BER), which is compared to an equivalent notional building of the same geometry but with a set of benchmark performance characteristics as specified in the 2010 NCM modelling guide, known as the Target Emissions Rate (TER). Compliance is achieved when the BER is lower than TER.

In addition to the requirement for the BER to be lower than the TER of the notional building, each dwelling needs to achieve a lower dwelling fabric energy efficiency (DFEE) than the notional target fabric energy efficiency (TFEE) and lower primary energy rate than that of the notional.

The target U-values and air permeability rate given in the following section have been selected in order to meet these three criteria stipulated by Part L.

In accordance with Part L Section 10.10, Part L compliance for the extension is achieved by demonstrating that the BER, DFEE and DPER of the proposed refurbished building and new extension is lower than that of the existing house and notional extension.

3.2. SAP Model Input

The following fabric U-values have been assigned in order to meet dwelling fabric energy efficiency (DFEE) compliance. An airtightness of 3 m^3m^2h at 50Pa has been assumed for the extension. As can be seen these U-values are in line with those indicated on architectural detail drawings. It is currently not proposed to replace the windows of the existing house.

Element	Proposed U-Value [W/m^2K] Design
Upgraded External Wall	0.28
Upgraded Roof	0.16
Existing Windows	2.90
New External Wall	0.18
New Floor	0.18
New Roof	0.15
New Windows	1.40
New Rooflights	2.20

Heating and hot water is provided via an ASHP system with a COP of 2.5. An MVHR system provides supply ventilation to habitable spaces and extract in kitchen and wet rooms with a heat recovery efficiency of 88%. The lighting has been assumed to have a minimum luminous efficacy of 95lm/W. A PV installation is not currently proposed for the development. Ventilation ductwork insulation is specified as type 2, in order to meet the dwelling primary energy rate criteria.

3.3. Results

SAP results demonstrate that the combined dwelling carbon dioxide emission rate calculated is 69.10% below the target CO_2 emission rate therefore meeting Part L compliance. The dwelling fabric efficiency also passes, but marginally by 0.17%. Lower performance of fabric U-values would mean the target fabric energy efficiency may not be met. The dwelling primary energy rate passes by 44.31% over the target primary energy rate.

	Existing	Refurbishment	Notional Extension	Extension
DER	20.51	4.39	8.18	4.54
DFEE	74.5	63.4	52.9	61.1
DPER	117.09	44.94	46.31	47.14

	Baseline	Proposed	Improvement (%)	Pass/Fail
DER	15.16	4.46	70.61	Pass
DFEE	65.13	62.40	4.18	Pass
DPER	86.37	45.89	46.87	Pass

4. OVERHEATING RISK ANALYSIS

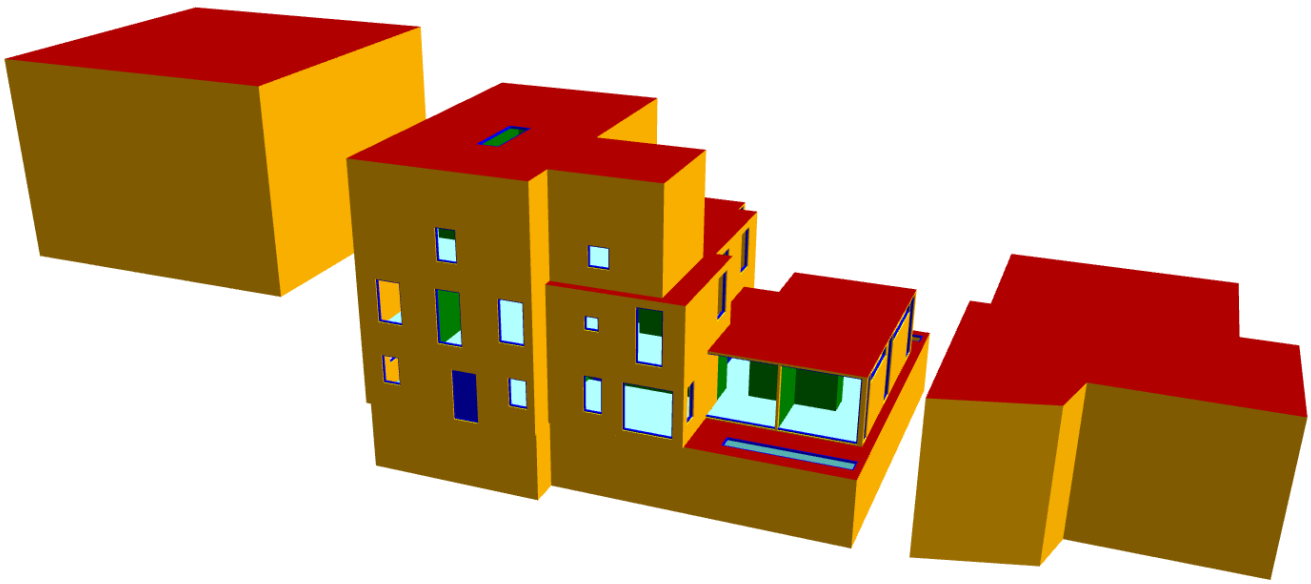
The development's design was tested in order to gauge its capabilities of mitigating overheating risk during summer months. **CIBSE TM59: Design methodology for the assessment of overheating risk in homes** was used to assess to assess this. In accordance with TM59 the following criteria need to be met.

1) The number of hours during which delta T of indoor air temperature to outdoor is greater than or equal to one degree (K) during the period of May to September shall not exceed 3% of occupied hours.

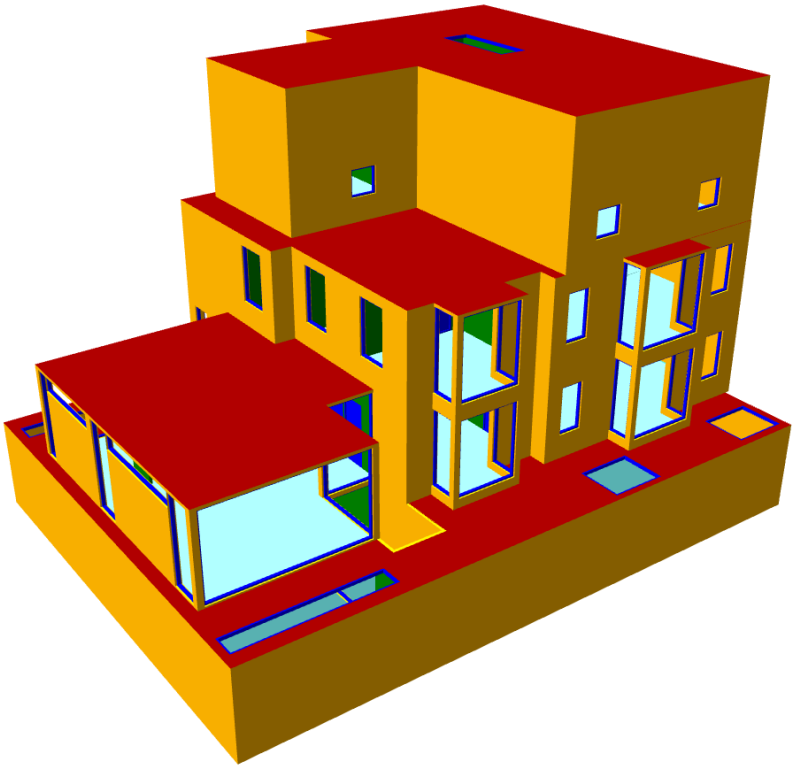
2) For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26˚C for more than 1% of annual hours

In accordance with CIBSE TM59, compliance needs to be achieved for DSY1 2020 50th percentile high emissions scenario. The weather file for London Heathrow, simulating a suburban environment was used for selected for testing.

A dynamic energy model of the property in order to test its summer overheating performance was created in TAS. The model considers the massing, orientation and external shading elements of the building.



Existing glazing is assumed to have an approximate g-value of 0.7 with new glazing set to 0.4. Degree of window openings of new and existing glazing were modelled based on architectural elevations. Window opening schedules have been modelled in accordance with guidance from TM59 and Building Regulations Part O: Overheating. Ground Floor windows have been modelled as closed at night-time due to perceived security risk. U-values were assigned based on requirements to meet Part L compliance as previously discussed.



Element	Proposed U-Value [W/m²K] Design
Upgraded External Wall	0.28
Upgraded Roof	0.16
Existing Windows	2.90
New External Wall	0.18
New Floor	0.18
New Roof	0.15
New Windows	1.40
New Rooflights	2.20

A summary of testing can be seen below. Living areas need to achieve 59 hours or below to achieve Criterion 1 and bedrooms need to achieve 110 hours or below. Additionally, bedrooms need to achieve 32 hours or below to be compliant with Criterion 2.

As results indicate, there is high risk of overheating in rooms of the existing house. It will not be possible to fit external shading elements or blinds to this building. Due to its high risk of overheating and limited potential to reduce risk via passive measures it is deemed that mechanical cooling will be needed for habitable spaces.

For the portions of extension, it is proposed to provide mechanical cooling to Basement Gym, Media Room and Pool Room. With TM59 not providing representative internal conditions and occupancy profiles for these type of spaces, it is believed that risk of overheating is considerably underestimated. Design specialists of each respective room are to advise on cooling requirements.

Due to the proportion of glazing area, the kitchen is at risk of overheating. Various options to mitigate risk were considered. Due to degree of failure at baseline scenario, minor means of improvement such as improving the *g*-value from 0.4 to 0.3 were disregarded.
External blinds of a transparency 7% were applied to all glazing within the extension. With this degree of shading, the room meets TM59 criteria when tested against DSY1. Considering future weather scenarios and more intense heat spells of DSY2 and DSY3, the space is at risk of overheating and so it is been considered to make allowance for mechanical cooling to mitigate overheating in a limited amount of hours of the year. Results show that with the measures available, TM59 compliance will be difficult to achieve and mechanical cooling is therefore proposed.

	Baseline			External Blinds		
Zone Name	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms.	Result	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms.	Result
1st - Bedroom II	120	42	Fail	117	41	Fail
1st - Bedroom III	436	205	Fail	432	206	Fail
1st - Master Bedroom	198	78	Fail	197	77	Fail
2nd - Bedroom IV	3	67	Fail	3	67	Fail
2nd - Study	0	N/A	Pass	0	N/A	Pass
Basement - Games/Media	0	N/A	Pass	0	N/A	Pass
Basement - Gym	0	N/A	Pass	0	N/A	Pass
Basement - Pool	0	N/A	Pass	0	N/A	Pass
GF - Dining Room	0	N/A	Pass	0	N/A	Pass
GF - Drawing Room	104	N/A	Fail	103	N/A	Fail
GF - Kitchen	121	N/A	Fail	34	N/A	Pass
GF - Study	0	N/A	Pass	0	N/A	Pass

5. CONCLUSION

In line with the Local Plan and Part L 2021 compliance, this report outlines the requirements for the development in terms energy efficiency and fabric efficiency along with mitigating overheating risk. Target U-values and air permeability have been selected on this basis.

	Baseline	Proposed	Improvement (%)	Pass/Fail
DER	15.16	4.46	70.61	Pass
DFEE	65.13	62.40	4.18	Pass
DPER	86.37	45.89	46.87	Pass

As can be seen the fabric energy efficiency, dwelling emission rate and primary energy rate for the building is lower than that of the notional. Therefore, demonstrating full compliance with Building Regulations Part L Volume 1.

APPENDIX A – SAP REPORT

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Stroma SAP 10.2 SAP 10 program, 10.2

Date: Tue 13 Jun 2023 10:27:49

Project Information			
Assessed By	Webb Yates Engineers	Building Type	House, Detached
OCDEA Registration	STRO037816	Assessment Date	2023-05-17

Dwelling Details			
Assessment Type	As designed	Total Floor Area	446 m^2
Site Reference	J5106 - Existing Maresfield Gardens	Plot Reference	Refurb
Address	NW3 5RX		

Client Details	
Name	Not Provided
Company	Not Provided
Address	Not Provided, Not Provided, WF10 5QU

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*8.49 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	20.51 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*45.14 kWh_{PE}/m^2*	
Dwelling primary energy	117.09 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*43.9 kWh/m^2*	
Dwelling fabric energy efficiency	74.5 kWh/m^2	**FAIL**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.36	External Wall (0.37)	**FAIL**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.45	Floor (0.45)	**FAIL**
Roofs	*0.16*	0.24	Pitched Roof (0.25)	**FAIL**
Windows, doors, and roof windows	*1.6*	2.81	2 (2.9)	**FAIL**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: External Wall	237.72	0.37
Exposed wall: Replaced Wall	17.67	0.18
Ground floor: Floor	17.02	0.45
Exposed roof: Pitched Roof	285.83	0.25
Exposed roof: Flat Roof	18.64	0.15

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
1, Doors	4.65	West	N/A	1 **(!)**
2, Windows (1)	21.41	West	0.9	2.9
3, Windows (1)	14.53	North	0.9	2.9
4, Windows (1)	28.76	East	0.9	2.9
5, Windows (1)	3.06	South	0.9	2.9
6, Roof windows (1)	1.26	West	0.9	2.9
7, Roof windows (1)	2.44	North	0.9	2.9
8, Roof windows (1)	2.96	East	0.9	2.9
9, Roof windows (1)	4	South	0.9	2.9
10, Roof windows (1)	10.66	South	0.9	2.9

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1 - Main Dwelling**: SAP default y-value (0.2 W/m^{2}K) used for thermal bridging

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	10 m^3/hm^2, Design value	**FAIL**
Air permeability test certificate reference	Not Provided	

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	80.0%
Emitter type	Radiators
Flow temperature	
System type	
Manufacturer	
Model	
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Programmer, TRVs, and bypass	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: N/A	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	90 lm/W	**OK**
External lights control	N/A	

8 Mechanical ventilation		
System type: N/A		
Maximum permitted specific fan power	*N/A*	
Specific fan power	N/A	**N/A**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model		
Commissioning		

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Stroma SAP 10.2 SAP 10 program, 10.2

Date: Tue 13 Jun 2023 10:25:21

Project Information			
Assessed By	Webb Yates Engineers	Building Type	House, Detached
OCDEA Registration	STRO037816	Assessment Date	2023-05-17

Dwelling Details			
Assessment Type	As designed	Total Floor Area	446 m^2
Site Reference	J5106 - Refurbishment Maresfield Gardens	Plot Reference	Refurb
Address	NW3 5RX		

Client Details	
Name	Not Provided
Company	Not Provided
Address	Not Provided, Not Provided, WF10 5QU

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*8.46 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	4.39 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*44.97 kWh_{PE}/m^2*	
Dwelling primary energy	44.96 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*43.6 kWh/m^2*	
Dwelling fabric energy efficiency	63.4 kWh/m^2	FAIL

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.27	External Wall (0.28)	FAIL
Party walls	*0.2*	N/A	N/A	N/A
Curtain walls	*1.6*	N/A	N/A	N/A
Floors	*0.18*	0.45	Floor (0.45)	FAIL
Roofs	*0.16*	0.16	Pitched Roof (0.16)	OK
Windows, doors, and roof windows	*1.6*	2.52	2 (2.9)	FAIL
Rooflights	*2.2*	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: External Wall	235.13	0.28
Exposed wall: Replaced Wall	17.67	0.18
Ground floor: Floor	17.02	0.45
Exposed roof: Pitched Roof	285.39	0.16
Exposed roof: Flat Roof	29.3	0.15

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
1, Doors	4.65	West	N/A	1 **(!)**
2, Windows (1)	21.41	West	0.9	2.9
3, Windows (1)	9.62	North	0.9	2.9
4, Windows (1)	25.82	East	0.9	2.9
5, Windows (1)	3.06	South	0.9	2.9
6, Windows (2)	2.68	North	0.9	1.4
7, Windows (2)	2.94	East	0.9	1.4
8, Windows (2)	4.82	South	0.9	1.4
9, Roof windows (1)	1.26	West	0.9	2.9
10, Roof windows (1)	2.44	North	0.9	2.9
11, Roof windows (1)	1.7	East	0.9	2.9

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
12, Roof windows (2)	4	South	0.9	1.4
13, Roof windows (2)	0.85	West	0.9	1.4
14, Roof windows (2)	0.85	East	0.9	1.4

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1 - Main Dwelling**: SAP default y-value (0.2 W/m^2K) used for thermal bridging

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	8 m^3/hm^2, Design value	OK
Air permeability test certificate reference	Not Provided	

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	250.0%
Emitter type	Underfloor
Flow temperature	
System type	
Manufacturer	
Model	
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Programmer, TRVs, and bypass	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: N/A	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	95 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation		
System type: N/A		
Maximum permitted specific fan power	*N/A*	
Specific fan power	N/A	**N/A**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model		
Commissioning		

9 Local generation
N/A

10 Heat networks

N/A

11 Supporting documentary evidence

N/A

12 Declarations

a. Assessor Declaration

This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:

b. Client Declaration

N/A

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Stroma SAP 10.2 SAP 10 program, 10.2

Date: Fri 07 Jul 2023 14:37:53

Project Information			
Assessed By	Webb Yates Engineers	Building Type	House, Detached
OCDEA Registration	STRO037816	Assessment Date	2023-05-17

Dwelling Details			
Assessment Type	As designed	Total Floor Area	342 m^2
Site Reference	J5106 - Extension Maresfield Gardens	Plot Reference	J5106
Address	NW3 5RX		

Client Details	
Name	Not Provided
Company	Not Provided
Address	Not Provided, Not Provided, WF10 5QU

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*8.18 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	4.54 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*46.31 kWh_{PE}/m^2*	
Dwelling primary energy	47.14 kWh_{PE}/m^2	FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*52.9 kWh/m^2*	
Dwelling fabric energy efficiency	61.1 kWh/m^2	FAIL

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Basement Wall (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.18	Basement Floor (0.18)	OK
Roofs	*0.16*	0.15	GF Roof (0.15)	OK
Windows, doors, and roof windows	*1.6*	1.51	5 (2.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Basement wall: Basement Wall	275.1	0.18
Exposed wall: GF Wall	26.624	0.18
Basement floor: Basement Floor	283.7	0.18
Exposed roof: GF Roof	78.159	0.15
Exposed roof: Basement Roof	67.64	0.15

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
1, Windows (1)	16.51	West	0.9	1.4
2, Windows (1)	7.69	South	0.9	1.4
3, Windows (1)	16.65	East	0.9	1.4
4, Windows (1)	7.176	North	0.9	1.4
5, Roof windows (1)	7.7	South	0.9	2.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1 - Main Dwelling**: SAP default y-value (0.2 W/m^2K) used for thermal bridging

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	3 m^3/hm^2, Design value **(!)**	OK
Air permeability test certificate reference	Not Provided	

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	250.0%
Emitter type	Underfloor
Flow temperature	
System type	
Manufacturer	
Model	
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	300 litres
Declared heat loss	1.6 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Programmer, TRVs, and bypass		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	95 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	*1.5 W/(l/s)*	
Specific fan power	0.53 W/(l/s)	OK
Minimum permitted heat recovery efficiency	*73%*	
Heat recovery efficiency	90%	OK
Manufacturer/Model		
Commissioning	Not Provided / Not Provided	

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations

a. Assessor Declaration

This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.

Signed:		Assessor ID:	
Name:		Date:	

b. Client Declaration

N/A

SAP WORKSHEET

Dwelling Reference: Refurb
Dwelling Type: New Dwelling Design Stage
NW3 5RX

1. Overall dwelling dimensions

	Area(m^2)		Av. Height(m)		Volume(m^3)	
Ground Floor	170.3 (1a)	x	2.98	(2a) =	507.49	(3a)
First Floor	168.6 (1b)	x	3	(2b) =	505.8	(3b)
2nd Floor	107.2 (1c)	x	4.6	(2c) =	493.12	(3c)
Total floor area TFA					446.1	(4)
Dwelling volume					1506.41	(5)

2. Ventilation Rate

Chimneys/Flues	0	x	80	=	0	(6a)
Open chimneys	0	x	20	=	0	(6b)
Chimneys / flues attached to closed fire	0	x	10	=	0	(6c)
Flues attached to solid fuel boiler	0	x	20	=	0	(6d)
Flues attached to other heater	0	x	35	=	0	(6e)
Number of blocked chimneys	0	x	20	=	0	(6f)
Number of intermittent extract fans	6	x	10	=	60	(7a)
Number of passive vents	0	x	10	=	0	(7b)
Number of flueless gas fires	0	x	40	=	0	(7c)

	Air changes per hour		
Number of storeys in the dwelling (ns)	0.04	0.04	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0	0	(9)
Additional infiltration	0	0	(10)
Structural infiltration	0	0	(11)
Suspended wooden ground floor	0	0	(12)
No draught lobby	0	0	(13)
Percentage of windows and doors draught proofed	0	0	(14)
Window infiltration	0	0	(15)
Infiltration rate	0	0	(16)
Air permeability value, AP50, ($m^3/h/m^2$)	10	10	(17)
Air permeability value, AP4, ($m^3/h/m^2$)	0	0	(17a)
Air permeability value)	0.54	0.54	(18)
Number of sides on which dwelling is sheltered	0	0	(19)
Shelter factor		1	(20)

Infiltration rate incorporating shelter factor 0.54 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Monthly average wind speed from Table U2														
	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Wind Factor														
	1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)														
	0.69	0.67	0.66	0.59	0.58	0.51	0.51	0.5	0.54	0.58	0.61	0.63	7.09	(22b)

Calculate effective air change rate for the applicable case:

0 (23a)

0 (23b)

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR)

0	0	0	0	0	0	0	0	0	0	0	0		(24a)

b) If balanced mechanical ventilation without heat recovery (MV)

0	0	0	0	0	0	0	0	0	0	0	0		(24b)

c) If whole house extract ventilation or positive input ventilation from outside

0	0	0	0	0	0	0	0	0	0	0	0		(24c)

d) If natural ventilation or whole house positive input ventilation from loft

0.74	0.73	0.72	0.68	0.67	0.63	0.63	0.62	0.65	0.67	0.68	0.7		(24d)

Effective air change rate

0.74	0.73	0.72	0.68	0.67	0.63	0.63	0.62	0.65	0.67	0.68	0.7		(25)

Effective air change rate from PCDB:

0.74	0.73	0.72	0.68	0.67	0.63	0.63	0.62	0.65	0.67	0.68	0.7		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value

ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	4.65		(26)
Windows	176.08		(27)
Roof window	55.4		(27a)
Basement floor	0	0	(28)
Ground floor	7.66	340.4	(28a)
Exposed floor	0	0	(28b)
Basement wall	0	0	(29)
External wall	91.14	48524.1	(29a)
Roof	74.25	2740.23	(30)

Total area of external elements ∑A, m²												670.61	(31)
Party Wall							0					0	(32)
Party floor												0	(32a)
Party ceiling												0	(32b)
Internal wall **												0	(33c)
Internal floor												0	(32d)
Internal ceiling floor												0	(32e)
Fabric heat loss, W/K = ∑ (A x U)												409.18	(33)
Heat capacity Cm = ∑(A x k)												51604.73	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K												250	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K												0	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available												0	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ												409.18	(37)
Ventilation heat loss calculated monthly													
366.31	361.74	357.25	336.2	332.26	313.93	313.93	310.53	320.99	332.26	340.23	348.56		(38)
Heat transfer coefficient, W/K													
775.49	770.92	766.43	745.38	741.44	723.11	723.11	719.71	730.17	741.44	749.41	757.74		(39)
Heat loss parameter (HLP), W/m²K													
1.74	1.73	1.72	1.67	1.66	1.62	1.62	1.61	1.64	1.66	1.68	1.7		(40)
Number of days in month (Table 1a)													
31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N												3.32	(42)
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
0	0	0	0	0	0	0	0	0	0	0	0		(42a)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
92.22	90.85	88.92	85.36	82.7	79.75	78.15	80.07	82.15	85.31	88.94	91.91		(42b)
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
48.65	46.88	45.11	43.34	41.57	39.8	39.8	41.57	43.34	45.11	46.88	48.65		(42c)
Annual average hot water usage in litres per day Vd,average (from Appendix J)												129.73	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)													
140.87	137.73	134.03	128.71	124.27	119.55	117.96	121.64	125.5	130.42	135.82	140.56	1557.05	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)													
223.1	196.12	206	176.19	167.3	147	142.66	150.62	154.75	176.98	193.5	220.08	2154.3	(45)
Distribution loss (46) = 0.15 x (45)													
33.46	29.42	30.9	26.43	25.09	22.05	21.4	22.59	23.21	26.55	29.03	33.01		(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel												0	(47)
Water storage loss (or HIU loss)													
a) If manufacturer's declared loss factor is known (kWh/day):												0	(48)

Temperature factor from Table 2b 0 (49)
Energy lost from water storage, kWh/day (48) x (49) = 0 (50)
b) If manufacturer's declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)
Volume factor from Table 2a 0 (52)
Temperature factor from Table 2b 0 (53)
Energy lost from water storage, kWh/day 0 (54)
Enter (50) or (54) in (55) 0 (55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

0	0	0	0	0	0	0	0	0	0	0	0	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,
(57)m = (56)m [(47) – Vs] ÷ (47), else (57)m = (56)m
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss for each month from Table 3
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)

50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

274.06	242.15	256.96	225.51	218.26	196.32	193.62	201.58	204.06	227.94	242.82	271.03	2754.3	(62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)

0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

274.06	242.15	256.96	225.51	218.26	196.32	193.62	201.58	204.06	227.94	242.82	271.03	2754.3	(64)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

0	0	0	0	0	0	0	0	0	0	0	0	(64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

86.92	76.72	81.23	70.91	68.37	61.21	60.17	62.82	63.78	71.59	76.67	85.91	(65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

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

Metabolic gains (Table 5), watts

199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	(66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5

75.98 67.49 54.89 41.55 31.06 26.22 28.33 36.83 49.43 62.77 73.26 78.1 (67)

Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5

847.86 856.65 834.48 787.28 727.7 671.71 634.3 625.5 647.67 694.87 754.45 810.45 (68)

Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

58.25 58.25 58.25 58.25 58.25 58.25 58.25 58.25 58.25 58.25 58.25 58.25 (69)

Pumps and fans gains (Table 5a)

7 7 7 7 7 0 0 0 0 7 7 7 (70)

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

-132.87 -132.87 -132.87 -132.87 -132.87 -132.87 -132.87 -132.87 -132.87 -132.87 -132.87 -132.87 (71)

Water heating gains (Table 5)

116.83 114.16 109.19 98.49 91.89 85.01 80.88 84.44 88.59 96.22 106.48 115.48 (72)

Total internal gains

1172.36 1170 1130.25 1059.02 982.34 907.63 868.2 871.45 910.38 985.54 1065.88 1135.71 (73)

6. Solar gains

Solar gains in watts, calculated for each month

678.33 1328.96 2211.95 3290.52 4107.93 4242.72 4023.54 3402.63 2591.11 1581.41 845.71 558.12 (83)

Total gains – internal and solar (watts)

1850.68 2498.96 3342.19 4349.54 5090.27 5150.35 4891.74 4274.08 3501.49 2566.96 1911.59 1693.83 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, ⍯1,m (see Table 9a)

1 1 0.99 0.97 0.89 0.75 0.6 0.68 0.91 0.99 1 1 (86)

Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

18.59 18.84 19.3 19.94 20.48 20.83 20.95 20.91 20.59 19.86 19.14 18.59 (87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

19.51 19.52 19.53 19.56 19.57 19.6 19.6 19.6 19.59 19.57 19.56 19.54 (88)

Roof

Utilisation factor for gains for rest of dwelling, ⍯2,m (see Table 9a)

1 1 0.99 0.95 0.84 0.64 0.43 0.52 0.84 0.98 1 1 (89)

Roof

Mean internal temperature in the rest of dwelling T2

17.35 17.61 18.07 18.73 19.23 19.52 19.59 19.58 19.35 18.66 17.93 17.37 (90)

Living area fraction 0.11 (91)

Mean internal temperature (for the whole dwelling)

17.5 17.75 18.21 18.86 19.37 19.67 19.74 19.73 19.49 18.8 18.07 17.51 (92)

Adjusted mean internal temperature:

17.5 17.75 18.21 18.86 19.37 19.67 19.74 19.73 19.49 18.8 18.07 17.51 (93)

8. Space heating requirement

Utilisation factor for gains,

1	1	0.98	0.94	0.83	0.64	0.45	0.53	0.84	0.98	1	1	(94)

Useful gains, mGm , W

1847.8	2487.17	3287.17	4089.63	4237.55	3315.1	2206.89	2279.01	2930.04	2509.29	1905.45	1692	(95)

Monthly average external temperature from Table U1

4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature

10232.81	9908.23	8977.31	7427	5687.17	3668.33	2271.64	2398.8	3939.01	6078.77	8217.8	10086.18	(97)

Space heating requirement for each month

6238.45	4986.95	4233.46	2402.91	1078.52	0	0	0	0	2655.69	4544.89	6245.27	(98a)

Solar space heating calculated using Appendix H (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	(98b)

Space heating requirement for each month after solar contribution

6238.45	4986.95	4233.46	2402.91	1078.52	0	0	0	0	2655.69	4544.89	6245.27	(98c)

Space heating requirement in kWh/m²/year 72.6 (99)

8c. Space Cooling requirement

Heat loss rate,

0	0	0	0	0	0	0	0	0	0	0	0	(100)

Utilisation factor for loss

0	0	0	0	0	0	0	0	0	0	0	0	(101)

Useful loss, mLm (watts)

0	0	0	0	0	0	0	0	0	0	0	0	(102)

Gains

0	0	0	0	0	0	0	0	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) (104)

0	0	0	0	0	0	0	0	0	0	0	0	(104)

Cooled fraction 0 (105)

Intermittency factor

0	0	0	0	0	0	0	0	0	0	0	0	(106)

Space cooling requirement for month 0 0

0	0	0	0	0	0	0	0	0	0	0	0	(107)

Space cooling requirement in kWh/m²/year 0 (108)

8f. Space heating requirement

Fabric Energy Efficiency, 0 0 (109)

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

Fraction of space heat from secondary/supplementary system,							0					0	(201)
Fraction of space heat from main system(s),												1	(202)
Fraction of main heating from main system 2,												0	(203)
Fraction of total space heat from main system 1,												1	(204)
Fraction of total space heat from main system 2,												0	(205)
Efficiency of main space heating system 1 (in %),												80	(206)
Efficiency of main space heating system 2 (in %),												0	(207)
Efficiency of secondary/supplementary heating system, %,												0	(208)
Cooling System Seasonal Energy Efficiency Ratio,							0					0	(209)
Space heating requirement (calculated above),													
0	0	0	0	0	0	0	0	0	0	0	0		(210)
Space heating fuel (main heating system 1), kWh/month							0					0	
7798.06	6233.69	5291.83	3003.64	1348.15	0	0	0	0	3319.61	5681.11	7806.59		(211)
Space heating fuel (main heating system 2), kWh/month							0					0	
0	0	0	0	0	0	0	0	0	0	0	0		(213)
Space heating fuel (secondary), kWh/month							0					0	
0	0	0	0	0	0	0	0	0	0	0	0		(215)
Output from water heater),							0					85	(216)
Efficiency of water heater													
85	85	85	85	85	85	85	85	85	85	85	85		(217)
Fuel for water heating													
322.42	284.88	302.3	265.3	256.77	230.96	227.79	237.15	240.08	268.17	285.67	318.86	3240.35	(219)
Space Cooling													
0	0	0	0	0	0	0	0	0	0	0	0		(221)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1			40482.69 (211)
Space heating fuel used, main system 2			0 (213)
Space heating fuel used, secondary			0 (215)
Water heating fuel used			3240.35 (219)
Electricity for instantaneous electric shower(s)			0 (64a)
Space cooling fuel used			0 (221)
Electricity for pumps, fans and electric keep-hot			
Mechanical vent fans - balanced, extract or positive input from outside	0	0	0 (230a)
warm air heating system fans			0 (230b)
Heating circulation pump or water pump within warm air heating unit			149.5 (230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)			0 (230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)			0 (230e)
Maintaining electric keep-hot facility for gas combi boiler			0 (230f)
Pump for solar water heating			0 (230g)
Pump for storage WWHRS			0 (230h)
Total electricity for the above			149.5 (231)
Electricity for lighting			536.76 (232)

Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(233a)

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)

Energy saving/generation technologies (Appendices M, N) - Energy exported

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(233b)

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(234b)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235b)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)

Appendix Q items: annual energy

	Fuel	kWh/year		
Appendix Q, <item 1 description>				
energy saved			0	(236a)
energy used			0	(237a)
Total delivered energy for all uses			44409.3	

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1473.57	(240a)
Low-rate fraction	0		1473.57	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1473.57	(241a)
Low-rate fraction	0		1473.57	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1473.57	(242a)

Low-rate fraction	0		1473.57	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		117.95	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		24.65	(249)
Energy For lighting	0		88.51	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		1796.68	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP

Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.32	(257)
SAP rating	78.65	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissions kg CO2/year	
Space heating - main system 1			8501.36	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			456.65	(264)
Energy for instantaneous electric shower(s)			0	(264a)

Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		20.74	(267)
Electricity for lighting		77.47	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		9056.22	(272)
Dwelling CO2 Emission Rate		20.3	(273)
EI rating		75	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissionsr kg CO2/year	
Space heating - main system 1			45745.43	(275)
Space heating - main system 2			0	(276)
Space heating - secondary			0	(277)
Energy for water heating			4928.89	(278)
Energy for instantaneous electric shower(s)			0	(278a)
Space and water heating			0	(279)
Space cooling			0	(280)
Electricity for pumps, fans and electric keep			226.16	(281)
Electricity for lighting			823.31	(282)
energy saved or generated	0		0	
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(284b)
energy used			0	(285b)
Total PE, kWh/year			51723.8	(286)
Dwelling PE Rate			115.95	(287)

SAP WORKSHEET

Dwelling Reference: Refurb
Dwelling Type: New Dwelling Design Stage
NW3 5RX

1. Overall dwelling dimensions

	Area(m^2)		Av. Height(m)		Volume(m^3)	
Ground Floor	170.3 (1a)	x	2.98	(2a) =	507.49	(3a)
First Floor	168.6 (1b)	x	3	(2b) =	505.8	(3b)
2nd Floor	107.2 (1c)	x	4.6	(2c) =	493.12	(3c)
Total floor area TFA					446.1	(4)
Dwelling volume					1506.41	(5)

2. Ventilation Rate

Chimneys/Flues	0	x	80	=	0	(6a)
Open chimneys	0	x	20	=	0	(6b)
Chimneys / flues attached to closed fire	0	x	10	=	0	(6c)
Flues attached to solid fuel boiler	0	x	20	=	0	(6d)
Flues attached to other heater	0	x	35	=	0	(6e)
Number of blocked chimneys	0	x	20	=	0	(6f)
Number of intermittent extract fans	6	x	10	=	60	(7a)
Number of passive vents	0	x	10	=	0	(7b)
Number of flueless gas fires	0	x	40	=	0	(7c)

	Air changes per hour		
Number of storeys in the dwelling (ns)	0.04	0.04	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0	0	(9)
Additional infiltration	0	0	(10)
Structural infiltration	0	0	(11)
Suspended wooden ground floor	0	0	(12)
No draught lobby	0	0	(13)
Percentage of windows and doors draught proofed	0	0	(14)
Window infiltration	0	0	(15)
Infiltration rate	0	0	(16)
Air permeability value, AP50, ($m^3/h/m^2$)	8	8	(17)
Air permeability value, AP4, ($m^3/h/m^2$)	0	0	(17a)
Air permeability value)	0.44	0.44	(18)
Number of sides on which dwelling is sheltered	0	0	(19)
Shelter factor		1	(20)

Infiltration rate incorporating shelter factor 0.44 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Monthly average wind speed from Table U2														
	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Wind Factor														
	1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)														
	0.56	0.55	0.54	0.48	0.47	0.42	0.42	0.41	0.44	0.47	0.49	0.52	5.77	(22b)

Calculate effective air change rate for the applicable case:

0 (23a)

0 (23b)

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR)

0	0	0	0	0	0	0	0	0	0	0	0		(24a)

b) If balanced mechanical ventilation without heat recovery (MV)

0	0	0	0	0	0	0	0	0	0	0	0		(24b)

c) If whole house extract ventilation or positive input ventilation from outside

0	0	0	0	0	0	0	0	0	0	0	0		(24c)

d) If natural ventilation or whole house positive input ventilation from loft

0.66	0.65	0.65	0.62	0.61	0.59	0.59	0.58	0.6	0.61	0.62	0.63		(24d)

Effective air change rate

0.66	0.65	0.65	0.62	0.61	0.59	0.59	0.58	0.6	0.61	0.62	0.63		(25)

Effective air change rate from PCDB:

0.66	0.65	0.65	0.62	0.61	0.59	0.59	0.58	0.6	0.61	0.62	0.63		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value

ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	4.65		(26)
Windows	169.52		(27)
Roof window	24.37		(27a)
Basement floor	0	0	(28)
Ground floor	7.66	340.4	(28a)
Exposed floor	0	0	(28b)
Basement wall	0	0	(29)
External wall	69.02	48032	(29a)
Roof	50.06	2832.21	(30)

Total area of external elements ∑A, m²		670.61	(31)
Party Wall	0	0	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)
Internal wall **		0	(33c)
Internal floor		0	(32d)
Internal ceiling floor		0	(32e)
Fabric heat loss, W/K = ∑ (A x U)		325.28	(33)
Heat capacity Cm = ∑(A x k)		51204.61	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K		250	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K		0	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available		0	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ		325.28	(37)

Ventilation heat loss calculated monthly

326.72	323.69	320.71	306.74	304.12	291.95	291.95	289.7	296.64	304.12	309.41	314.94	(38)

Heat transfer coefficient, W/K

652	648.97	645.99	632.02	629.4	617.23	617.23	614.98	621.92	629.4	634.69	640.22	(39)

Heat loss parameter (HLP), W/m²K

1.46	1.45	1.45	1.42	1.41	1.38	1.38	1.38	1.39	1.41	1.42	1.44	(40)

Number of days in month (Table 1a)

31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

Assumed occupancy, N	3.32	(42)

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

0	0	0	0	0	0	0	0	0	0	0	0	(42a)

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

92.22	90.85	88.92	85.36	82.7	79.75	78.15	80.07	82.15	85.31	88.94	91.91	(42b)

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

48.65	46.88	45.11	43.34	41.57	39.8	39.8	41.57	43.34	45.11	46.88	48.65	(42c)

Annual average hot water usage in litres per day Vd,average (from Appendix J)	129.73	(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

140.87	137.73	134.03	128.71	124.27	119.55	117.96	121.64	125.5	130.42	135.82	140.56	1557.05	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

223.1	196.12	206	176.19	167.3	147	142.66	150.62	154.75	176.98	193.5	220.08	2154.3	(45)

Distribution loss (46) = 0.15 x (45)

33.46	29.42	30.9	26.43	25.09	22.05	21.4	22.59	23.21	26.55	29.03	33.01	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)

Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)
b) If manufacturer's declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.14	(51)
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0	(55)

Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

0	0	0	0	0	0	0	0	0	0	0	0	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,
(57)m = (56)m [(47) – Vs] ÷ (47), else (57)m = (56)m
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss for each month from Table 3
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)

0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

351.48	312.08	334.38	300.43	295.67	188.92	185.97	193.93	196.66	305.36	317.74	348.45	3331.07	(62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)

0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

351.48	312.08	334.38	300.43	295.67	188.92	185.97	193.93	196.66	305.36	317.74	348.45	3331.07	(64)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

0	0	0	0	0	0	0	0	0	0	0	0	(64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

176.88	157.97	171.2	157.97	158.33	82.41	82.08	84.73	84.99	161.55	163.73	175.88	(65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

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

Metabolic gains (Table 5), watts

199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	199.31	(66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5

73.82	65.57	53.32	40.37	30.18	25.48	27.53	35.78	48.03	60.98	71.18	75.88	(67)

Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5

847.86	856.65	834.48	787.28	727.7	671.71	634.3	625.5	647.67	694.87	754.45	810.45	(68)

Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

58.25	58.25	58.25	58.25	58.25	58.25	58.25	58.25	58.25	58.25	58.25	58.25	(69)

Pumps and fans gains (Table 5a)

3	3	3	3	3	0	0	0	0	3	3	3	(70)

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

-132.87	-132.87	-132.87	-132.87	-132.87	-132.87	-132.87	-132.87	-132.87	-132.87	-132.87	-132.87	(71)

Water heating gains (Table 5)

237.74	235.08	230.1	219.41	212.81	114.46	110.33	113.89	118.04	217.14	227.4	236.39	(72)

Total internal gains

1287.11	1284.99	1245.6	1174.75	1098.38	936.33	896.84	899.86	938.42	1100.68	1180.72	1250.41	(73)

6. Solar gains

Solar gains in watts, calculated for each month

626.34	1186.92	1893.94	2719.29	3328.12	3412.79	3246.18	2785.55	2184.13	1389.31	773.25	520.46	(83)

Total gains – internal and solar (watts)

1913.45	2471.92	3139.54	3894.04	4426.5	4349.12	4143.03	3685.41	3122.55	2489.98	1953.97	1770.87	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, ⍯1,m (see Table 9a)

1	1	0.99	0.97	0.9	0.77	0.62	0.69	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

18.96	19.18	19.58	20.11	20.58	20.86	20.96	20.94	20.67	20.06	19.43	18.95	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

19.72	19.72	19.73	19.75	19.75	19.78	19.78	19.78	19.77	19.75	19.75	19.74	(88)

Roof Utilisation factor for gains for rest of dwelling, ⍯2,m (see Table 9a)

1	1	0.99	0.96	0.86	0.67	0.46	0.54	0.86	0.98	1	1	(89)

Roof Mean internal temperature in the rest of dwelling T2

17.87	18.09	18.49	19.04	19.47	19.71	19.77	19.76	19.57	19	18.35	17.87	(90)

Living area fraction 0.11 (91)

Mean internal temperature (for the whole dwelling)

17.99	18.22	18.61	19.16	19.59	19.84	19.9	19.9	19.7	19.12	18.48	17.99	(92)

Adjusted mean internal temperature:

17.99	18.22	18.61	19.16	19.59	19.84	19.9	19.9	19.7	19.12	18.48	17.99	(93)

8. Space heating requirement

Utilisation factor for gains,

1	1	0.99	0.95	0.85	0.68	0.48	0.56	0.85	0.98	1	1	(94)

Useful gains, mGm , W

1911	2462.5	3098.48	3704.56	3781.49	2947.91	1990.1	2059.34	2664.9	2439.08	1948.48	1769.27	(95)

Monthly average external temperature from Table U1

4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature

8926.16	8642.66	7824.37	6483.42	4967.98	3236.75	2038.7	2149.9	3481.73	5360.83	7221.15	8829.79	(97)

Space heating requirement for each month

5219.28	4153.07	3516.06	2000.78	882.75	0	0	0	0	2173.78	3796.32	5253.03	(98a)

Solar space heating calculated using Appendix H (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	(98b)

Space heating requirement for each month after solar contribution

5219.28	4153.07	3516.06	2000.78	882.75	0	0	0	0	2173.78	3796.32	5253.03	(98c)

Space heating requirement in kWh/m²/year 60.51 (99)

8c. Space Cooling requirement

Heat loss rate,

0	0	0	0	0	0	0	0	0	0	0	0	(100)

Utilisation factor for loss

0	0	0	0	0	0	0	0	0	0	0	0	(101)

Useful loss, mLm (watts)

0	0	0	0	0	0	0	0	0	0	0	0	(102)

Gains

0	0	0	0	0	0	0	0	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) (104)

0	0	0	0	0	0	0	0	0	0	0	0	(104)

Cooled fraction 0 (105)

Intermittency factor

0	0	0	0	0	0	0	0	0	0	0	0	(106)

Space cooling requirement for month 0 0

0	0	0	0	0	0	0	0	0	0	0	0	(107)

Space cooling requirement in kWh/m²/year 0 (108)

8f. Space heating requirement

Fabric Energy Efficiency, 0 0 (109)

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

Fraction of space heat from secondary/supplementary system,							0					0	(201)
Fraction of space heat from main system(s),												1	(202)
Fraction of main heating from main system 2,												0	(203)
Fraction of total space heat from main system 1,												1	(204)
Fraction of total space heat from main system 2,												0	(205)
Efficiency of main space heating system 1 (in %),												250	(206)
Efficiency of main space heating system 2 (in %),												0	(207)
Efficiency of secondary/supplementary heating system, %,												0	(208)
Cooling System Seasonal Energy Efficiency Ratio,							0					0	(209)
Space heating requirement (calculated above),													
0	0	0	0	0	0	0	0	0	0	0	0		(210)
Space heating fuel (main heating system 1), kWh/month							0					0	
2087.71	1661.23	1406.42	800.31	353.1	0	0	0	0	869.51	1518.53	2101.21		(211)
Space heating fuel (main heating system 2), kWh/month							0					0	
0	0	0	0	0	0	0	0	0	0	0	0		(213)
Space heating fuel (secondary), kWh/month							0					0	
0	0	0	0	0	0	0	0	0	0	0	0		(215)
Output from water heater),							0					250	(216)
Efficiency of water heater													
250	250	250	250	250	250	250	250	250	250	250	250		(217)
Fuel for water heating													
140.59	124.83	133.75	120.17	118.27	75.57	74.39	77.57	78.67	122.14	127.1	139.38	1332.43	(219)
Space Cooling													
0	0	0	0	0	0	0	0	0	0	0	0		(221)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1			10798.03 (211)
Space heating fuel used, main system 2			0 (213)
Space heating fuel used, secondary			0 (215)
Water heating fuel used			1332.43 (219)
Electricity for instantaneous electric shower(s)			0 (64a)
Space cooling fuel used			0 (221)
Electricity for pumps, fans and electric keep-hot			
Mechanical vent fans - balanced, extract or positive input from outside	0	0	0 (230a)
warm air heating system fans			0 (230b)
Heating circulation pump or water pump within warm air heating unit			0 (230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)			0 (230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)			0 (230e)
Maintaining electric keep-hot facility for gas combi boiler			0 (230f)
Pump for solar water heating			0 (230g)
Pump for storage WWHRS			0 (230h)
Total electricity for the above			0 (231)
Electricity for lighting			521.5 (232)

Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling

Electricity generated by PVs (Appendix M) (negative quantity)													
0	0	0	0	0	0	0	0	0	0	0	0	0	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)
Electricity generated by hydro-electric generators													
0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)
Electricity used or net electricity generated by micro-CHP													
0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)

Energy saving/generation technologies (Appendices M, N) - Energy exported

Electricity generated by PVs (Appendix M) (negative quantity)													
0	0	0	0	0	0	0	0	0	0	0	0	0	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
0	0	0	0	0	0	0	0	0	0	0	0	0	(234b)
Electricity generated by hydro-electric generators													
0	0	0	0	0	0	0	0	0	0	0	0	0	(235b)
Electricity used or net electricity generated by micro-CHP													
0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)

Appendix Q items: annual energy

	Fuel	kWh/year		
Appendix Q, <item 1 description>				
energy saved			0	(236a)
energy used			0	(237a)
Total delivered energy for all uses			12651.95	

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1780.59	(240a)
Low-rate fraction	0		1780.59	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1780.59	(241a)
Low-rate fraction	0		1780.59	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1780.59	(242a)

Low-rate fraction	0		1780.59	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		219.72	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		86	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		2086.31	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP

Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.53	(257)
SAP rating	75.21	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissions kg CO2/year	
Space heating - main system 1			1672.38	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			190.28	(264)
Energy for instantaneous electric shower(s)			0	(264a)

Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		75.27	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		1937.93	(272)
Dwelling CO2 Emission Rate		4.34	(273)
EI rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissionsr kg CO2/year	
Space heating - main system 1			16989.62	(275)
Space heating - main system 2			0	(276)
Space heating - secondary			0	(277)
Energy for water heating			2036.2	(278)
Energy for instantaneous electric shower(s)			0	(278a)
Space and water heating			0	(279)
Space cooling			0	(280)
Electricity for pumps, fans and electric keep			0	(281)
Electricity for lighting			799.89	(282)
energy saved or generated	0		0	
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(284b)
energy used			0	(285b)
Total PE, kWh/year			19825.71	(286)
Dwelling PE Rate			44.44	(287)

SAP WORKSHEET

Dwelling Reference: J5106
Dwelling Type: New Dwelling Design Stage
NW3 5RX

1. Overall dwelling dimensions

	Area(m^2)		Av. Height(m)		Volume(m^3)	
Basement	283.7 (1a)	x	3.93	(2a) =	1114.94	(3a)
Ground Floor	58.26 (1b)	x	2.98	(2b) =	173.63	(3b)
Total floor area TFA					341.96	(4)
Dwelling volume					1288.57	(5)

2. Ventilation Rate

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

Air changes per hour

Number of storeys in the dwelling (ns)	0	0	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0	0	(9)
Additional infiltration	0	0	(10)
Structural infiltration	0	0	(11)
Suspended wooden ground floor	0	0	(12)
No draught lobby	0	0	(13)
Percentage of windows and doors draught proofed	0	0	(14)
Window infiltration	0	0	(15)
Infiltration rate	0	0	(16)
Air permeability value, AP50, ($m^3/h/m^2$)	3	3	(17)
Air permeability value, AP4, ($m^3/h/m^2$)	0	0	(17a)
Air permeability value)	0.15	0.15	(18)
Number of sides on which dwelling is sheltered	0	0	(19)
Shelter factor		1	(20)
Infiltration rate incorporating shelter factor		0.15	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Monthly average wind speed from Table U2													
5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Wind Factor													
1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.19	0.19	0.18	0.17	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.18	1.97	(22b)

Calculate effective air change rate for the applicable case:

	0.5	(23a)
	0.5	(23b)
	45	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR)

0.47	0.46	0.46	0.44	0.44	0.42	0.42	0.41	0.43	0.44	0.44	0.45	(24a)

b) If balanced mechanical ventilation without heat recovery (MV)

0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate

0.47	0.46	0.46	0.44	0.44	0.42	0.42	0.41	0.43	0.44	0.44	0.45	(25)

Effective air change rate from PCDB:

0.47	0.46	0.46	0.44	0.44	0.42	0.42	0.41	0.43	0.44	0.44	0.45	(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value

ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	0		(26)
Windows	63.07		(27)
Roof window	15.57		(27a)
Basement floor	51.07	31207	(28)
Ground floor	0	0	(28a)
Exposed floor	0	0	(28b)
Basement wall	49.52	52269	(29)
External wall	4.87	5145.2	(29a)
Roof	21.87	1312.19	(30)
Total area of external elements ∑A, m²		786.95	(31)

Party Wall	0	0	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)
Internal wall **		0	(33c)
Internal floor		0	(32d)
Internal ceiling floor		0	(32e)
Fabric heat loss, W/K = ∑ (A x U)		205.96	(33)
Heat capacity Cm = ∑(A x k)		89933.39	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K		250	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K		0	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available		0	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ		205.96	(37)

Ventilation heat loss calculated monthly

198.26	196.67	195.07	187.1	185.51	177.53	177.53	175.94	180.72	185.51	188.69	191.88	(38)

Heat transfer coefficient, W/K

404.23	402.63	401.04	393.06	391.47	383.5	383.5	381.9	386.69	391.47	394.66	397.85	(39)

Heat loss parameter (HLP), W/m²K

1.18	1.18	1.17	1.15	1.14	1.12	1.12	1.12	1.13	1.14	1.15	1.16	(40)

Number of days in month (Table 1a)

31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

Assumed occupancy, N	3.19	(42)

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

0	0	0	0	0	0	0	0	0	0	0	0	(42a)

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

89.59	88.26	86.39	82.93	80.34	77.48	75.93	77.79	79.81	82.88	86.41	89.29	(42b)

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

47.26	45.54	43.83	42.11	40.39	38.67	38.67	40.39	42.11	43.83	45.54	47.26	(42c)

Annual average hot water usage in litres per day Vd,average (from Appendix J)	126.03	(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

136.85	133.8	130.21	125.04	120.73	116.15	114.6	118.17	121.92	126.71	131.95	136.55	1512.68	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

216.74	190.53	200.13	171.17	162.53	142.81	138.59	146.33	150.34	171.94	187.99	213.8	2092.91	(45)

Distribution loss (46) = 0.15 x (45)

32.51	28.58	30.02	25.68	24.38	21.42	20.79	21.95	22.55	25.79	28.2	32.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	1.6	(48)
Temperature factor from Table 2b	0.54	(49)

Energy lost from water storage, kWh/day (48) x (49) = 0.86 (50)

b) If manufacturer's declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/day 0 (54)

Enter (50) or (54) in (55) 0.86 (55)

Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

26.78	24.19	26.78	25.92	26.78	25.92	26.78	26.78	25.92	26.78	25.92	26.78	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,

(57)m = (56)m [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

26.78	24.19	26.78	25.92	26.78	25.92	26.78	26.78	25.92	26.78	25.92	26.78	(57)

Primary circuit loss for each month from Table 3

modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

23.26	21.01	23.26	22.51	23.26	0	0	0	0	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)

0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

266.79	235.74	250.18	219.6	212.58	168.73	165.38	173.11	176.26	221.99	236.42	263.85	2590.62	(62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)

0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

266.79	235.74	250.18	219.6	212.58	0	0	0	0	221.99	236.42	263.85	1907.14	(64)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

0	0	0	0	0	0	0	0	0	0	0	0	(64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

112.1	99.52	106.58	95.66	94.08	68.22	67.51	70.08	70.72	97.21	101.25	111.13	(65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

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

Metabolic gains (Table 5), watts

191.19	191.19	191.19	191.19	191.19	191.19	191.19	191.19	191.19	191.19	191.19	191.19	(66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5

58.94	52.35	42.57	32.23	24.09	20.34	21.98	28.57	38.34	48.69	56.82	60.58	(67)

Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5

733.47	741.08	721.9	681.07	629.52	581.08	548.72	541.11	560.29	601.12	652.66	701.1	(68)

Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

57.31	57.31	57.31	57.31	57.31	57.31	57.31	57.31	57.31	57.31	57.31	57.31	(69)

Pumps and fans gains (Table 5a)

3	3	3	3	3	0	0	0	0	3	3	3	(70)

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

-127.46	-127.46	-127.46	-127.46	-127.46	-127.46	-127.46	-127.46	-127.46	-127.46	-127.46	-127.46	(71)

Water heating gains (Table 5)

150.68	148.09	143.25	132.86	126.45	94.75	90.74	94.19	98.23	130.66	140.63	149.36	(72)

Total internal gains

1067.12	1065.55	1031.76	970.19	904.1	817.21	782.47	784.91	817.89	904.5	974.15	1035.08	(73)

6. Solar gains

Solar gains in watts, calculated for each month

234.26	444.18	708.85	1017.04	1243.57	1274.56	1212.61	1041.42	817.3	519.99	289.27	194.62	(83)

Total gains – internal and solar (watts)

1301.38	1509.73	1740.6	1987.23	2147.67	2091.77	1995.08	1826.33	1635.19	1424.48	1263.42	1229.7	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, ⍰1,m (see Table 9a)

1	1	1	0.99	0.97	0.9	0.76	0.82	0.97	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

19.3	19.45	19.73	20.13	20.51	20.82	20.95	20.92	20.66	20.17	19.68	19.29	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

19.93	19.94	19.94	19.96	19.96	19.98	19.98	19.99	19.98	19.96	19.96	19.95	(88)

Roof

Utilisation factor for gains for rest of dwelling, ⍰2,m (see Table 9a)

1	1	1	0.99	0.95	0.83	0.62	0.7	0.94	0.99	1	1	(89)

Roof

Mean internal temperature in the rest of dwelling T2

18.37	18.52	18.8	19.21	19.59	19.88	19.97	19.96	19.74	19.26	18.76	18.37	(90)

Living area fraction 0.28 (91)

Mean internal temperature (for the whole dwelling)

18.63	18.78	19.06	19.47	19.85	20.14	20.24	20.23	20	19.51	19.02	18.63	(92)

Adjusted mean internal temperature:

18.63	18.78	19.06	19.47	19.85	20.14	20.24	20.23	20	19.51	19.02	18.63	(93)

8. Space heating requirement

Utilisation factor for gains,

1	1	1	0.99	0.95	0.84	0.66	0.73	0.94	0.99	1	1	(94)

Useful gains, mGm , W

1300.72	1507.99	1734.66	1961.48	2042.65	1764.17	1320.11	1336.75	1537.38	1415.25	1262.14	1229.25	(95)

Monthly average external temperature from Table U1

4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature

5792.48	5588.06	5036.66	4154.13	3189.75	2125.21	1395.68	1460.9	2280.99	3488.86	4703.44	5741.27	(97)

Space heating requirement for each month

3341.87	2741.81	2456.69	1578.7	853.44	0	0	0	0	1542.77	2477.74	3356.94	(98a)

Solar space heating calculated using Appendix H (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	(98b)

Space heating requirement for each month after solar contribution

3341.87	2741.81	2456.69	1578.7	853.44	0	0	0	0	1542.77	2477.74	3356.94	(98c)

Space heating requirement in kWh/m²/year 53.66 (99)

8c. Space Cooling requirement

Heat loss rate,

0	0	0	0	0	0	0	0	0	0	0	0	(100)

Utilisation factor for loss

0	0	0	0	0	0	0	0	0	0	0	0	(101)

Useful loss, mLm (watts)

0	0	0	0	0	0	0	0	0	0	0	0	(102)

Gains

0	0	0	0	0	0	0	0	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) (104)

0	0	0	0	0	0	0	0	0	0	0	0	(104)

Cooled fraction 0 (105)

Intermittency factor

0	0	0	0	0	0	0	0	0	0	0	0	(106)

Space cooling requirement for month 0 0

0	0	0	0	0	0	0	0	0	0	0	0	(107)

Space cooling requirement in kWh/m²/year 0 (108)

8f. Space heating requirement

Fabric Energy Efficiency, 0 0 (109)

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

Fraction of space heat from secondary/supplementary system,							0					0	(201)
Fraction of space heat from main system(s),												1	(202)
Fraction of main heating from main system 2,												0	(203)
Fraction of total space heat from main system 1,												1	(204)
Fraction of total space heat from main system 2,												0	(205)
Efficiency of main space heating system 1 (in %),												250	(206)
Efficiency of main space heating system 2 (in %),												0	(207)
Efficiency of secondary/supplementary heating system, %,												0	(208)
Cooling System Seasonal Energy Efficiency Ratio,							0					0	(209)
Space heating requirement (calculated above),													
0	0	0	0	0	0	0	0	0	0	0	0		(210)
Space heating fuel (main heating system 1), kWh/month							0					0	
1336.75	1096.72	982.68	631.48	341.38	0	0	0	0	617.11	991.1	1342.78		(211)
Space heating fuel (main heating system 2), kWh/month							0					0	
0	0	0	0	0	0	0	0	0	0	0	0		(213)
Space heating fuel (secondary), kWh/month							0					0	
0	0	0	0	0	0	0	0	0	0	0	0		(215)
Output from water heater),							0					250	(216)
Efficiency of water heater													
250	250	250	250	250	250	250	250	250	250	250	250		(217)
Fuel for water heating													
106.71	94.29	100.07	87.84	85.03	0	0	0	0	88.79	94.57	105.54	762.85	(219)
Space Cooling													
0	0	0	0	0	0	0	0	0	0	0	0		(221)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		7339.98	(211)
Space heating fuel used, main system 2		0	(213)
Space heating fuel used, secondary		0	(215)
Water heating fuel used		762.85	(219)
Electricity for instantaneous electric shower(s)		0	(64a)
Space cooling fuel used		0	(221)
Electricity for pumps, fans and electric keep-hot			
Mechanical vent fans - balanced, extract or positive input from outside	0	1041.48	(230a)
warm air heating system fans		0	(230b)
Heating circulation pump or water pump within warm air heating unit		0	(230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)		0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)		0	(230e)
Maintaining electric keep-hot facility for gas combi boiler		0	(230f)
Pump for solar water heating		0	(230g)
Pump for storage WWHRS		0	(230h)
Total electricity for the above		1041.48	(231)
Electricity for lighting		416.36	(232)

Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(233a)

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)

Energy saving/generation technologies (Appendices M, N) - Energy exported

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(233b)

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(234b)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235b)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)

Appendix Q items: annual energy

Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved			0	(236a)
energy used			0	(237a)
Total delivered energy for all uses			10244.16	

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1210.36	(240a)
Low-rate fraction	0		1210.36	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1210.36	(241a)
Low-rate fraction	0		1210.36	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		1210.36	(242a)

Low-rate fraction	0		1210.36	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		125.79	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		171.74	(249)
Energy For lighting	0		68.66	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		1689.26	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP

Energy cost deflator		0.36	(256)
Energy cost factor (ECF)		1.57	(257)
SAP rating		74.53	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissions kg CO2/year	
Space heating - main system 1			1131.53	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			115.14	(264)
Energy for instantaneous electric shower(s)			0	(264a)

Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		144.47	(267)
Electricity for lighting		60.09	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		1530.73	(272)
Dwelling CO2 Emission Rate		4.48	(273)
EI rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissionsr kg CO2/year	
Space heating - main system 1			11529.25	(275)
Space heating - main system 2			0	(276)
Space heating - secondary			0	(277)
Energy for water heating			1189.09	(278)
Energy for instantaneous electric shower(s)			0	(278a)
Space and water heating			0	(279)
Space cooling			0	(280)
Electricity for pumps, fans and electric keep			1575.56	(281)
Electricity for lighting			638.62	(282)
energy saved or generated	0		0	
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(284b)
energy used			0	(285b)
Total PE, kWh/year			15908.84	(286)
Dwelling PE Rate			46.52	(287)