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Section 73 (Ref. 2015/1243/P)
Revised Energy Strategy

44 Gloucester Avenue

On behalf of
Victoria Square Property Company

Date: 26/10/2016

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Planning
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1.0 Introduction

1.1 This revised Energy Strategy has been prepared by Metropolis Green on behalf of Victoria Square Property Company in relation to the Section 73 amendments made to the approved development at 44 Gloucester Avenue, Camden, London, NW1 8JD.

1.2 The development of 44 Gloucester Avenue (Application Ref. 2015/1243/P) was granted full planning permission, subject to a Section 106 Agreement dated 30th November 2015.

1.3 The approved mixed-use development at 44 Gloucester Avenue comprises of:

"Demolition of existing buildings identified as Number 2 at the northwest corner of the site and Number 4 at the eastern corner of the site to provide a new ground plus 5 upper storey building along the north west part of the site and a ground plus 2 storey building at the eastern corner and refurbishment of existing building on site to create 40 residential units, employment floor area (Class B1a), car parking and landscaping within the courtyard with ancillary works."

1.4 The refurbished blocks A, C, E & F consist of 22Nos. residential units whereas new blocks B & D consist of 18Nos. residential units; and approximately 698m² of commercial space at basement and ground floor levels.

1.5 The original Energy Strategy for the approved development was prepared by XCO2 Energy, dated September 2015.

1.6 During the detailed design stages of the development, changes and improvements to the scheme were identified. As such, a revised Energy Strategy has been undertaken to reflect the minor amendments to the scheme and to ensure that the measures proposed in the original Energy Strategy submitted for planning by XCO_2 Energy have been implemented and met, where feasible.

1.7 This revised Energy Strategy details the design changes impacting the energy performance of the approved development and how the proposed changes will ensure compliance with GLA and LBC.'s energy targets.

1.8 A summary of the main changes and improvements to the fabric and M&E design include;

- Existing external wall of the refurbished residential units to be retained with a U value of 2.10W/m2K
- Existing external wall of the commercial units to be upgraded from 2.10W/m2 to 0.5W/m2K
- New external wall of the new build units to be improved from 1.5W/m2K to 1.3W/m2K.
- 60% of the total windows (windows facing Sunny Mews and Network Rail) to be affected by increased U value from 1.2W/m2K to 1.8W/m2K due to the requirement of fire rated windows.
- Remaining 40% windows to be double glazed with a U value of 1.4W/m2K. A U value of 1.2W/m2K has not been possible to achieve for double glazed windows.
- Major change to the building services design include replacement of individual gas boilers with communal gas boilers. Individual gas boiler to be retained for the private house.

- 12 new build residential units facing the railway tracks to be specified with cooling to mitigate overheating risks.
- Ventilation to all new build units will be provided via Mechanical Ventilation with Heat Recovery unit (MVHR).
- 36Nos. efficient PV panels of E20/333 to be specified to achieve the approved total system output of 11.9kWp requiring a roof area of 60m².

1.9 Based on the above changes and improvements, the revised energy calculation undertaken have demonstrated a marginal 3.6% reduction from the original 44.3% to the revised 40.7% CO_2 reduction. However, the revised calculation results demonstrate that scheme is still compliant by achieving an overall 40.7% reduction and exceeding the LP Policy 5.2 and LBC's DP 22 to achieve a 35% reduction in regulated carbon on 2013 Building Regulations.

1.10 Figure 1. Appendix A provides the floor plans from the 44 Gloucester Avenue development.

Figure 1 – Planned Development

Policy Requirements

1.11 This revised Energy Strategy prepared for the approved development at 44 Gloucester Avenue (Application Ref. 2015/1243/P) has considered the following key planning policies set out in the London Plan (LP), LBC's local core strategy (November 2010) and other relevant supplementary guidance:

- LP Policy 5.2 and LBC's DP 22, requires developments to achieve a 35% reduction in regulated carbon on 2013 Building Regulations.
- Relevant sections of LP Policy 5.3 on sustainable design and construction standards, regarding energy and carbon reduction have been addressed.

- Investigation of decentralised energy use on site or the possible integration of a Combined Heat and Power plant, in line with LP Policies 5.5 and 5.6.

- LP Policy 5.7 and LBC CS 13 encourages developments, to include on-site renewable energy technologies to achieve a 20% in carbon emissions.

- The potential for overheating must be addressed through the cooling hierarchy in line with LP Policy 5.9.

1.12 Appendix A of the report provides full details of national, regional, local policies and Building Regulations with regards to sustainability and energy conservation.

2.0 Methodology and Notional Baseline

2.1 This document has been prepared in line with best practice[1] and the methodology that has been applied is in line with the widely adopted energy hierarchy and national calculation methodologies.

2.2 All energy and carbon figures have been calculated using approved Standard Assessment Procedure (SAP) software and Simplified Building Energy Modelling (SBEM), which are used to demonstrate compliance with Approved Documents Part L1A, L1B, L2A and L2B 2013 edition, and BREEAM requirements.

2.3 The London Plan promotes a 'regulated' energy approach to calculating the energy demand and carbon baseline of development. The baseline therefore includes the energy consumed in the operation of the space heating/cooling and hot water systems, ventilation and all internal lighting. Reported separately, are the carbon emissions from cooking and all electrical appliances which are not covered by the Building Regulations, this is called 'unregulated' energy.

2.4 All residential and commercial areas were modelled. Table 1 below provides the summary of the Notional Baseline results for the 44 Gloucester Avenue development. Detailed calculation results, sample As Designed SAP and BRUKL reports, can be found in Appendix C and D, of this report.

[1] Energy Planning, Greater London Authority guidance on preparing energy assessments (March 2016)

2.5 Please note that the revised calculations in this report are based on the updated scheme drawings and detailed design specifications prepared by 21st Architecture Ltd. The M&E design and technical specifications are based on the M&E tender documents and technical specifications prepared by GDM Partnership Building Services Consultants Limited.

2.6 These results reflect the detailed As Designed stage SAP and SBEM calculations to achieve the targets set out in the Energy Strategy prepared by XCO2 Energy, dated October 2015.

Table 1 – Notional Baseline: CO_2 Emissions

Notional Baseline	Total
Regulated Carbon Emissions (tCO_2/yr)	218.6
Un-Regulated Carbon Emissions (tCO_2/yr)	102.7

3.0 Demand Reduction (Be Lean)

3.1 The first stage in the energy hierarchy is to improve the energy performance of the building through fabric and services improvements.

3.2 Metropolis Green have worked with 21st Architecture Ltd. and GDM Partnership to identify the proposed changes to the scheme and determine the most efficient and feasible way to reduce the carbon emissions of the development through both passive and active design measures.

Fabric: Changes and Improvements

3.3 21st Architecture Ltd. have placed particular consideration on the thermal performance of the construction build ups, providing significantly low U-values without impacting on space.

3.4 The changes to the fabric, fenestration and mechanical elements proposed during the detailed design stages are discussed below and the design parameters are detailed in Table 2 to 6.

3.5 In the approved original Energy Strategy, improvements were proposed to the external cavity wall of the existing building with increased insulation thickness. However, due to space constraints and loss of internal floor area, the existing external cavity walls for the refurbished residential units with a U value of 2.10W/m2K have been retained and are in compliance with Part L1B Building Regulations 2013.

3.6 However, the existing external cavity walls of the commercial areas have been upgraded from 2.10W/m2K to 0.50W/m2K and have therefore improved significantly due to the additional insulation levels.

3.7 Detailed architectural specifications have demonstrated that external wall U value of the new build units has been improved from 1.5W/m2K to 1.3W/m2K providing improved thermal performance and therefore reduced CO_2 emissions.

3.8 Further changes to the envelope include variations to the performance of the windows for the new build areas facing the Sunny Mews and Network Rail. Due to the requirement of fire rated windows on the external boundary of the development, achieving high thermal performance from this window type has not been feasible. The fire rated windows consists of clips around the edges creating cold bridging and therefore reducing the thermal performance. Detailed design specification of windows have demonstrated that approximately 60% of the total windows to the new build element of the scheme will be fire rated windows with a U Value of 1.8W/m².K

3.9 Furthermore, the thermal performance of the remaining 40% windows has been reduced from 1.2 W/m².K (from the original Energy Strategy) to 1.4 W/m².K. During the design development stage, manufactures specifications demonstrated that a U value of 1.2 W/m².K is not achievable for double glazed window. However, calculation results demonstrated that high specification double glazed windows with a U value of 1.4W/m².K can achieve the required thermal performance and contribute sufficiently towards reducing the total CO_2 emissions.

3.10 All existing windows have been upgraded to achieve a U value of 2.0 W/m².K and are better than Part L1B Building Regulations 2013 limiting parameters.

3.11 In summary, the thermal performance of the new and existing building fabric has been improved where feasible. However, elements where improvements have not been feasible i.e. existing external wall U value and windows with reduced thermal performance, considerations have been given to comply with the limiting parameters set in Part L of the Building Regulations.

M&E Services: Changes and Improvements

3.12 In addition to the changes and improvements to the fabric and fenestration, following are the improvements being made to the mechanical systems and building services design.

3.13 The main change to the building services design is the replacement of individual boilers with communal boilers providing space heating and DHW to the whole site. The approved original Energy Strategy specified space heating and DHW to all residential and commercial units via individual gas boilers. However, during design development stage, calculations and detailed feasibility studies demonstrated that a communal boilers will offer the maximum benefits of reducing CO2 emissions of the site whilst delivering heat to all the residential units in the most efficient way.

3.14 The boiler plant will be located within a dedicated boiler/chiller plantroom located within the basement of the building. Three floor standing condensing boilers will generate low temperature hot water (LTHW) to meet the site heating demand. Communal condensing boilers with 97.9% seasonal efficiency are highly efficient boilers that have much lower fuel and running costs than individual gas boilers with SEDBUK efficiency of 89.5%.

3.15 Calculations undertaken have demonstrated that the proposed communal boilers with 97.9% seasonal efficiency provide the most optimal CO_2 savings for the site, hence providing a higher CO_2 savings when compared to the proposed individual gas boilers.

3.16 Due to technical feasibility and uncomplicated arrangement for provision and operation of services, the individual private house

will have its own standalone system for delivering space heating and DHW via 89.5% SEDBUK 2009 efficiency individual gas boiler.

3.17 Further changes to the scheme include the specification of cooling to the new build residential units facing the Network Rail. Due to the orientation of 12 units within Block B and D facing network rail, these units will likely have a limited scope for opening windows due to air quality and noise impact arising from the adjacent railway tracks. As such, to avoid overheating and provide comfortable indoor conditions cooling has been specified to these units.

3.18 Comfort cooling to the 12 new residential units will be provided via void mounted or low level exposed or concealed fan coil units (FCUs), provided with chilled water from the central chilled water pipes which branch from the main riser to the heat exchanger in each apartment.

3.19 Due to adjacency of the railway tracks, the single house will also be specified with comfort cooling via standalone VRF condenser unit.

3.20 Other improvements include changing the ventilation system for the new build residential units and the private from local extract fans for toilets and kitchens to Mechanical Ventilation & Heat Recovery (MVHR). All refurbished units will be naturally ventilated with openable windows.

3.21 Space heating and cooling to all commercial units will be provided with ceiling mounted exposed cassette 4 pipe fan coil units (FCUs) to achieve the space design temperatures.

3.22 Ventilation to all commercial areas will be provided via Mechanical Ventilation with Heat recovery (MVHR) units.

3.23 In summary, the changes and improvements proposed to the M&E services design and efficiencies of systems have altered the energy performance of the development by marginally reducing the overall site-wide CO_2 emissions improvements.

3.24 The fabric parameters utilised in the revised Energy Strategy are listed in the Table 2 below. These parameters are compared alongside the parameters from the approved original Energy strategy.

Table 2 – Building Fabric Performance

Passive Design Measures	Approved Scheme (September 2015) (W/m²K)	Revised Scheme 2016 (W/m²K)
External Wall U-value (Refurbished Residential)	0.50	2.10
External Wall U-value (Refurbished Commercial)	0.50	0.50
External Wall U-value (New Build Residential)	0.15	0.13
Ground floor / Exposed floor U-Value (Refurbished Residential & Commercial)	0.25	0.25
Ground floor / Exposed floor U-Value (New Build Residential & Commercial)	0.10	0.10
Roof U-value (Refurbished Residential & Commercial)	0.18	0.18
Roof U-value (New Build Residential)	0.10	0.10
Windows U-values (Refurbished Residential & Commercial)	2.0	2.0

Windows U-values (fire rated) (New Build Residential facing Sunny Mews & Network Rail)	1.2	1.8
Windows U-values (other New Build Residential)	1.2	1.4

3.25 In addition to the fabric improvements, building services improvements are shown in Table 3 to 6 below.

Table 3 – Active Demand Reduction Measures (New Build Dwellings)

Active Design Measures	Approved Scheme (September 2015)	Revised Scheme (2016)
Space Heating System	Individual gas boilers	Communal gas boiler with 97.9% seasonal efficiency
DHW System	Individual gas boilers	Communal gas boiler with 97.9% seasonal efficiency with HIU located in each dwelling
Ventilation System	Local extract fans for Toilets and Kitchen	MVHR Vent Axia Kinetic Plus E
Cooling (New Build units facing railway tracks)	None	Comfort cooling via Water Cooled Chiller with SEER of 4.65
Water Consumption	105 litres per person per day or less	105 litres per person per day or less
Energy Efficient Lighting	100%	100%

Table 4 – Active Demand Reduction Measures (Refurbished Dwellings)

Active Design Measures	Approved Scheme (September 2015)	Revised Scheme (2016)
Space Heating System	Individual gas boilers	Communal gas boiler with 97.9% seasonal efficiency
DHW System	Individual gas boilers	Communal gas boiler with 97.9% seasonal efficiency with HIU located in each dwelling
Ventilation System	Naturally Ventilated with fully openable windows	Naturally Ventilated with fully openable windows
Cooling (REFURB)	None	None
Water Consumption	105 litres per person per day or less	105 litres per person per day or less
Energy Efficient Lighting	100%	100%

Table 5 - Active Demand Reduction Measures (New Build House)

Active Design Measures	Approved Scheme (September 2015)	Revised Scheme (2016)
Space Heating System	Individual gas boilers	Gas boiler, 89.5% SEDBUK 2009 efficiency, radiators, time and temperature zone control, weather compensator
Domestic Hot Water System	Individual gas boilers	Indirect cylinder 210 L, heat loss 1.9 kWh/24h

Ventilation System	Local extract fans for Toilets and Kitchen	MVHR Vent Axia Kinetic Plus E
Cooling	None	Individual VRF condenser unit (A+ rated)
Water Consumption	105 litres per person per day or less	105 litres per person per day or less
Energy Efficient Lighting	100%	100%

Table 6 - Active Demand Reduction Measures (Commercial)

Active Design Measures	Approved Scheme (September 2015)	Revised Scheme (2016)
Space Heating System	Individual gas boilers	Communal gas boiler with 97.9% seasonal efficiency to feed 4 pipe FCU
Domestic Hot Water System	Electric Point of use water heaters	Electric Point of use water heaters
Ventilation System	MVHR	MVHR system with 88% Heat recovery efficiency and SFP of 0.5 W/l/s or lower
Cooling	Comfort cooling via Chiller	Cooling via Water Cooled Chiller with SEER of 4.65
Energy Efficient Lighting	Energy efficient lighting with Occupant sensors	Luminaire efficacy of 85 lm/W, photoelectric control, metering with 'out of range' alarm

3.26 As a result of the revised fabric and M&E design measures, calculations results have demonstrated that a total 83.6 tonnes of CO_2 can be saved, equating to a 38.3% improvement over the Notional Baseline, shown in Table 7.

Table 7 – Efficient Baseline: CO_2 Emissions

Efficient Baseline	Approved Scheme (September 2015)	Revised Scheme (2016)
Regulated Carbon Emissions (tCO_2/yr)	159	134.9
Total Improvement over Notional Baseline	42.5%	38.3%

4.0 Overheating and Cooling

4.1 Through the application of passive design and low energy measures, the design team have worked to reduce the risk of summer overheating in line with the 'cooling hierarchy' and London Plan Policy 5.9, as follows:

i. Minimising internal heat generation through energy efficient design

ii. Reducing the amount of heat entering the building in summer

iii. Use of thermal mass and high ceilings to manage the heat within the building

iv. Passive Ventilation

v. Mechanical Ventilation

vi. Comfort Cooling

4.2 Refer to Appendix E: Thermal Comfort analysis report for further information on the principles and methodology of the cooling hierarchy, and for details on how passive design and low energy strategies have been applied to the development to diminish the risk of overheating in summer.

Thermal Comfort analysis.

4.3 The GLA's Guidance on Preparing Energy Assessments, March 2016, states that developments should undertake Dynamic Simulation Modelling (DSM) to demonstrate that the proposed development does not overheat in the summer months. As such, Metropolis Green have modelled selected occupied areas against CIBSE TM52 criteria and TM49 future climate scenarios, in line with the LP's cooling hierarchy approach to address thermal comfort.

4.4 A sample of 10 expected worst performing residential units (i.e. mid and top floor residential units & units facing the railway tracks) and all commercial units were selected and simulated considering all aspects of occupancy, solar gains and predicted internal heat gains.

Conclusion: Overheating and Cooling.

4.5 Passive design considerations, natural ventilation, background mechanical ventilation to remove heat build-up, and internal blinds to selectively control solar gains, work together to prevent and mitigate overheating.

4.6 With expedient prevention and mitigation measures proposed at the detailed design stage, all of the residential units meet the TM52 thermal comfort overheating criteria for the main 'future near extreme summer' weather file (DSY1). Compliance with this standard demonstrates that the building is resilient to overheating during its lifetime.

4.7 Although all residential units are in compliance with the TM52 overheating assessment methodology, comfort cooling has been specified for 12 new build residential units in Blocks B, D and E1, adjacent to the railway tracks. It is considered that due to the air quality and noise impact arising from the adjacent railway tracks, these units will be subject to restricted window openings. In addition to the noise and air quality issues, the ground floor units will be subject to security issues with restricted window openings during day and night. As such, to mitigate overheating risks and maintain favourable internal conditions, cooling to these units has been specified.

4.8 Similarly, due to the location of the individual private house and adjacency of the railway tracks, cooling has been specified to the house via standalone (A+ rated) VRF condenser unit.

4.9 Commercial areas tend to have particularly high internal gains from equipment, people, lighting, with periods of occupation and activity typically through the hottest parts of the day.

4.10 However, even with expedient prevention and mitigation measures in place, all of the commercial units demonstrated non-compliance against the TM52 overheating criteria.

4.11 Therefore, to maintain specific internal conditions and to meet the market expectations and requirements of the occupants cooling has been specified to the commercial units via water cooled chillers.

4.12 The cooling demand of all the commercial spaces has been reduced significantly from the notional cooling demand of a standard commercial building by introducing improved passive and active design measures. This can be seen from the Efficient Baseline SBEM BRUKL report in Appendix D.

4.13 Refer to Appendix E: Thermal Comfort Analysis report prepared by Metropolis Green for further information on the principles and methodology of the cooling hierarchy, and for details on how passive design and low energy strategies have been applied to the development to diminish the risk of overheating in summer.

5.0 Heating Infrastructure Including CHP (Be Clean)

5.1 The Mayor's energy hierarchy and London Plan Policy 5.6 require all major developments to demonstrate that the proposed energy systems have been selected in accordance with the following hierarchy:

1. Connection to existing or planned area wide, low carbon heat distribution networks;
2. Site wide heat networks;
3. Combined Heat and Power (CHP).

Connection to an Existing Heat Network

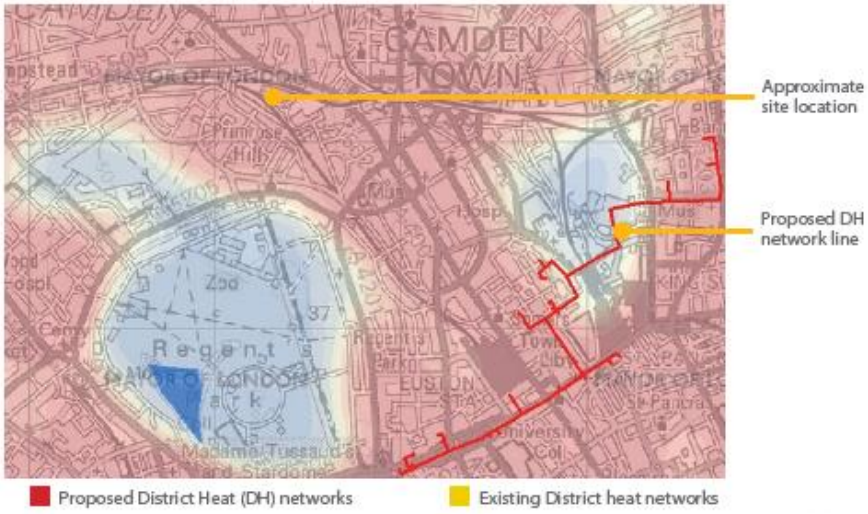
5.2 The approved original Energy Strategy prepared by XCO2 Energy identified the proposed District Heating Network on Euston Road, as the closest network (within 2km to the southeast) to the development site. Due to distance and subsequent large connection cost, this was not investigated further.

5.3 The original Energy Strategy also concluded that it is not considered economically or technically feasible to incorporate a communal heat system with a CHP for a predominantly refurbishment based and relatively small scale development, therefore, it was not investigated further.

5.4 Metropolis Green has further investigated the progress with the potential Euston Road District Heat Network and have not identified any additional progress or updates on expansion of this network. As shown in Figure 2, the London Heat Map tool identified that the Euston Road Network is potentially extending towards southeast and in the opposite direction to the site.

5.5 In addition to the above constraints, it is also identified that the site is located within a predominantly low rise area, mainly consisting of low density single dwellings on the south and railway tracks on the north. As such, due to a relatively low heat demand in the area around the site it is considered very unlikely for a heat network to come forward. Therefore, due to the reasons and constraints discussed above, the site has not been future proofed to connect to a future heat network.

Figure 2 – London Heat Map



Site Wide Heat Network and Combined Heat and Power

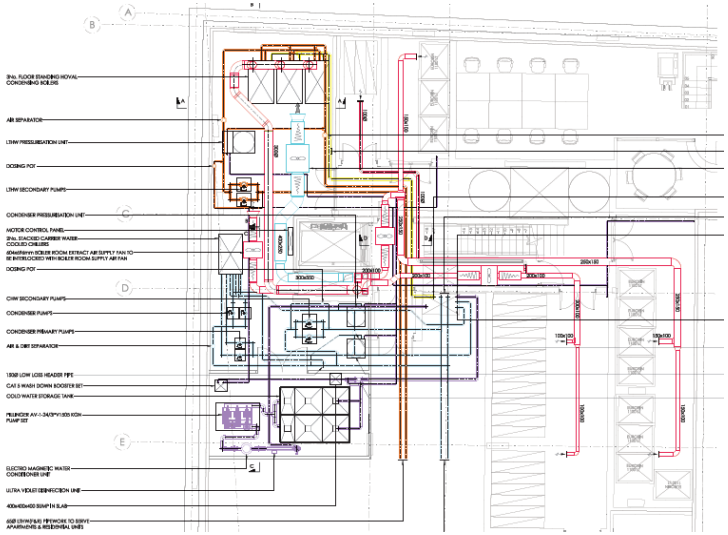
5.6 As stated in the approved original Energy Strategy, a CHP engine was investigated and found not suitable for the proposed development.

5.7 However, further major amendments to the building services elements of the scheme include the provision of site-wide communal plant serving heating and DHW to the entire development. The communal arrangement has demonstrated improvements in CO_2 emission reduction of the scheme as compared to the approved scheme consisting of individual gas boilers.

Plantroom and Services Design

5.8 The boiler plant will be located within a dedicated boiler/chiller plantroom located within the basement of the building. Three floor standing condensing boilers will generate low temperature hot water (LTHW) to meet the site heating demand. Refer to Figure 3 below for the plantroom layout prepared by GDM Partnership Building Services Consultants Limited.

Figure 3 – Plantroom Layout



5.9 To maximise the efficiency of the communal plant, the communal gas boilers will include heat exchangers to maximise heat transfer from the burner whilst recovering useful heat, normally lost with the flue gases.

5.10 Heat Interface Units (HIUs) that incorporate plate heat exchangers will be used to transfer heat from the central plant to provide localised heating and hot water to each residential apartment.

5.11 The chiller plant will be located within the same basement plant. Two water cooled chillers will generate chilled water to meet the site cooling demand. Dry air coolers will be fitted on the roof for heat rejection purposes.

5.12 All residential apartments and the individual private house will be heated via underfloor heating, whereas bathrooms will be provided with electric towel heaters. The 12 identified new residential units consisting comfort cooling will be serviced via ceiling mounted fan coil units, fed by chilled water from the central chiller.

5.13 All commercial areas will be heated and cooled via ceiling mounted exposed cassette 4 pipe fan coil units, fed by chilled water from the central chiller.

6.0 Renewable Energy

6.1 The third stage of the energy hierarchy refers to the production of renewable energy, which relates to London Plan Policy 5.7 and LBC CS 13.

6.2 London Plan approved renewable energy technologies include:

- Photovoltaics
- Solar Water systems
- Biomass Heating
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Wind

6.3 The original Energy Strategy prepared by XCO2 Energy identified PVs as the most suitable technology for this development. An installation of 49 PV panels covering 78m² of roof area with 15% efficient PV panels (0.15kWp per panel), rated at a total system output of 11.8kWp was specified on the south-southwest facing areas of the roof. Please see the original PV layout in Figure 4 and 5 below;

Figure 4 – Original PV layout – Fifth Floor

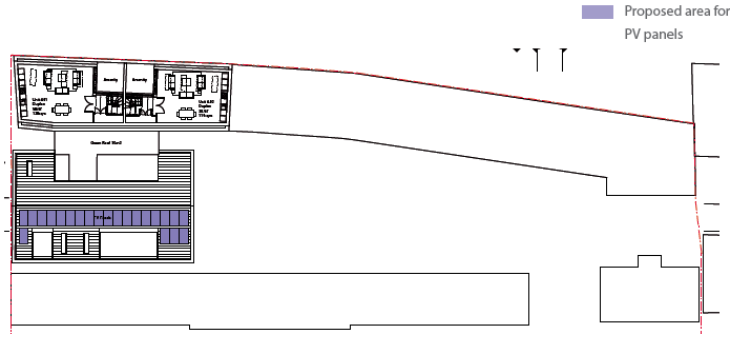
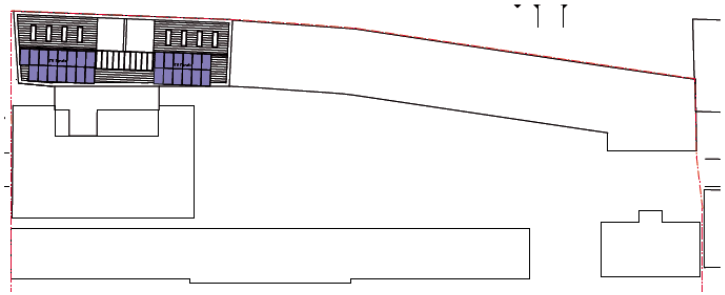


Figure 5 – Original PV layout – Sixth Floor



6.4 However, Metropolis Green have further investigated and found that the most efficient PV panel currently available is the Sunpower E20/333. As such, the approved total system output of 11.98kWp can be achieved by specifying 36Nos. PV panels of E20/333 having an out of 0.333kWp per panel and requiring a total roof area of approximately 60m².

6.5 For the purposes of the revised Energy Strategy, an efficient PV module of Sunpower E20/333 has been used, however there are a number of products available which may be selected and as such the PV array is subject to change.

6.6 The revised energy calculations have therefore concluded that 36Nos. Photovoltaic (PV) panels delivering 11.9kWp can provide a 2.5% reduction in CO_2 over the Notional Baseline, and 4% reduction over the Efficient Baseline.

6.7 An appropriate location for the 36Nos. PV panels was identified once the site constraints were taken into account. The factors considered were;

- avoiding any potential overshadowing from adjacent PV panels or roof forms;
- space required for maintenance including all health and safety requirements for roof access;
- avoiding areas which are intended as outdoor spaces (e.g. terraces)
- Reduction of visual impact as far as possible due to the location of the site within a Conservation Area.

6.8 The PV panels have been positioned for optimal performance in terms of exposure to light, orientation and angle to reduce their visual impact. The panels are therefore south- southwest facing as far as possible. A revised PV array is illustrated in Figures 6 and 7 below.

Figure 6 – Revised PV Layout - Fifth Floor

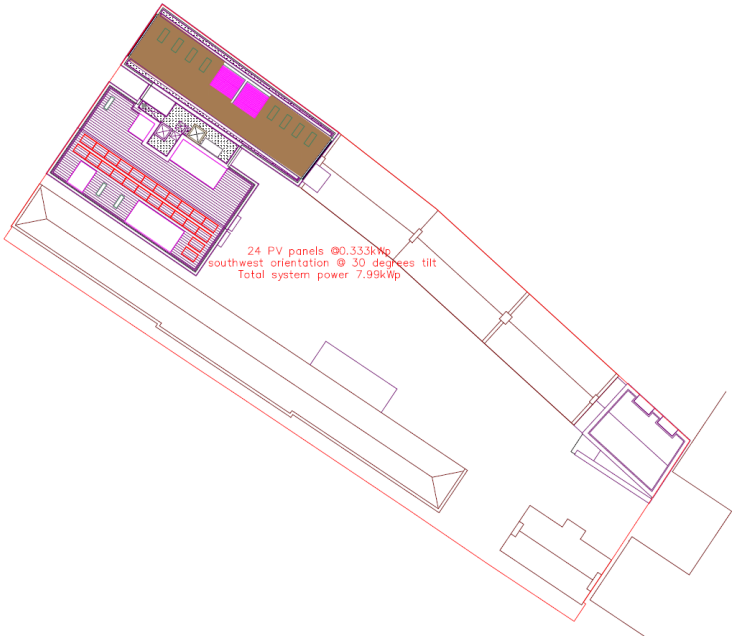
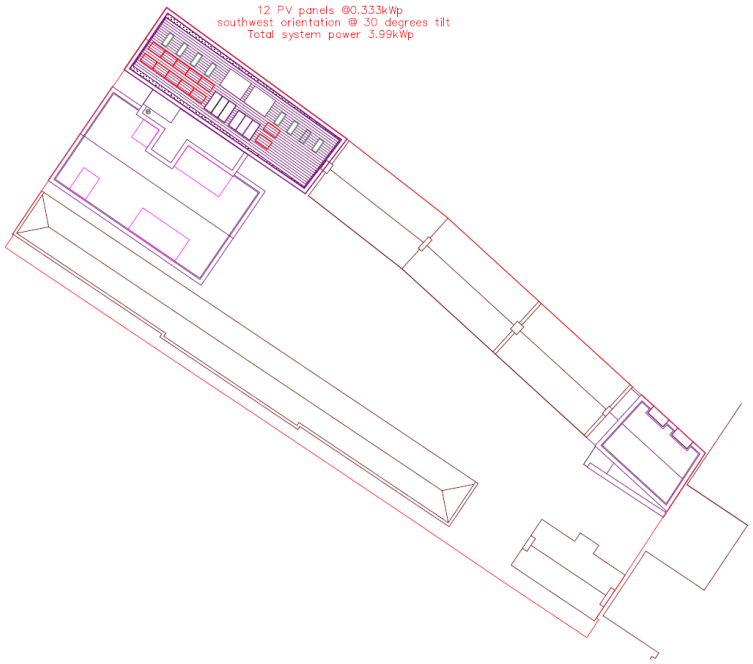


Figure 7 – Revised PV Layout - Sixth Floor



6.9 Table 8 below sets out the carbon emissions results from the revised energy calculations from the Renewables Baseline.

Table 8 – Renewable Baseline: CO_2 Emissions

Renewable Baseline	Consented Scheme (September 2015)	Revised Scheme (2016)
Regulated Carbon Emissions (tCO_2/yr)	154.2	129.6
& Improvement over Notional Baseline	1.7%	2.5%

7.0 Conclusion

7.1 A summary of all amendments and improvements to the fabric and M&E design is stated below;

- The existing external wall U value of the refurbished residential units have been retained to 2.1W/m2K due to space implications. However, the existing external wall of the commercial units has been significantly improved from 2.1W/m2K to 0.5W/m2K.
- Detailed architectural design specification and calculations have demonstrated improvement in the new build external wall U value from 1.5W/m2K to 1.3W/m2K providing improved thermal performance and therefore reduced CO_2 emissions.
- The thermal performance of 60% of the total windows facing Sunny Mews and Network Rail has been affected due to the requirement for fire rated windows. As such, the U value of these windows has been increased from 1.2W/m2k to 1.8W/m2K. In addition, the remaining 40% windows have been proposed as double glazed windows with a realistic U value of 1.4W/m2K, as specified by the glazing manufacture. It was confirmed by the manufacturer that a U value of 1.2W/m2K is only achieved for triple glazed windows.
- A considerable improvement to the building services design includes replacement of individual gas boilers with communal gas boilers providing space heating and domestic hot water to the apartments and commercial areas. Individual gas boiler has been retained for the individual private house.
- Due to air quality, noise and security issues arising from the adjacent railway tracks, the 12 new build residential units

facing the railway tracks have been specified with cooling to mitigate overheating risks.

- Ventilation to all new build units will be provided via Mechanical Ventilation with Heat Recovery unit (MVHR) of Vent Axia Kinetic Plus E or similar.

- 36Nos. efficient PV panels of E20/333 with a module output of 0.333kWP per panel has been specified to achieve the approved total system output of 11.9kWp requiring a comparatively less roof area of 60m² from the original 78 m².

7.2 As such, the revised energy strategy has maximised the carbon emissions reductions (where possible) calculated for the 44 Gloucester Avenue development. A total overall carbon reduction of 40.7% can be achieved through the energy strategy detailed in this report.

7.3 Site analysis and calculations have determined that:

- A carbon reduction of 38.3% can be achieved with revised fabric and M&E measures.

- The renewable strategy has determined that 36Nos. PV panels with a system size of 11.9 kWp, can deliver 2.5% reduction over the Notional Baseline and 4% reduction over Efficient Baseline.

7.4 Table 9 below demonstrates a marginal 3.6% reduction (from 44.3% to 40.7%) in the total carbon reduction improvement due to the proposed changes to the scheme at detailed design stage, as stated above. The revised calculation results demonstrate that scheme is still compliant by achieving an overall 40.7% reduction and exceeding the LP Policy 5.2 and LBC's DP 22 to achieve a 35% reduction in regulated carbon on 2013 Building Regulations.

7.5 Table 10 and 11 below provides a summary of the CO_2 emissions, and overall carbon reductions for the modelled baselines of the development at 44 Gloucester Avenue.

7.6 A summary of revised U-values and input parameters for the proposed development are shown in Appendix G.

Table 9 – Regulated CO2 Emissions Reduction

		Approved Scheme (September 2015)	Revised Scheme (2016)
Notional Baseline	Un-Regulated Carbon Emissions (tCO_2/yr)	92.3	102.7
	Regulated Carbon Emissions (tCO_2/yr)	276.6	218.6
Efficient Baseline	Regulated Carbon Emissions (tCO_2/yr)	159	134.9
	% Improvement over Notional Baseline	42.5%	38.3%
Renewable Baseline	Regulated Carbon Emissions (tCO_2/yr)	154.2	129.6
	% Improvement over Notional Baseline	1.7%	2.5%
Total Regulated Carbon Emission Improvement		44.3%	40.7%

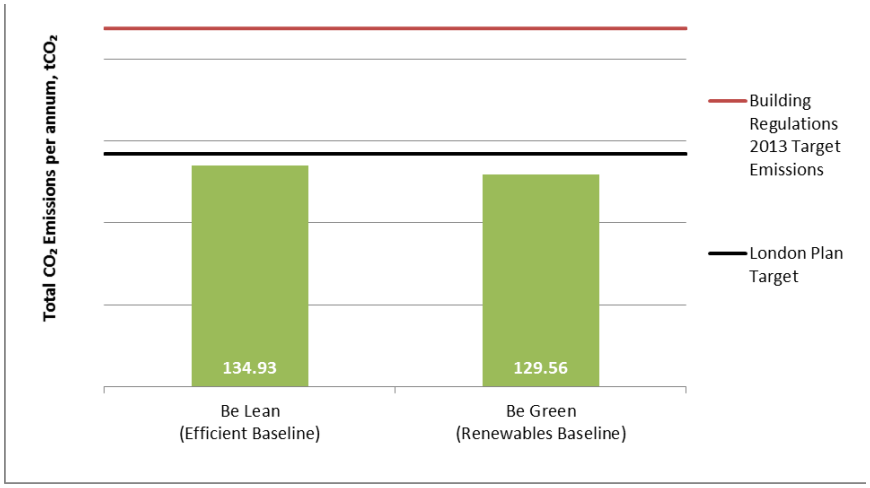
Table 10 – CO_2 emissions after Each Stage of the Energy Hierarchy

	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L Compliant Development	218.6	102.7
After energy demand reduction	134.9	102.7
After renewable energy	129.6	102.7

Table 11 – CO_2 savings after Each Stage of the Energy Hierarchy

	Regulated Carbon dioxide savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	83.6	38.3%
Savings from renewable energy	5.4	4.0%
Total Cumulative Savings	**89.0**	**40.7%**
Total Target Savings	**76.5**	**35.0%**

Figure 8 –The Energy Hierarchy



Glossary

Building Emissions Rate (BER) or Dwelling Emission Rate (DER) - the actual building/dwelling CO2 emission rate. It is expressed in terms of the mass of CO2 emitted per year per square metre of the total useful floor area of the building (kg/m2/year). In order to comply with Part L of the Building Regulations, the BER/DER must be less than the TER (see below).

Combined Heat and Power (CHP) - defined as the simultaneous generation of heat and power in a single process.

Communal heating - a general term for a shared heating system where heat is supplied to multiple dwellings and/or non-domestic buildings using pipes containing hot water.

District Heat Network – a system for distributing heat generated in a centralized location for residential and commercial heating requirements such as space heating and water heating.

Individual gas boiler – a gas boiler is installed in a dwelling or a non-domestic building to provide the property with heat. In this case natural gas (rather than hot water) is piped to the property.

Kilowatt (kW) – One thousand watts. A watt is a measure of power.

Megawatt (MW) – One million watts. A watt is a measure of power.

Part L of the Building Regulations – Approved documents Part L of the Building Regulations relate to the conservation of fuel and power in new dwellings and new buildings other than dwellings respectively.

Regulated CO2 emissions – The CO2 emissions arising from energy used by fixed building services, as defined in Approved Document Part L of the Building Regulations. These include fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation.

Shared Heat Network – A heat network created as part of a new development which includes the connection of neighbouring buildings.

Simplified Building Energy Model (SBEM) - a computer program that provides an analysis of a building's energy consumption. The purpose of the software is to produce consistent and reliable evaluations of energy use in non-domestic buildings for Building Regulations compliance.

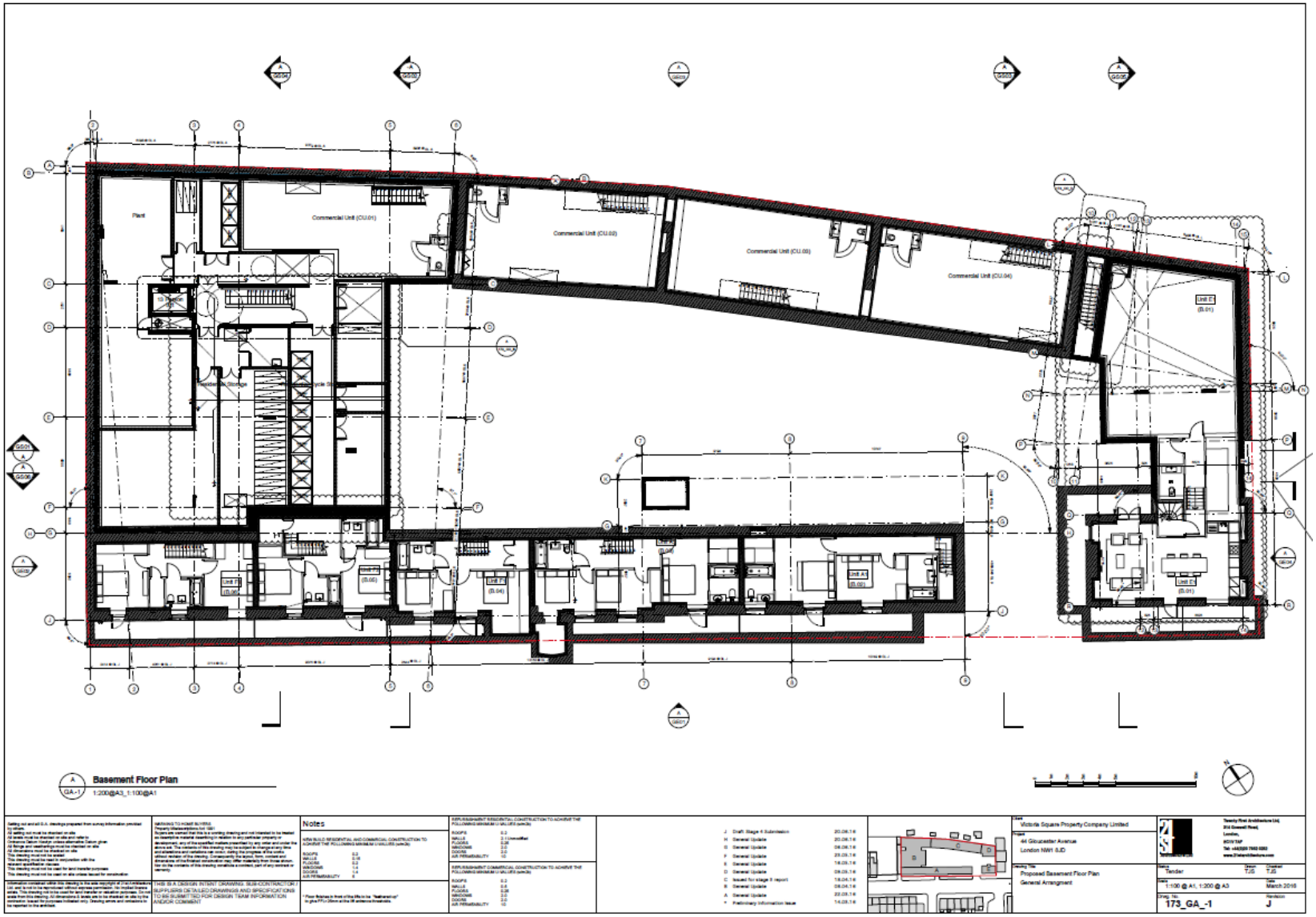
Site wide heat network – a set of flow and return pipes circulating hot water to the apartment blocks (and apartments contained therein) and non-domestic buildings on a development.

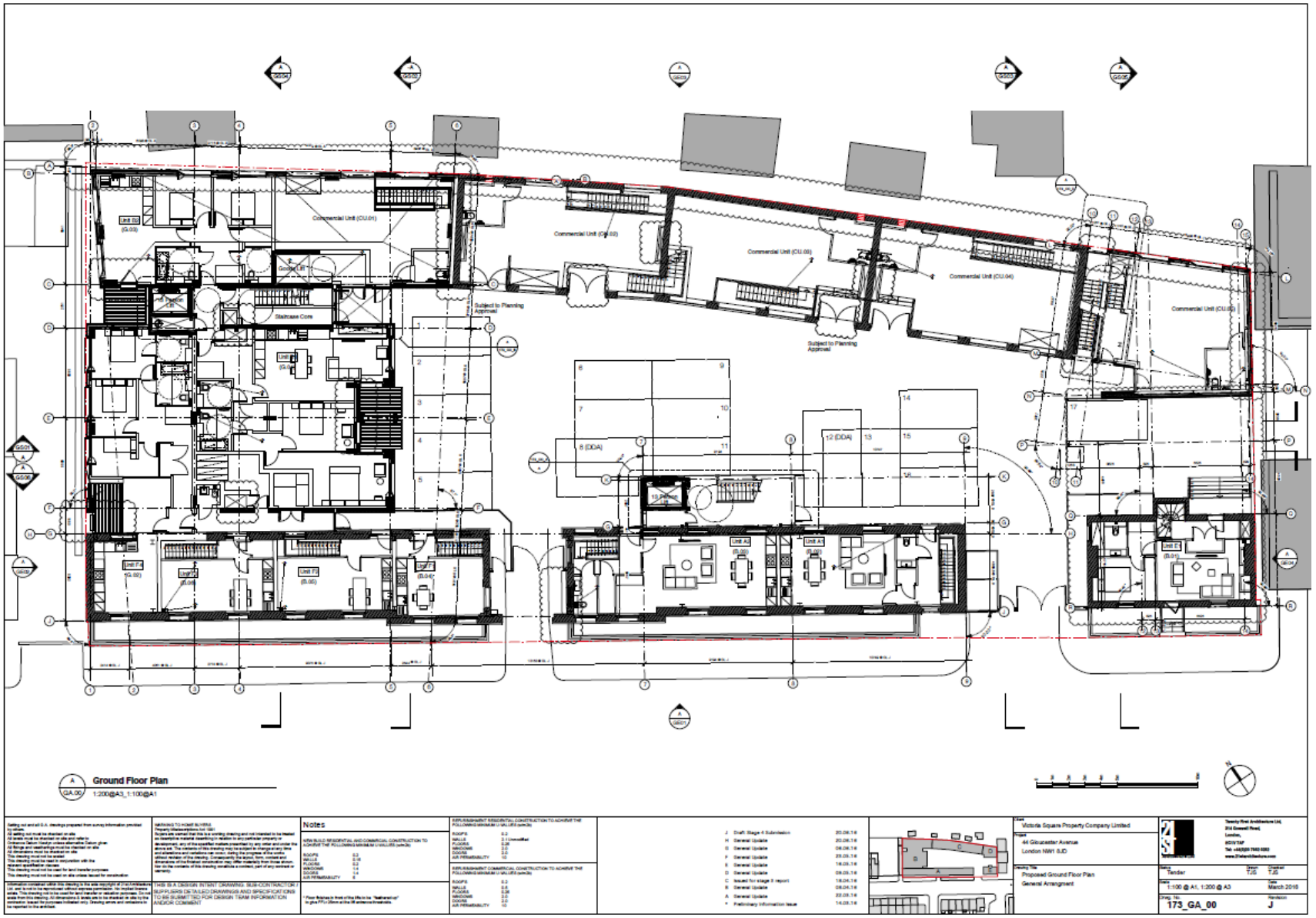
Standard Assessment Procedure (SAP) - a methodology for assessing and comparing the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of dwelling energy performances that are needed to underpin Building Regulations and other policy initiatives

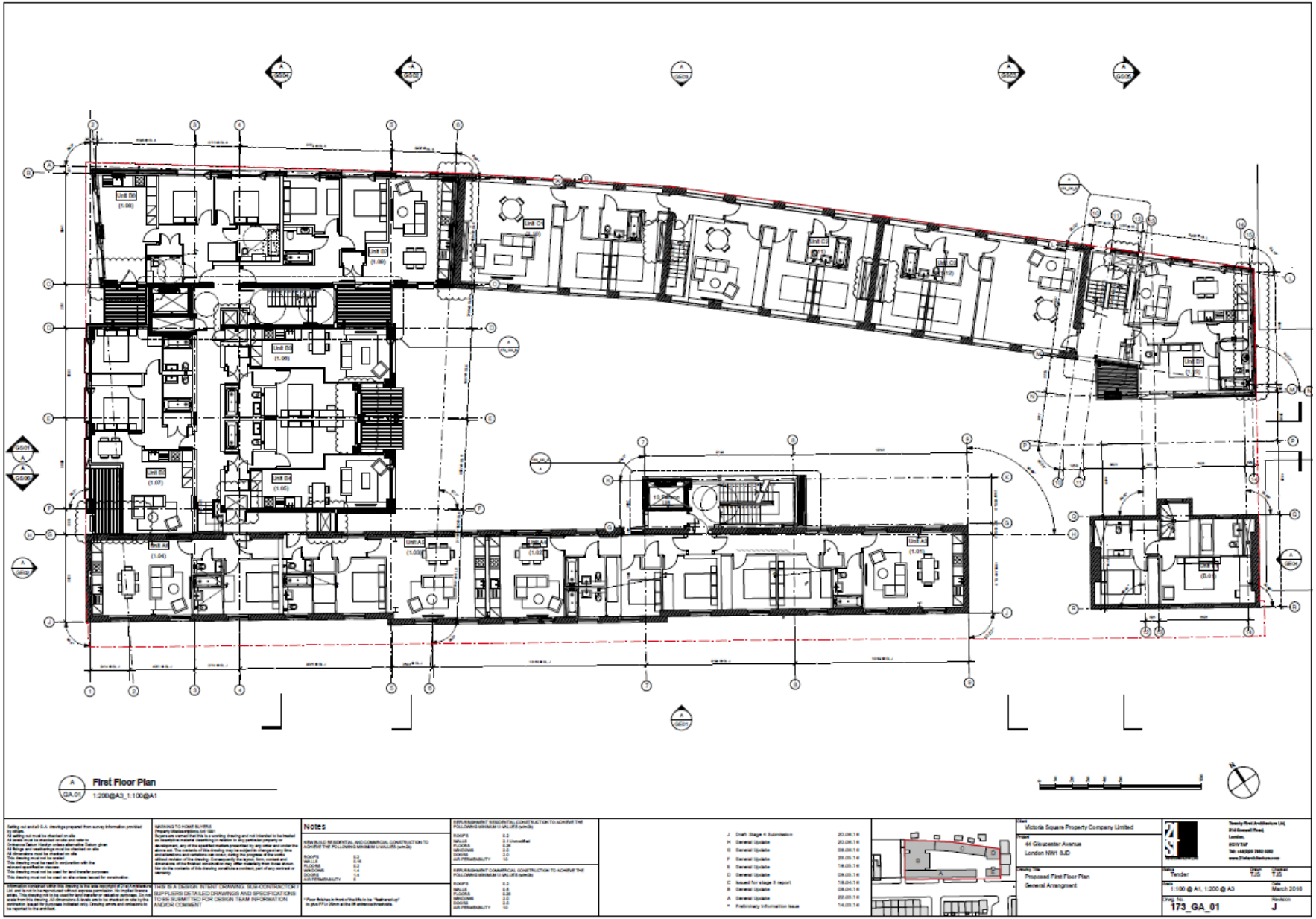
Target CO2 Emission Rate (TER) - the minimum energy performance requirement for a new dwelling/building. It is expressed in terms of the mass of CO2 emitted per year per square metre of the total useful floor area of the building (kg/m2/year).

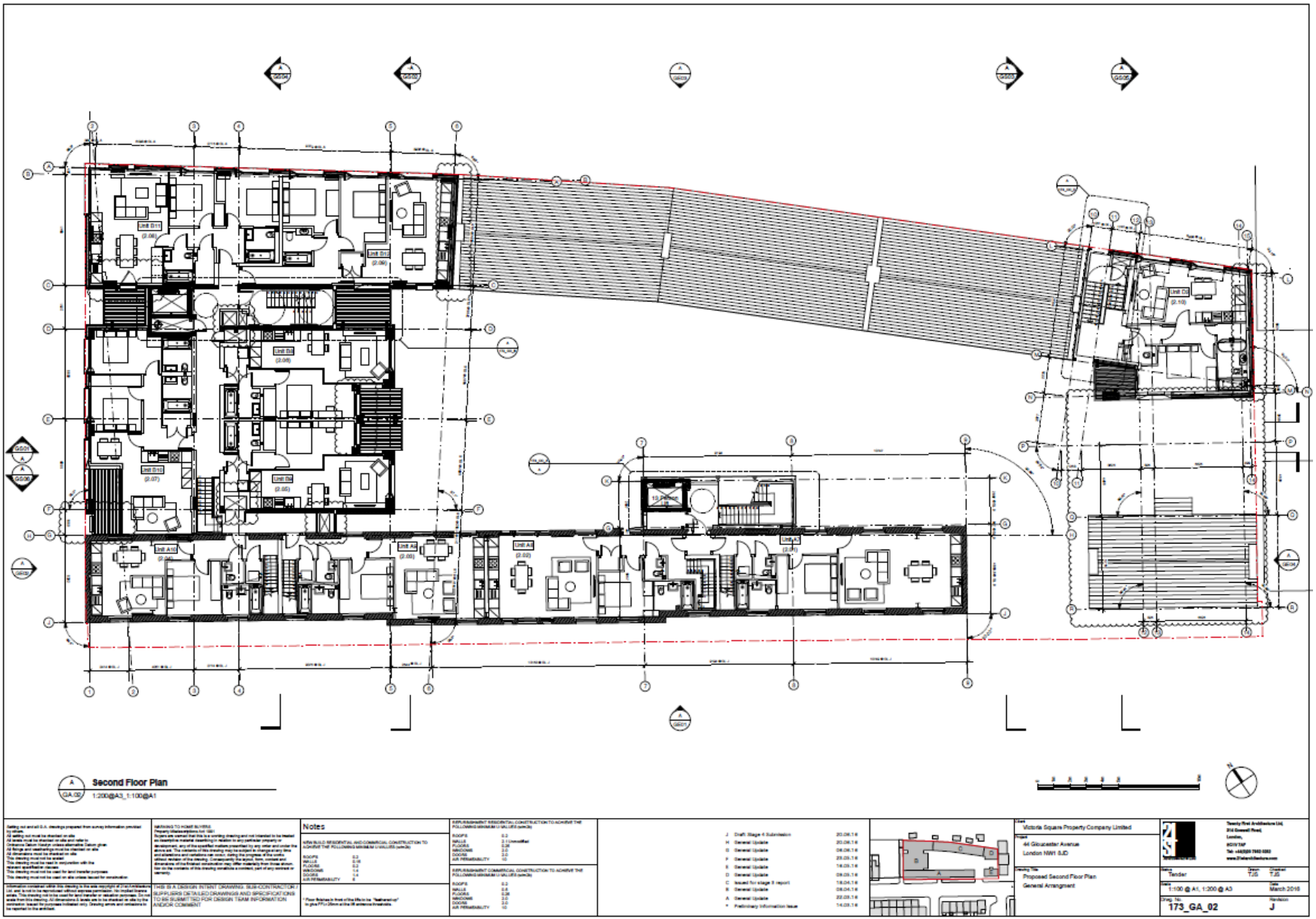
Unregulated CO_2 Emissions – carbon emissions from cooking and all electrical appliances which are not covered by the Building Regulations

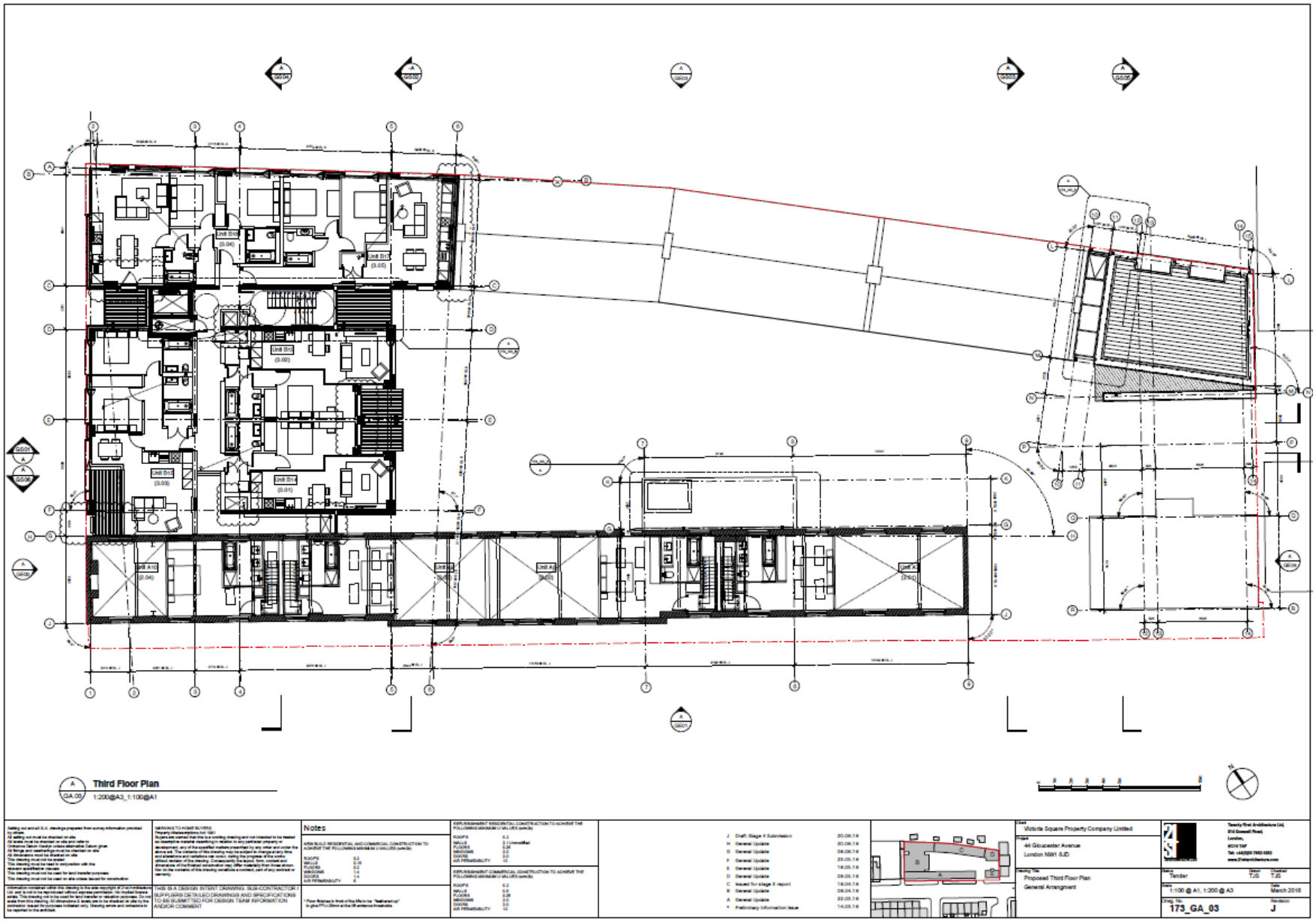
Appendix A – Floor Plans

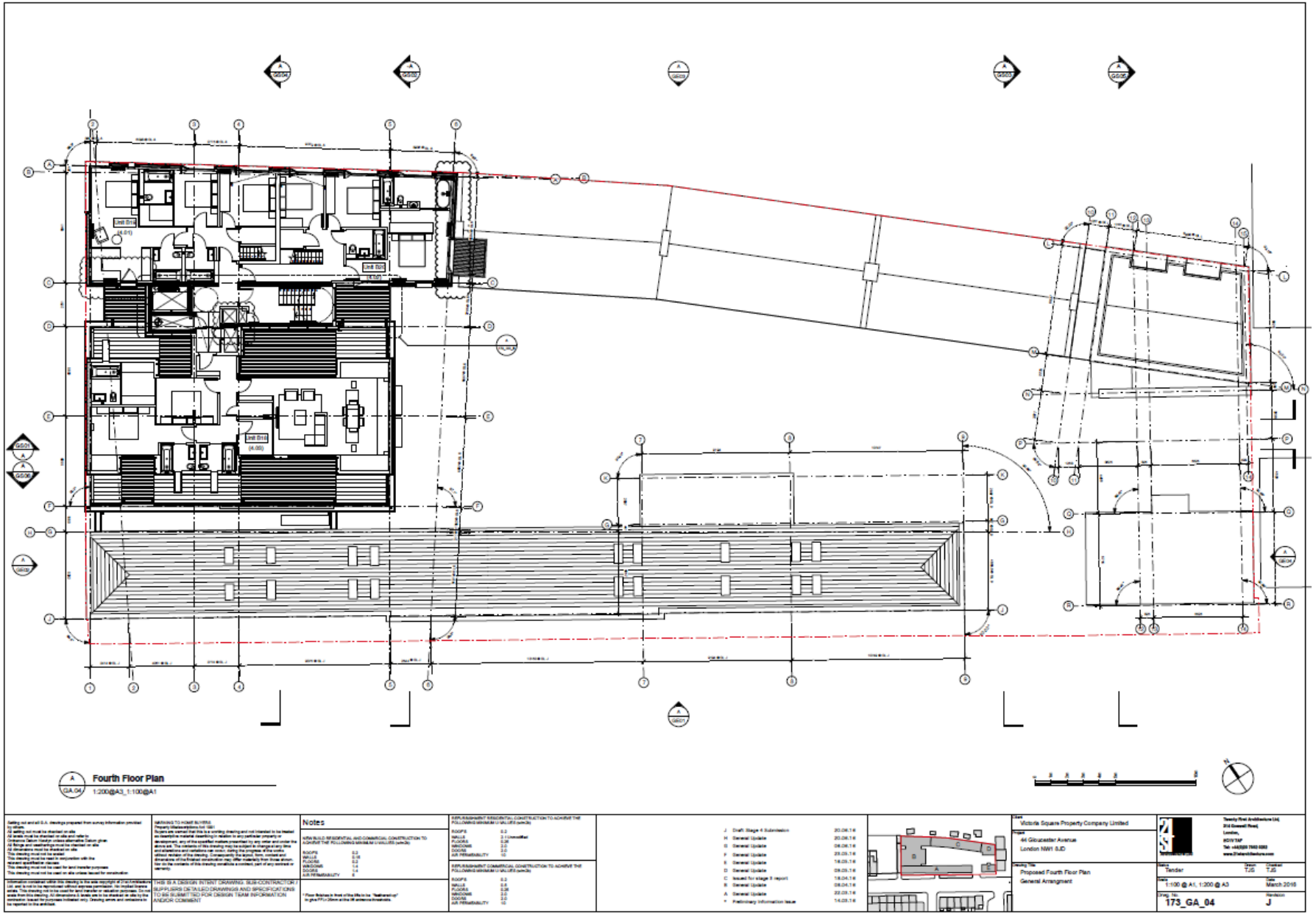



Ground Floor Plan
1:200@A3, 1:100@A1
Notes
Victoria Square Property Company Limited
44 Gloucester Avenue
London NW1 8JD
Proposed Ground Floor Plan
General Arrangement
Tender
1:100 @ A1, 1:200 @ A3
March 2018
173_GA_00
J


First Floor Plan
1:200@A3_1:100@A1
Notes
Proposed First Floor Plan
General Arrangment
173_GA_01
J


Second Floor Plan
GA 05
1:200@A3, 1:100@A1
Notes
Victoria Square Property Company Limited
44 Gloucester Avenue
London NW1 8JD
Proposed Second Floor Plan
General Arrangment
1:100 @ A1, 1:200 @ A3
March 2016
173_GA_02
J


Third Floor Plan
GA 05
1:200@A3, 1:100@A1
Notes
Victoria Square Property Company Limited
44 Gloucester Avenue
London NW1 8JD
Proposed Third Floor Plan
General Arrangement
1:100 @ A1, 1:200 @ A3
March 2016
173_GA_03
J


Fourth Floor Plan
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Victoria Square Property Company Limited
44 Gloucester Avenue
London NW1 8JD
Proposed Fourth Floor Plan
General Arrangment
Tender
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March 2016
173_GA_04
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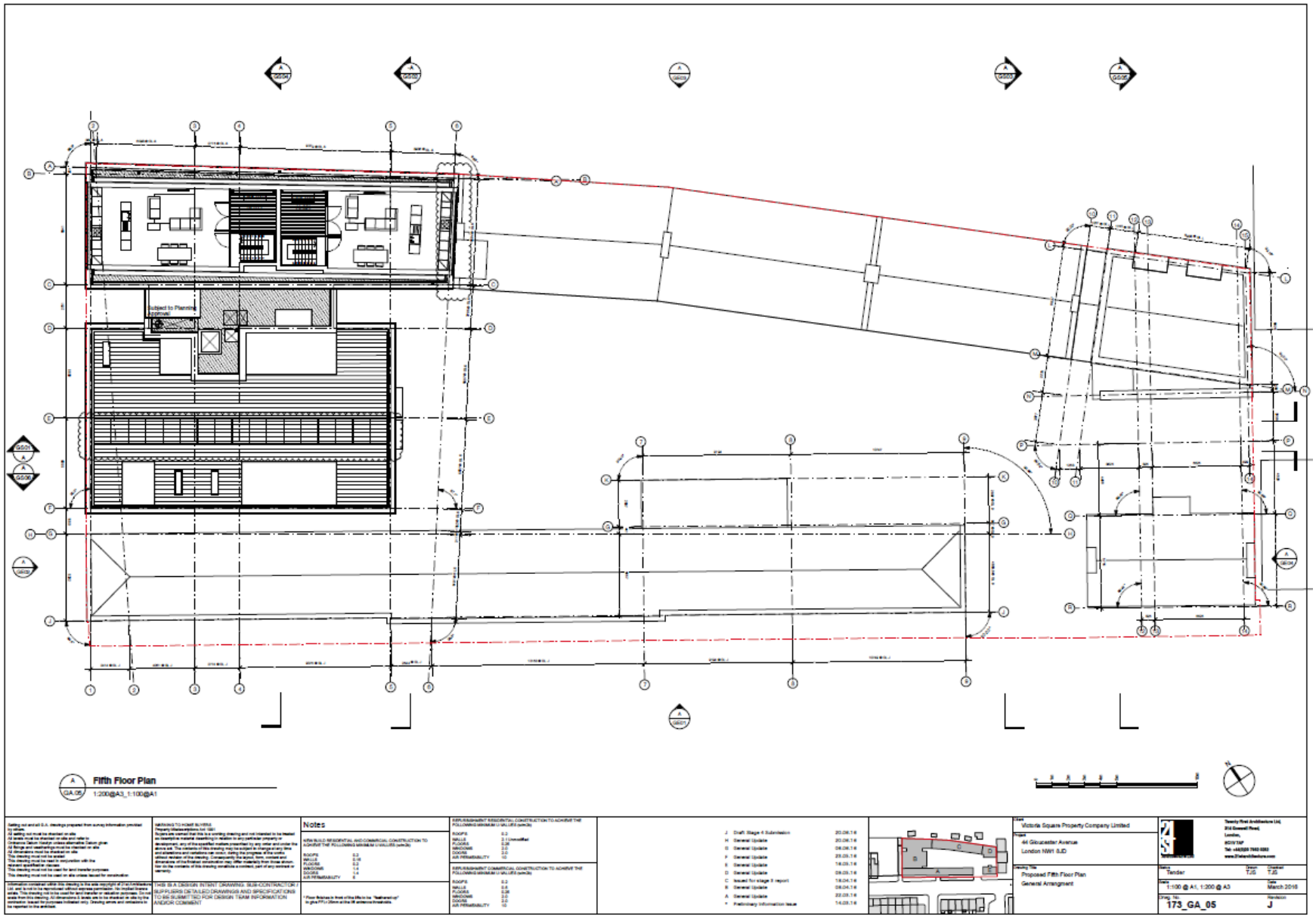
Fifth Floor Plan
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Victoria Square Property Company Limited
44 Gloucester Avenue
London NW1 8JD
Proposed Fifth Floor Plan
General Arrangement
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March 2016
173_GA_05
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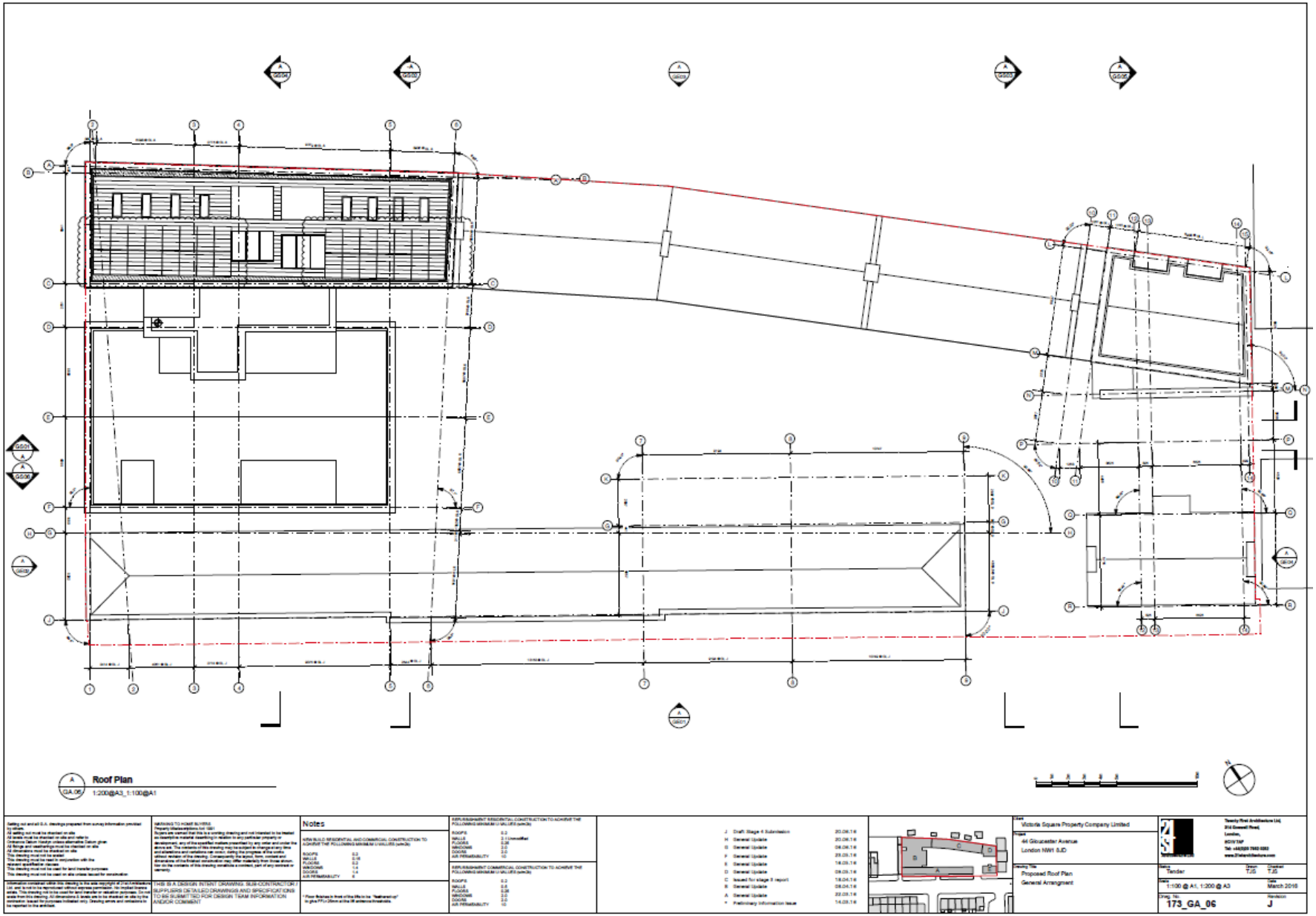
Roof Plan
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Notes
Proposed Roof Plan
General Arrangment
1:100 @ A1, 1:200 @ A3
March 2018
173_GA_06
J

Appendix B – Policy Context

B.0.1 The proposed development at Royal Docks must comply with a number of the following policies, regulations and standards which require the calculation of energy demand and carbon emissions:

- Approved Document Part L1A, 2013 edition
- London Plan and London Borough of Newham (LBN)

B.0.2 The calculations of energy demand and carbon emissions are slightly different for each of the policies/standards; this is discussed in the sections below.

B.0.3 Increased development of renewable energy resources and improvements in energy efficiency are vital to facilitating the delivery of the European, National, Regional and Local commitments on climate change. It is also worth noting that the EU has an ever increasing focus on carbon emissions and in February 2007, EU environment ministers agreed in principle to cut greenhouse gas emissions by 20% by 2020 based on 1990 levels.

B.0.4 The key documents of relevance to this development are highlighted below.

B.1 National Policy

B.1.1 Sustainable development is the core principle underpinning planning. At the heart of sustainable development is the simple idea of ensuring a better quality of life for everyone, now, and for future generations. A widely used definition was drawn up by the World Commission on Environment and Development in 1987: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

B.1.2 Planning has a key role to play in the creation of sustainable communities: communities that will stand the test of time, where people want to live, and which will enable people to meet their aspirations and potential.

National Planning Policy Framework

B.1.3 The National Planning Policy Framework (NPPF) was published in March 2012 and sets out the Government’s planning policies for England, and how these policies are expected to be applied. The policies in the document, taken as a whole, constitute the Government’s view of what sustainable development in England means in practice for the planning system.

B.1.4 Paragraph 14 of the NPPF states that:

> At the heart of the NPPF **is a presumption in favour of sustainable development**, which should be seen as a golden thread running through both plan-making and decision-taking. For **decision-taking** this means approving development proposals that accord with the development plan without delay.

B.1.5 The NPPF outlines a set of core land-use planning principles that should underpin both plan-making and decision-taking, three of which are particularly relevant to this SDCS. Under paragraph 17, these principles are that planning should:

- support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the reuse of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy);
- Contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this Framework; and
- Encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value.

B.1.6 Design is addressed in section 7 of the NPPF, and paragraph 56 states:

The Government attaches great importance to the design of the built environment. Good design is a key aspect of sustainable development, is indivisible from good planning, and should contribute positively to making places better for people.

B.1.7 Meeting the challenge of climate change is addressed in section 10 of the NPPF, and paragraph 93 states: Planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development.

B.1.8 Further to the above, paragraph 95 addresses local plan-making and state:

To support the move to a low carbon future, local planning authorities should:

- plan for new development in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- when setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.

B.1.9 Additionally, paragraph 96 discussed decision-taking and states that:

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

- comply with adopted Local 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

take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

B.1.10 Lastly, it is important to note that paragraph 187 of the NPPF addresses decision-taking by local planning authorities with respect to development applications. This paragraph states that:

Local planning authorities should look for solutions rather than problems, and decision-takers at every level should seek to approve applications for sustainable development where possible. Local planning authorities should work

proactively with applicants to secure developments that improve the economic, social and environmental conditions of the area.

B.2 Building Regulations

B.2.1 Building Regulations exist to ensure the health, safety, welfare and convenience of people in and around buildings, and the energy efficiency of buildings. The regulations apply to most new buildings and many alterations of existing buildings in England and Wales, whether new residential, commercial or industrial.

B.2.2 The development at Orchard Wharf will be constructed to be compliant with Building Regulations which are current at the time of construction. The relevant Approved Document Part L1A "Conservation of fuel and power in new dwellings" (Edition 2013) provide guidance on ways of complying with the energy efficiency requirements.

B.2.3 The development has been assessed for Part L compliance using approved Government Standard Assessment Procedures for Energy Rating of Dwellings/Building (SAP software).

B.3 Regional Policy

B.3.1 The London Plan (2011) is the Spatial Development Strategy for London. Section 5 of the Plan covers the mitigation of, and adaptation to climate change and the management of natural resources. The London Plan supports the Mayor's Energy Strategy. The key policies regarding energy efficiency are summarised below.

Policy 5.2 - Minimising CO_2 Emissions

Planning decisions

A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

B. The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings:

Year	Improvement on 2010 Building Regulations
2010 – 2013	25 per cent (Code for Sustainable Homes level 4)
2013 – 2016	40 per cent
2016 – 2031	Zero carbon

Non-domestic buildings:

Year	Improvement on 2010 Building Regulations
2010 – 2013	25 per cent
2013 – 2016	40 per cent
2016 – 2019	As per building regulations requirements
2019 – 2031	Zero carbon

C. Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D. As a minimum, energy assessments should include the following details:

   a. Calculation of baseline energy demand and carbon dioxide emissions on a 'whole energy' basis, showing the contribution of emissions both from uses covered by building regulations and those that are not (see paragraph 5.22)

   b. Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services

   c. Proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)

   d. Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

E. The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Policy 5.6 - Decentralised Energy in Development Proposals

Planning decisions

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B. Major development proposals should select energy systems in accordance with the following hierarchy:

   1. Connection to existing heating or cooling networks

   2. Site wide CHP network

   3. Communal heating and cooling.

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7 - Renewable Energy

Strategic

A. The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Planning decisions

B. Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

B.3.2 Section 5.42 of the London Plan states that:

Individual development proposals will also help to achieve these targets by applying the energy hierarchy in Policy 5.2. There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible.

Policy 5.9 – Overheating and Cooling

Strategic

A. The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Planning decisions

B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. minimise internal heat generation through energy efficient design
2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. passive ventilation
5. mechanical ventilation
6. active cooling systems (ensuring they are the lowest carbon options).

C. Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

B.4 Local Policy

B.4.1 The London Borough of Camden (LBC) require all developments to take measures to minimise the effects of - and adapt to - climate change, and encourages all development to meet the highest feasible environmental standards that are financially viable during construction and occupation.

London Borough of Camden's Core Strategy, November 2010

B.4.2 The London Borough of Camden's Core Strategy sets out the key elements of the Council's planning vision and strategy for the borough. It is a central part of Local Development Framework (LDF) and was adopted in November 2010.

B.4.3 Within the Core Strategy, specific policies set out the Council's approach to managing Camden's growth so that it is sustainable, meeting needs for homes, jobs and services, and protecting and enhancing quality of life and the borough's many valued and high quality places. Section 3 focuses on delivering the key elements of Camden's strategy relating to:

- making Camden more sustainable and tackling climate change, in particular improving the environmental performance of buildings, providing decentralised energy and heating networks, and reducing and managing our water use;
- promoting a more attractive local environment through securing high quality places, conserving our heritage, providing parks and open spaces, and encouraging biodiversity;
- improving health and well-being;
- making Camden a safer place while retaining its vibrancy; and
- dealing with our waste and increasing recycling.

CS13: Tackling climate change through promoting higher environmental standards

B.4.4 Policy CS13 sets out the approach that developers should take when considering energy and carbon reductions for developments:

Reducing the effects of and adapting to climate change

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;
b) promoting the efficient use of land and buildings;
c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

    1. ensuring developments use less energy,
    2. making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralized energy networks;
    3. generating renewable energy on-site; and

d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions.

Local energy generation

The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them;
f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road).

Water and surface water flooding

The Council will make Camden a water efficient borough and minimise the potential for surface water flooding by:

g) protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;
h) making sure development incorporates efficient water and foul water infrastructure;
i) requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and down-stream flooding, especially in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross.

Camden's carbon reduction measures

The Council will take a lead in tackling climate change by:

j) taking measures to reduce its own carbon emissions;
k) trialling new energy efficient technologies, where feasible; and
l) raising awareness on mitigation and adaptation measures.

B.4.5 The Camden Core Strategy contains other policies relevant to this report, which are not outlined in full. These policies are set out below, and reference should be made to the original document for further information:

- Policy CS16: Improving Camden's health and well-being; and
- Policy CS18: Dealing with our waste and encouraging recycling.

Camden Development Policies, November 2010

B.4.6 Camden Development Policies contribute towards delivering the Core Strategy by setting out detailed planning policies that the Council will use when determining applications for planning permission, to achieve the vision and objectives of the Core Strategy.

Policy DP22: Promoting sustainable design and construction

B.4.7 Policy DP22 has been developed to provide details on sustainability standards. The policy states, in part:

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5, have been incorporated into the design and proposed implementation; and
b) incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

e) expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;
g) limiting run-off;
h) reducing water consumption;
i) reducing air pollution; and
j) not locating vulnerable uses in basements in flood-prone areas.

B.4.8 Paragraph 22.5 states: When a building is constructed, the accessibility of its location; its density and mix of uses; its detailed design taking into account the orientation of the site; and the mechanical services and materials chosen can all have a major impact on its energy efficiency. The Council will require all schemes to consider these general sustainable development principles, along with the detailed elements identified in the table below, from the start of the design process. Developments of 5 or more dwellings or 500sqm of any floorspace should address sustainable development principles in their Design and Access statements or in a separate Energy Efficiency Statement, including how these principles have contributed to reductions in carbon dioxide emissions. When justifying the chosen design with regards to sustainability the following appropriate points must be considered:

Design	**Fabric/ Services**
• the layout of uses • floorplates size/depth • floor to ceiling heights • location, size and depth of windows • limiting excessive solar gain • reducing the need for artificial lighting • shading methods, both on or around the building • optimising natural ventilation • design for and inclusion of renewable energy technology • impact on existing renewable and low carbon technologies in the area • sustainable urban drainage, including provision of a green or brown roof • adequate storage space for recyclable material, composting where possible • bicycle storage • measures to adapt to climate change (see below) • impact on microclimate	• level of insulation • choice of materials, including - responsible sourcing, re-use and recycled content • air tightness • efficient heating, cooling and lighting systems • effective building management system • the source of energy used • metering • counteracting the heat expelled from plant equipment • enhancement of / provision for biodiversity • efficient water use • re-use of water • educational elements, for example visible meters • on-going management and review

B.4.9 The Camden Development Policies contains a number of other policies relevant to this report, which are not outlined in full. These policies can be found in the list below, and reference should be made to the original document for further information:

- Policy DP23: Water;
- Policy DP28: Noise and vibration; and
- Policy DP32: Air quality and Camden's Clear Zone.

Camden Planning Guidance - Sustainability (CPG3), July 2015

B.4.10 The Core Strategy is supported by Supplementary Planning Documents and CPG3 contains advice and guidance for developers on ways to achieve carbon reductions and more sustainable developments. It also highlights the Council's requirements and guidelines which support the relevant Development Policies, including DP22 as noted above.

B.4.11 Within this document it sets standards for:

- Renewable energy;
- Water efficiency;
- Sustainable use of materials;
- Brown and green roofs;
- Flooding;
- Adapting to climate change; and
- Biodiversity.

B.4.12 It is stated within the document that developments should achieve a 20% reduction in carbon dioxide emissions from on-site renewable technologies. All developments should also be water efficient and look to install efficient water fixtures and fittings.

B.4.13 Materials should be responsibly sourced, and the waste hierarchy should be implemented to prioritise the reduction, re-use and recycling of materials.

Appendix C – Calculation Results

Notional baseline

Residential														SAP 2012		Baseline CO_2 Emissions	Regulated CO_2 Emissions	Unregulated CO_2 Emissions
Floor	Unit	Dwelling Type	Floor area (m^2)	FEE (kWh/m^2/yr)	Space Heating from Boiler (Main 1) (kWh/an)	Space Heating (Main 2) (kWh/an)	Space Heating (Secondary) (kWh/an)	DHW from Boiler (kWh/an)	Cooling (kWh/an)	Lighting (kWh/an)	Aux (kWh/an)	Occupants	Un-Reg (kWh/an)	TER	DER	$kgCO_2$/annum	$kgCO_2$/annum	$kgCO_2$/annum
1	New Build Flats	Apt, mid tce	1379.29										67,540	19.05	19.05	26,275	26,275	35,053
2	Refurb Flats	Apt, mid tce	1768.91										65,500	74.08	74.08	131,041	131,041	33,995
Total /	42		3985.7	#DIV/0!	0	0	0	0	0	0	0	0	168,432	49.97	49.97	199,166	199,166	87,416

Non-Residential													SBEM 2013		Baseline CO_2 Emissions	Regulated CO_2 Emissions	Unregulated CO_2 Emissions
Floor	Description	Floor area (m2)	HLP	Space Heating (Main) (kWh/an)	Space Heating (Main 2) (kWh/an)	Space Heating (Secondary) (kWh/an)	DHW (kWh/an)	Cooling (SBEM) (kWh/an)	Lighting (kWh/an)	Aux (kWh/an)		Un-Reg (kWh/an)	TER	BER	$kgCO_2$/annum	$kgCO_2$/annum	$kgCO_2$/annum
	Non-resi	698		0			0	0	0	0		29,449	27.80	27.80	19,404	19,404	15,284
Total		698		0	0	0	0	0	0	0		29,449	27.80	27.80	19,404	19,404	15,284

Efficient baseline

Residential															SAP 2012		Baseline CO_2 Emissions	Regulated CO_2 Emissions	Unregulated CO_2 Emissions	Code Ene 7		% Improvement DER over TER
Total Units	Unit	Dwelling Type	Floor area (m^2)	FEE (kWh/m^2/yr)	Space Heating from Boiler (Main 1) (kWh/an)	Space Heating (Main 2) (kWh/an)	Space Heating (Secondary) (kWh/an)	DHW from Boiler (kWh/an)	Cooling (kWh/an)	Lighting (kWh/an)	Aux (kWh/an)	Occupants	Un-Reg (kWh/an)	TER	DER	$kgCO_2$/annum	$kgCO_2$/annum	$kgCO_2$/annum	Standard case emissions	Actual case emissions	
22	22 New Build Flats	Apt, mid tce	1379.29										67,540	19.05	17.12	26,275	23,613	35,053	0.00	0.00	10.1%
2	20 Refurb Flats	Apt, mid tce	1768.91										65,500	74.08	40.42	131,041	71,499	33,995	0.00	0.00	45.4%
Total /	42		3985.7		0	0	0	0	0	0	0	0	168,432	49.97	30.21	199,166	120,415	87,416	0.00	0.00	39.5%

Non-Residential													SBEM 2013		Baseline CO_2 Emissions	Regulated CO_2 Emissions	Unregulated CO_2 Emissions	% Improvement BER over TER	% Improvement BER over TER
Floor	Description	Floor area (m2)	HLP	Space Heating (Main) (kWh/an)	Space Heating (Main 2) (kWh/an)	Space Heating (Secondary) (kWh/an)	DHW (kWh/an)	Cooling (SBEM) (kWh/an)	Lighting (kWh/an)	Aux (kWh/an)		Un-Reg (kWh/an)	TER	BER	$kgCO_2$/annum	$kgCO_2$/annum	$kgCO_2$/annum		
	Non-resi	698		0			0	0	0	0		29,449	27.80	20.80	19,404	14,518	15,284	25.2%	25.2%
Total /		698		0	0	0	0	0	0	0		29,449	27.80	20.80	19,404	14,518	15,284	25.2%	25.2%

Renewables Baseline

Residential														PVs		Electricity Offset	SAP 2012		Baseline CO_2 Emissions	Regulated CO_2 Emissions	Unregulated CO_2 Emissions	% Improvement DER over TER
Floor	Unit	Dwelling Type	Floor area (m^2)	FEE (kWh/m^2/yr)	Space Heating from Boiler (Main 1) (kWh/an)	Space Heating (Main 2) (kWh/an)	Space Heating (Secondary) (kWh/an)	DHW from Boiler (kWh/an)	Cooling (kWh/an)	Lighting (kWh/an)	Aux (kWh/an)	Occupants	Un-Reg (kWh/an)	PVs kWp	PVs Energy Offset	kWh/annum	TER	DER	$kgCO_2$/annum	$kgCO_2$/annum	$kgCO_2$/annum	
22	22 New Build Flats	Apt, mid tce	1379.29								0		67,540	4.149	-3582.74		19.05	15.77	26,275	21,754	35,053	17.2%
2	20 Refurb Flats	Apt, mid tce	1768.91								0		65,500	5.320	-4594.79		74.08	39.07	131,041	69,115	33,995	47.3%
Total /	42		3985.7	0.00	0	0	#DIV/0!	0	0	0	0	####	168,432	11.988	-10352.957	#DIV/0!	49.97	28.86	199,166	115,042	87,416	42.2%

Non-Residential													PVs		Electricity Offset	SBEM 2010		Baseline CO_2 Emissions	Regulated CO_2 Emissions	Unregulated CO_2 Emissions	% Improvement BER over TER
Floor	Description	Floor area (m2)	HLP	Space Heating (Main) (kWh/an)	Space Heating (Main 2) (kWh/an)	Space Heating (Secondary) (kWh/an)	DHW (kWh/an)	Cooling (SBEM) (kWh/an)	Lighting (kWh/an)	Aux (kWh/an)		Un-Reg (kWh/an)	PVs (m2)	PVs Energy Offset	kWh/annum	TER	BER	$kgCO_2$/annum	$kgCO_2$/annum	$kgCO_2$/annum	
	#REF!	698		0			0	0	#REF!	#REF!	####	29,449	0	0.00	#REF!	27.80	20.80	19,404	14,518	15,284	25.2%
Total /		698		0	0	0	0	0	#REF!	#REF!		29,449	0	0	#REF!			19,404	14,518	15,284	25.2%

Appendix D – Sample SAPs and BRUKL reports

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

44 Gloucester Ave_Commercial Only As built

Date: Wed Apr 13 11:19:21 2016

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.5

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	27.8
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	27.8
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	20.8
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{s\text{-}Limit}$	$U_{s\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.44	0.5	BS000002_W1_-1
Floor	0.25	0.25	0.25	BS000002_F_-1
Roof	0.25	0.2	0.2	BS000002_C_2
Windows***, roof windows, and rooflights	2.2	1.82	2.01	GR000001_W1-W0
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

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

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	9.4

Page 1 of 6

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs.
Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Heating & Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.98	4.65	-	0.5	0.88
Standard value	0.91*	N/A	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- SYST0002-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Basement Unit CU.02	-	-	-	-	-	-	-	0.3	-	-	N/A
Basement Unit CU.03	-	-	-	-	-	-	-	0.3	-	-	N/A
Basement Unit CU.04	-	-	-	-	-	-	-	0.3	-	-	N/A
Ground Floor Unit CU.01	-	-	-	-	-	-	-	0.3	-	-	N/A
Ground Floor Unit CU.02	-	-	-	-	-	-	-	0.3	-	-	N/A
Ground Floor Unit CU.03	-	-	-	-	-	-	-	0.3	-	-	N/A
Ground Floor Unit CU.04	-	-	-	-	-	-	-	0.3	-	-	N/A
Ground Floor Unit CU.05	-	-	-	-	-	-	-	0.3	-	-	N/A
Basement Unit CU.01	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Basement Unit CU.02	85	-	-	696

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Basement Unit CU.03	85	-	-	675
Basement Unit CU.04	85	-	-	686
Ground Floor Unit CU.01	85	-	-	580
Ground Floor Unit CU.02	85	-	-	668
Ground Floor Unit CU.03	85	-	-	650
Ground Floor Unit CU.04	85	-	-	663
Ground Floor Unit CU.05	85	-	-	445
Basement Unit CU.01	85	-	-	595

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Basement Unit CU.02	N/A	N/A
Basement Unit CU.03	N/A	N/A
Basement Unit CU.04	N/A	N/A
Ground Floor Unit CU.01	NO (-40.6%)	NO
Ground Floor Unit CU.02	NO (-49.7%)	NO
Ground Floor Unit CU.03	NO (-54.4%)	NO
Ground Floor Unit CU.04	NO (-53.3%)	NO
Ground Floor Unit CU.05	NO (-81.7%)	NO
Basement Unit CU.01	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	771.8	771.8
External area [m²]	1099.3	1099.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	9	3
Average conductance [W/K]	544.29	642.92
Average U-value [W/m²K]	0.5	0.58
Alpha value* [%]	19.67	18.61

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	24.59	15.46
Cooling	4.57	10.7
Auxiliary	11.59	15.99
Lighting	14.09	19.63
Hot water	2.89	3.34
Equipment*	42.19	42.19
TOTAL**	57.73	65.11

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	148.18	184.21
Primary energy* [kWh/m²]	121.09	161.17
Total emissions [kg/m²]	20.8	27.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	GR000002_W1_-1
Floor	0.2	0.2	GR000002_F_2
Roof	0.15	0.2	BS000002_C_2
Windows, roof windows, and rooflights	1.5	1.4	GR000002_W1-W0
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	9.4

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Natural Gas										
	Actual	69	79.2	24.6	4.6	11.6	0.78	4.81	0.98	5.99
	Notional	45.6	138.6	15.5	10.7	16	0.82	3.6	---	---

Key to terms

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

Project Information

Building type Mid-floor flat

Reference

Date 8 April 2016

Project NW1

SAP 2012 worksheet for notional dwelling - calculation of target emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
First floor	100.18	3.00	300.54	(3a)
Total floor area	100.18			(4)
Dwelling volume (m^3)			300.54	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	4	x 10	40.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

		Air changes per hour	
Infiltration due to chimneys, fans and flues		0.13	(8)
Pressure test, result q50	5.00		(17)
Air permeability		0.38	(18)
Number of sides on which sheltered		2.00	(19)
Shelter factor		0.85	(20)
Infiltration rate incorporating shelter factor		0.33	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18

13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.42	0.41	0.40	0.36	0.35	0.31	0.31	0.30	0.33	0.35	0.37	0.38

4.27 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01_Living			**3.800**	**1.33 (1.40)**	5.04	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01			**3.800**	**1.33 (1.40)**	5.04	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01			**3.080**	**1.33 (1.40)**	4.08	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01			**3.080**	**1.33 (1.40)**	4.08	(27)
Walls 2013 External Wall New, Ground Floor Unit B1 G.01_Living			23.57	0.18	4.24	(29)
Walls 2013 External Wall New, Ground Floor Unit B1 G.01			32.13	0.18	5.78	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B1 G.01_Living			44.60	0.00	0.00	
Internal wall 2013 Internal Partition, Ground Floor Unit B1 G.01			96.02	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B1 G.01			142.01	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B1 G.01_Living			58.35	0.00	0.00	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B1 G.01			0.01	0.00	0.00	

Total area of external elements Sigma A, m²	69.46	(31)
Fabric heat loss, W/K	28.27	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	3.47	(36)
Total fabric heat loss	31.74	(37)

Ventilation heat loss calculated monthly

58.14	57.80	57.48	55.95	55.67	54.33	54.33	54.09	54.85	55.67	56.24	56.85	(38)

Heat transfer coefficient, W/K

89.88	89.55	89.22	87.69	87.41	86.08	86.08	85.83	86.59	87.41	87.99	88.59	
											87.69	(39)

Heat loss parameter (HLP), W/m²K

0.90	0.89	0.89	0.88	0.87	0.86	0.86	0.86	0.86	0.87	0.88	0.88	
HLP (average)											0.88	(40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K

Total area of external elements Sigma A, m²	69.46	(31)
Fabric heat loss, W/K	28.27	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	3.47	(36)
Total fabric heat loss	31.74	(37)

Ventilation heat loss calculated monthly

58.14	57.80	57.48	55.95	55.67	54.33	54.33	54.09	54.85	55.67	56.24	56.85	(38)

Heat transfer coefficient, W/K

89.88	89.55	89.22	87.69	87.41	86.08	86.08	85.83	86.59	87.41	87.99	88.59	

87.69 (39)

Heat loss parameter (HLP), W/m²K

0.90	0.89	0.89	0.88	0.87	0.86	0.86	0.86	0.86	0.87	0.88	0.88	

HLP (average) 0.88 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N	2.74	(42)
Annual average hot water usage in litres per day Vd,average	99.30	(43)

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

Hot water usage in litres per day for each month

109.23	105.26	101.29	97.32	93.34	89.37	89.37	93.34	97.32	101.29	105.26	109.23	(44)

Energy content of hot water used

161.99	141.68	146.20	127.46	122.30	105.54	97.79	112.22	113.56	132.34	144.46	156.88	

Energy content (annual) 1562.43 (45)

Distribution loss

24.30	21.25	21.93	19.12	18.35	15.83	14.67	16.83	17.03	19.85	21.67	23.53	(46)

Cylinder volume, l	150.00	(47)
Manufacturer's declared cylinder loss factor (kWh/day)	1.39	(48)
Temperature Factor	0.5400	(49)
Energy lost from hot water cylinder (kWh/day)	0.75	(55)

Total storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

Net storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary loss

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

Total heat required for water heating calculated for each month

208.59	183.76	192.79	172.55	168.90	150.63	144.39	158.82	158.65	178.94	189.56	203.47	(62)

Output from water heater for each month, kWh/month

208.59	183.76	192.79	172.55	168.90	150.63	144.39	158.82	158.65	178.94	189.56	203.47	(64)

2111.04 (64)

Heat gains from water heating, kWh/month

91.14	80.78	85.89	78.45	77.94	71.16	69.79	74.59	73.83	81.28	84.11	89.44	(65)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	(66)
Lighting gains												
24.65	21.89	17.80	13.48	10.07	8.51	9.19	11.95	16.03	20.36	23.76	25.33	(67)
Appliances gains												
256.62	259.28	252.57	238.29	220.25	203.30	191.98	189.32	196.03	210.31	228.35	245.30	(68)
Cooking gains												
36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	(71)
Water heating gains												
122.50	120.20	115.44	108.96	104.76	98.84	93.81	100.25	102.55	109.25	116.82	120.21	(72)
Total internal gains												
470.88	468.49	452.93	427.84	402.20	377.77	362.10	368.64	381.73	407.04	436.04	457.96	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.800 10.63	0.63 x 0.70	0.77	12.3489	
2013 External Window New, Ground Floor Unit B1 G.01_Living					
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.800 10.63	0.63 x 0.70	0.77	12.3489	
2013 External Window New, Ground Floor Unit B1 G.01					
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.080 10.63	0.63 x 0.70	0.77	10.0091	
2013 External Window New, Ground Floor Unit B1 G.01					
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.080 10.63	0.63 x 0.70	0.77	10.0091	
2013 External Window New, Ground Floor Unit B1 G.01					
Total solar gains, January				44.72	(83-1)

Solar gains

44.72	85.45	145.21	233.24	314.20	336.36	314.03	249.14	174.59	101.72	55.16	37.28	(83)
Total gains												
515.60	553.95	598.14	661.09	716.40	714.12	676.13	617.78	556.31	508.76	491.21	495.23	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.80	0.80	0.70 x 0.83	1.59
2013 External Window New, Ground Floor Unit B1 G.01_Living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.80	0.80	0.70 x 0.83	1.59
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.08	0.80	0.70 x 0.83	1.29
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.08	0.80	0.70 x 0.83	1.29
2013 External Window New, Ground Floor Unit B1 G.01				

SAP 2012 worksheet for notional dwelling - calculation of target emissions

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau											
77.40	77.69	77.97	79.33	79.59	80.82	80.82	81.05	80.34	79.59	79.07	78.53
alpha											
6.16	6.18	6.20	6.29	6.31	6.39	6.39	6.40	6.36	6.31	6.27	6.24
Utilisation factor for gains for living area											
1.00	1.00	1.00	0.98	0.91	0.73	0.55	0.63	0.89	0.99	1.00	1.00 (86)
Mean internal temperature in living area T1											
20.03	20.13	20.31	20.59	20.84	20.97	21.00	20.99	20.90	20.60	20.28	20.02 (87)
Temperature during heating periods in rest of dwelling Th2											
20.17	20.17	20.18	20.19	20.19	20.20	20.20	20.20	20.20	20.19	20.19	20.18 (88)
Utilisation factor for gains for rest of dwelling											
1.00	1.00	0.99	0.97	0.88	0.66	0.46	0.52	0.84	0.98	1.00	1.00 (89)
Mean internal temperature in the rest of dwelling T2											
18.86	19.00	19.27	19.69	20.03	20.18	20.20	20.20	20.11	19.70	19.23	18.85 (90)

Living area fraction (29.17 / 100.18) 0.29 (91)

Mean internal temperature (for the whole dwelling)

19.20	19.33	19.58	19.95	20.26	20.41	20.43	20.43	20.34	19.96	19.54	19.19 (92)

Apply adjustment to the mean internal temperature, where appropriate

19.20	19.33	19.58	19.95	20.26	20.41	20.43	20.43	20.34	19.96	19.54	19.19 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains											
1.00	1.00	0.99	0.97	0.88	0.68	0.49	0.55	0.85	0.98	1.00	1.00 (94)
Useful gains											
514.71	552.25	593.46	640.88	631.40	483.70	328.13	342.21	473.51	498.85	489.42	494.57 (95)
Monthly average external temperature											
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20 (96)
Heat loss rate for mean internal temperature											
1339.17	1291.91	1166.69	969.05	748.59	500.33	329.86	345.98	540.35	818.39	1094.13	1328.19 (97)
Fraction of month for heating											
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00
Space heating requirement for each month, kWh/month											
613.40	497.05	426.48	236.28	87.20	-	-	-	-	237.74	435.39	620.21

Total space heating requirement per year (kWh/year) (October to May) 3153.76 (98)

Space heating requirement per m² (kWh/m²/year) 31.48 (99)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

9a. Energy requirements

kWh/year

No secondary heating system selected
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main heating system 93.50% (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
613.40	497.05	426.48	236.28	87.20	-	-	-	-	237.74	435.39	620.21	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
656.04	531.61	456.13	252.71	93.26	-	-	-	-	254.27	465.66	663.33	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
208.59	183.76	192.79	172.55	168.90	150.63	144.39	158.82	158.65	178.94	189.56	203.47	(64)
Efficiency of water heater											79.80	(216)
87.52	87.34	86.87	85.65	83.15	79.80	79.80	79.80	79.80	85.57	86.96	87.60	(217)
Water heating fuel												
238.32	210.40	221.92	201.45	203.13	188.76	180.94	199.02	198.81	209.11	217.97	232.28	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	3373.00	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2502.12	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	435.26	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	6385.38	(238)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for notional dwelling - calculation of target emissions

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	3373.00	0.216	728.57	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2502.12	0.216	540.46	(264)
Space and water heating			1269.03	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	435.26	0.519	225.90	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			1533.85	(272)

	kg/m²/year	
Emissions per m² for space and water heating	**12.67**	(272a)
Emissions per m² for lighting	**2.25**	(272b)
Emissions per m² for pumps and fans	**0.39**	(272c)
Target Carbon Dioxide Emission Rate (TER)	**15.31**	(273)

= (12.6675 x 1.00) + 2.2549 + 0.3886

Project Information
Building type Mid-floor flat

Reference
Date 8 April 2016
Project NW1

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
First floor	100.18	3.00	300.54	(3a)
Total floor area	100.18			(4)
Dwelling volume (m^3)			300.54	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	0	x 10	0.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.25	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.21	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	
												52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18	
												13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25	
												2.79 (22b)

air change rate through system	0.50	(23a)
efficiency in % allowing for in-use factor	79.90	(23c)

Ventilation : balanced whole house mechanical with heat recovery

Effective air change rate

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01			**3.082**	**1.68 (1.80)**	5.17			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01			**3.082**	**1.68 (1.80)**	5.17			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01			**3.795**	**1.68 (1.80)**	6.37			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B1 G.01_Living			**3.795**	**1.68 (1.80)**	6.37			(27)
Walls 2013 External Wall New, Ground Floor Unit B1 G.01			32.13	0.14	4.50	21.95	705.32	(29)
Walls 2013 External Wall New, Ground Floor Unit B1 G.01_Living			23.57	0.14	3.30	21.95	517.36	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B1 G.01_Living			44.60	0.00	0.00	8.75	390.28	
Internal wall 2013 Internal Partition, Ground Floor Unit B1 G.01			96.02	0.00	0.00	8.75	840.18	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B1 G.01_Living			58.35	0.00	0.00	95.00	5542.79	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B1 G.01			142.01	0.00	0.00	95.00	13490.67	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B1 G.01			0.01	0.00	0.00	95.00	1.01	

Total area of external elements Sigma A, m²	69.46	(31)
Fabric heat loss, W/K	30.89	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	0.08	(36)
Total fabric heat loss	30.97	(37)

Ventilation heat loss calculated monthly

36.84	36.31	35.78	33.15	32.62	29.99	29.99	29.46	31.04	32.62	33.68	34.73	(38)

Heat transfer coefficient, W/K

67.81	67.28	66.76	64.12	63.60	60.96	60.96	60.43	62.02	63.60	64.65	65.70	
											63.99	(39)

Heat loss parameter (HLP), W/m²K

0.68	0.67	0.67	0.64	0.63	0.61	0.61	0.60	0.62	0.63	0.65	0.66	
HLP (average)											0.64	(40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K

Total area of external elements Sigma A, m² 69.46 (31)
Fabric heat loss, W/K 30.89 (33)
Thermal mass parameter, kJ/m²K (user-specified TMP) 250.00 (35)
Effect of thermal bridges 0.08 (36)
Total fabric heat loss 30.97 (37)
Ventilation heat loss calculated monthly

36.84	36.31	35.78	33.15	32.62	29.99	29.99	29.46	31.04	32.62	33.68	34.73

(38)
Heat transfer coefficient, W/K

67.81	67.28	66.76	64.12	63.60	60.96	60.96	60.43	62.02	63.60	64.65	65.70

63.99 (39)
Heat loss parameter (HLP), W/m²K

0.68	0.67	0.67	0.64	0.63	0.61	0.61	0.60	0.62	0.63	0.65	0.66

HLP (average) 0.64 (40)
Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N 2.74 (42)
Annual average hot water usage in litres per day Vd,average 104.53 (43)

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

Hot water usage in litres per day for each month

114.98	110.80	106.62	102.44	98.26	94.08	94.08	98.26	102.44	106.62	110.80	114.98

(44)
Energy content of hot water used

170.52	149.13	153.89	134.17	128.74	111.09	102.94	118.13	119.54	139.31	152.07	165.14

Energy content (annual) 1644.66 (45)
Distribution loss

25.58	22.37	23.08	20.13	19.31	16.66	15.44	17.72	17.93	20.90	22.81	24.77

(46)
Hot water storage volume (litres) 110.00 (50)
Hot water cylinder loss factor (kWh/day) 0.0152 (51)
Volume factor 1.0294 (52)
Temperature factor 0.6000 (53)
Energy lost from hot water cylinder (kWh/day) 1.03 (55)
Total storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(56)
Net storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(57)
Primary loss

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)
Total heat required for water heating calculated for each month

225.79	199.06	209.17	187.66	184.01	164.58	158.22	173.40	173.03	194.59	205.56	220.41

(62)
Output from water heater for each month, kWh/month

225.79	199.06	209.17	187.66	184.01	164.58	158.22	173.40	173.03	194.59	205.56	220.41

(64)
2295.50 (64)
Heat gains from water heating, kWh/month

100.92	89.53	95.39	87.41	87.03	79.73	78.45	83.50	82.54	90.54	93.36	99.13

(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	137.06	(66)
Lighting gains												
23.96	21.28	17.31	13.10	9.79	8.27	8.94	11.61	15.59	19.79	23.10	24.63	(67)
Appliances gains												
256.62	259.28	252.57	238.29	220.25	203.30	191.98	189.32	196.03	210.31	228.35	245.30	(68)
Cooking gains												
36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.71	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	-109.65	(71)
Water heating gains												
135.64	133.23	128.21	121.40	116.97	110.74	105.44	112.23	114.64	121.70	129.66	133.24	(72)
Total internal gains												
480.34	477.91	462.21	436.90	411.14	386.43	370.48	377.28	390.38	415.92	445.23	467.28	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.082 10.63	0.63 x 0.80	0.77	11.4464
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.082 10.63	0.63 x 0.80	0.77	11.4464
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.795 10.63	0.63 x 0.80	0.77	14.0944
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.795 10.63	0.63 x 0.80	0.77	14.0944
2013 External Window New, Ground Floor Unit B1 G.01_Living				

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.08	0.80	0.80 x 0.83	1.47
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.08	0.80	0.80 x 0.83	1.47
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.79	0.80	0.80 x 0.83	1.81
2013 External Window New, Ground Floor Unit B1 G.01				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.79	0.80	0.80 x 0.83	1.81
2013 External Window New, Ground Floor Unit B1 G.01_Living				

GL = 6.58 / 100.18 = 0.066
C1 = 0.500
C2 = 1.005
EI = 423

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
102.59	103.40	104.21	108.49	109.39	114.12	114.12	115.11	112.18	109.39	107.61	105.88	
alpha												
7.84	7.89	7.95	8.23	8.29	8.61	8.61	8.67	8.48	8.29	8.17	8.06	
Utilisation factor for gains for living area												
1.00	1.00	0.99	0.93	0.75	0.51	0.37	0.42	0.71	0.96	1.00	1.00	(86)
Mean internal temperature in living area T1												
20.38	20.48	20.64	20.87	20.98	21.00	21.00	21.00	20.99	20.85	20.59	20.39	(87)
Temperature during heating periods in rest of dwelling Th2												
20.36	20.37	20.37	20.39	20.40	20.42	20.42	20.43	20.41	20.40	20.39	20.38	(88)
Utilisation factor for gains for rest of dwelling												
1.00	1.00	0.98	0.91	0.70	0.46	0.32	0.37	0.66	0.95	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2												
19.52	19.66	19.91	20.25	20.38	20.42	20.42	20.43	20.41	20.22	19.85	19.54	(90)

Living area fraction (29.17 / 100.18) 0.29 (91)

Mean internal temperature (for the whole dwelling)

19.77	19.90	20.12	20.43	20.56	20.59	20.59	20.59	20.58	20.40	20.07	19.79	(92)

Apply adjustment to the mean internal temperature, where appropriate

19.77	19.90	20.12	20.43	20.56	20.59	20.59	20.59	20.58	20.40	20.07	19.79	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
1.00	0.99	0.98	0.91	0.72	0.47	0.33	0.38	0.67	0.95	0.99	1.00	(94)
Useful gains												
530.15	572.57	617.44	641.88	551.33	364.86	243.26	253.42	396.60	504.90	504.87	508.93	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
1049.21	1009.25	909.36	739.39	563.30	365.17	243.27	253.45	401.67	623.36	838.51	1024.31	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
386.18	293.45	217.19	70.21	8.91	-	-	-	-	88.13	240.22	383.44	

Total space heating requirement per year (kWh/year) (October to May) 1687.73 (98)

Space heating requirement per m² (kWh/m²/year) 16.85 (99)

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers												
-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W												
-	-	-	-	-	573.04	451.12	459.31	-	-	-	-	(100)
Utilisation factor for loss												
-	-	-	-	-	1.00	1.00	1.00	-	-	-	-	(101)
Useful loss W												
-	-	-	-	-	570.90	450.70	458.42	-	-	-	-	(102)
Internal gains W												
0.00	0.00	0.00	0.00	0.00	543.86	523.33	532.84	0.00	0.00	0.00	0.00	
Solar gains W												
0.00	0.00	0.00	0.00	0.00	449.11	419.30	332.66	0.00	0.00	0.00	0.00	
Gains W												
-	-	-	-	-	992.98	942.64	865.50	-	-	-	-	(103)
Fraction of month for cooling												
0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh												
-	-	-	-	-	26.34	4.54	0.00	-	-	-	-	(98)
Space cooling kWh												
-	-	-	-	-	303.90	366.00	302.87	-	-	-	-	(104)
Total											972.77	(104)
Cooled fraction											0.80	(105)
Intermittency factor												
-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month												
-	-	-	-	-	60.78	73.20	60.57	-	-	-	-	
Space cooling (June to August)											194.55	(107)
Space cooling requirement per m² (kWh/m²/year)											1.94	(108)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
Space heating			
Annual space heating requirement	1687.73		(98)
Space heat from Boilers		1772.11	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
Water heating			
Annual water heating requirement	2295.50		(64)
Water heat from Boilers		2410.27	(310a)
Other energy			
Cooling system energy efficiency ratio	5.81%		(314)
Space cooling		33.47	(315)
Electrical energy for heat distribution		41.82	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=0.60)		220.73	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		220.73	(331)
Electricity for lighting (100.00% fixed LEL)		423.16	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		4868.10	(338)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 97.90%				(367a)
CO2 emissions from Boilers	4272.10	0.2160	922.77	(368)
Electrical energy for heat distribution	41.82	0.5190	21.71	(372)
Total CO2 associated with community systems			944.48	(373)
Total CO2 associated with space and water heating			944.48	(376)
Space cooling	33.47	0.519	17.37	(377)
Electricity for pumps and fans	220.73	0.519	114.56	(378)
Electricity for lighting	423.16	0.519	219.62	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			1296.03	(383)
			kg/m²/year	
Dwelling Carbon Dioxide Emission Rate (DER)			**12.94**	(384)

Project Information

Building type Top-floor flat

Reference

Date 8 April 2016

Project NW1

SAP 2012 worksheet for notional dwelling - calculation of target emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Third floor	52.56	3.00	157.68	(3a)
Total floor area	52.56			(4)
Dwelling volume (m^3)			157.68	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	2	x 10	20.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

		Air changes per hour	
Infiltration due to chimneys, fans and flues		0.13	(8)
Pressure test, result q50	5.00		(17)
Air permeability		0.38	(18)
Number of sides on which sheltered		2.00	(19)
Shelter factor		0.85	(20)
Infiltration rate incorporating shelter factor		0.32	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18

13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.41	0.40	0.39	0.35	0.34	0.30	0.30	0.30	0.32	0.34	0.36	0.38

4.20 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(25)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B8 2.06			**3.140**	**1.33 (1.40)**	4.16	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B8 2.06_Living			**3.800**	**1.33 (1.40)**	5.04	(27)
Walls 2013 External Wall New, Ground Floor Unit B8 2.06_Living			17.24	0.18	3.10	(29)
Walls 2013 External Wall New, Ground Floor Unit B8 2.06			3.83	0.18	0.69	(29)
Walls 2013 External Wall New, Ground Floor Unit B8 2.06_Living			6.33	0.18	1.14	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B8 2.06			74.42	0.00	0.00	
Internal wall 2013 Internal Partition, Ground Floor Unit B8 2.06_Living			20.84	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B8 2.06			69.88	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B8 2.06_Living			31.47	0.00	0.00	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B8 2.06			3.77	0.00	0.00	

Total area of external elements Sigma A, m²	34.34	(31)
Fabric heat loss, W/K	14.13	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	1.72	(36)
Total fabric heat loss	15.85	(37)

Ventilation heat loss calculated monthly

30.36	30.19	30.02	29.25	29.10	28.43	28.43	28.30	28.69	29.10	29.40	29.70	(38)

Heat transfer coefficient, W/K

46.21	46.04	45.87	45.10	44.95	44.28	44.28	44.15	44.54	44.95	45.24	45.55	
											45.10	(39)

Heat loss parameter (HLP), W/m²K

0.88	0.88	0.87	0.86	0.86	0.84	0.84	0.84	0.85	0.86	0.86	0.87	

HLP (average) 0.86 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements

kWh/year

Assumed occupancy, N 1.77 (42)

Annual average hot water usage in litres per day Vd,average 76.13 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
83.75	80.70	77.66	74.61	71.56	68.52	68.52	71.56	74.61	77.66	80.70	83.75	(44)
Energy content of hot water used												
124.19	108.62	112.09	97.72	93.76	80.91	74.98	86.04	87.06	101.46	110.76	120.27	

Energy content (annual) 1197.86 (45)

Distribution loss												
18.63	16.29	16.81	14.66	14.06	12.14	11.25	12.91	13.06	15.22	16.61	18.04	(46)

Cylinder volume, l 150.00 (47)

Manufacturer's declared cylinder loss factor (kWh/day) 1.39 (48)

Temperature Factor 0.5400 (49)

Energy lost from hot water cylinder (kWh/day) 0.75 (55)

Total storage loss												
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
Net storage loss												
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
170.79	150.71	158.68	142.81	140.36	126.00	121.57	132.63	132.16	148.06	155.85	166.87	(62)
Output from water heater for each month, kWh/month												
170.79	150.71	158.68	142.81	140.36	126.00	121.57	132.63	132.16	148.06	155.85	166.87	(64)

1746.48 (64)

Heat gains from water heating, kWh/month												
78.57	69.78	74.54	68.57	68.45	62.98	62.21	65.88	65.02	71.01	72.90	77.27	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	(66)
Lighting gains												
14.91	13.24	10.77	8.15	6.09	5.14	5.56	7.23	9.70	12.31	14.37	15.32	(67)
Appliances gains												
153.88	155.47	151.45	142.88	132.07	121.91	115.12	113.52	117.55	126.11	136.93	147.09	(68)
Cooking gains												
31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	(71)
Water heating gains												
105.60	103.85	100.19	95.23	92.01	87.47	83.61	88.55	90.31	95.45	101.25	103.85	(72)
Total internal gains												
326.87	325.05	314.90	298.75	282.65	267.00	256.77	261.78	270.04	286.36	305.03	318.75	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.140 10.63	0.63 x 0.70	0.77	10.2041	
2013 External Window New, Ground Floor Unit B8 2.06					
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.800 10.63	0.63 x 0.70	0.77	12.3489	
2013 External Window New, Ground Floor Unit B8 2.06_Living					
Total solar gains, January				22.55	(83-1)

Solar gains

22.55	43.10	73.24	117.64	158.47	169.65	158.39	125.66	88.05	51.30	27.82	18.80	(83)

Total gains

349.43	368.15	388.13	416.39	441.12	436.65	415.16	387.44	358.09	337.66	332.85	337.55	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.14	0.80	0.70 x 0.83	1.31
2013 External Window New, Ground Floor Unit B8 2.06				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.80	0.80	0.70 x 0.83	1.59
2013 External Window New, Ground Floor Unit B8 2.06_Living				

GL = 2.90 / 52.56 = 0.055
C1 = 0.500
C2 = 1.043
El = 263

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)
Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
78.99	79.28	79.57	80.94	81.20	82.44	82.44	82.67	81.96	81.20	80.67	80.13	
alpha												
6.27	6.29	6.30	6.40	6.41	6.50	6.50	6.51	6.46	6.41	6.38	6.34	
Utilisation factor for gains for living area												
1.00	0.99	0.99	0.95	0.84	0.63	0.47	0.52	0.79	0.96	0.99	1.00	(86)
Mean internal temperature in living area T1												
20.20	20.29	20.47	20.72	20.91	20.99	21.00	21.00	20.95	20.73	20.44	20.19	(87)
Temperature during heating periods in rest of dwelling Th2												
20.19	20.19	20.19	20.20	20.21	20.22	20.22	20.22	20.21	20.21	20.20	20.20	(88)
Utilisation factor for gains for rest of dwelling												
0.99	0.99	0.98	0.94	0.80	0.56	0.39	0.43	0.72	0.95	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2												
19.12	19.26	19.51	19.87	20.12	20.21	20.22	20.22	20.18	19.90	19.47	19.11	(90)

Living area fraction (15.74 / 52.56) 0.30 (91)
Mean internal temperature (for the whole dwelling)

19.45	19.57	19.80	20.12	20.36	20.44	20.45	20.45	20.41	20.15	19.76	19.44	(92)

Apply adjustment to the mean internal temperature, where appropriate

19.45	19.57	19.80	20.12	20.36	20.44	20.45	20.45	20.41	20.15	19.76	19.44	(93)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.99	0.99	0.98	0.93	0.81	0.58	0.41	0.46	0.74	0.94	0.99	0.99	(94)
Useful gains												
347.16	364.40	379.66	388.66	355.23	255.09	170.17	178.23	265.92	319.03	328.40	335.75	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
699.82	675.19	609.94	506.18	389.12	258.67	170.48	178.86	281.03	429.08	572.86	694.03	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
262.38	208.85	171.33	84.61	25.22	-	-	-	-	81.87	176.01	266.56	

Total space heating requirement per year (kWh/year) (October to May) 1276.84 (98)
Space heating requirement per m² (kWh/m²/year) 24.29 (99)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

9a. Energy requirements

kWh/year

No secondary heating system selected

Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main heating system	93.50%	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
262.38	208.85	171.33	84.61	25.22	-	-	-	-	81.87	176.01	266.56	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
280.62	223.37	183.24	90.50	26.97	-	-	-	-	87.56	188.24	285.09	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
170.79	150.71	158.68	142.81	140.36	126.00	121.57	132.63	132.16	148.06	155.85	166.87	(64)
Efficiency of water heater												79.80 (216)
85.96	85.68	85.02	83.47	81.26	79.80	79.80	79.80	79.80	83.31	85.14	86.06	(217)
Water heating fuel												
198.69	175.88	186.64	171.09	172.72	157.90	152.34	166.20	165.61	177.73	183.05	193.90	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	1365.60	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2101.77	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	263.27	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	3805.64	(238)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for notional dwelling - calculation of target emissions

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	1365.60	0.216	294.97	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2101.77	0.216	453.98	(264)
Space and water heating			748.95	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	263.27	0.519	136.64	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			924.52	(272)

	kg/m²/year	
Emissions per m² for space and water heating	**14.25**	(272a)
Emissions per m² for lighting	**2.60**	(272b)
Emissions per m² for pumps and fans	**0.74**	(272c)
Target Carbon Dioxide Emission Rate (TER)	**17.59**	(273)

= (14.2495 x 1.00) + 2.5997 + 0.7406

Project Information
Building type Top-floor flat

Reference
Date 8 April 2016
Project NW1

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Third floor	52.56	3.00	157.68	(3a)
Total floor area	52.56			(4)
Dwelling volume (m^3)			157.68	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	0	x 10	0.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.25	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.21	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	
												52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18	
												13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25	
												2.79 (22b)

air change rate through system	0.50	(23a)
efficiency in % allowing for in-use factor	79.90	(23c)

Ventilation : balanced whole house mechanical with heat recovery

Effective air change rate

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B8 2.06_Living			**3.795**	**1.33 (1.40)**	5.03			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B8 2.06			**3.136**	**1.33 (1.40)**	4.16			(27)
Walls 2013 External Wall New, Ground Floor Unit B8 2.06_Living			17.24	0.14	2.41	21.95	378.37	(29)
Walls 2013 External Wall New, Ground Floor Unit B8 2.06_Living			6.33	0.14	0.89	21.95	139.01	(29)
Walls 2013 External Wall New, Ground Floor Unit B8 2.06			3.83	0.14	0.54	21.95	83.98	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B8 2.06_Living			20.84	0.00	0.00	8.75	182.36	
Internal wall 2013 Internal Partition, Ground Floor Unit B8 2.06			74.42	0.00	0.00	8.75	651.18	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B8 2.06			69.88	0.00	0.00	95.00	6638.30	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B8 2.06_Living			31.47	0.00	0.00	95.00	2989.88	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B8 2.06			3.77	0.00	0.00	95.00	358.48	

Total area of external elements Sigma A, m²	34.33	(31)
Fabric heat loss, W/K	13.02	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	0.08	(36)
Total fabric heat loss	13.10	(37)

Ventilation heat loss calculated monthly

19.33	19.05	18.77	17.39	17.12	15.73	15.73	15.46	16.29	17.12	17.67	18.22	(38)

Heat transfer coefficient, W/K

32.43	32.16	31.88	30.50	30.22	28.84	28.84	28.56	29.39	30.22	30.77	31.33	
											30.43	(39)

Heat loss parameter (HLP), W/m²K

0.62	0.61	0.61	0.58	0.57	0.55	0.55	0.54	0.56	0.57	0.59	0.60	

HLP (average) 0.58 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements

kWh/year

Assumed occupancy, N 1.77 (42)

Annual average hot water usage in litres per day Vd,average 80.14 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
88.15	84.95	81.74	78.54	75.33	72.13	72.13	75.33	78.54	81.74	84.95	88.15	(44)
Energy content of hot water used												
130.73	114.34	117.99	102.86	98.70	85.17	78.92	90.56	91.65	106.80	116.59	126.60	

Energy content (annual) 1260.91 (45)

Distribution loss												
19.61	17.15	17.70	15.43	14.80	12.78	11.84	13.58	13.75	16.02	17.49	18.99	(46)

Hot water storage volume (litres) 110.00 (50)

Hot water cylinder loss factor (kWh/day) 0.0152 (51)

Volume factor 1.0294 (52)

Temperature factor 0.6000 (53)

Energy lost from hot water cylinder (kWh/day) 1.03 (55)

Total storage loss												
32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
Net storage loss												
32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
186.01	164.26	173.26	156.36	153.98	138.66	134.20	145.84	145.14	162.08	170.08	181.88	(62)
Output from water heater for each month, kWh/month												
186.01	164.26	173.26	156.36	153.98	138.66	134.20	145.84	145.14	162.08	170.08	181.88	(64)

1911.75 (64)

Heat gains from water heating, kWh/month												
87.69	77.96	83.45	77.00	77.04	71.11	70.46	74.33	73.27	79.73	81.56	86.32	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	88.28	(66)
Lighting gains												
14.49	12.87	10.46	7.92	5.92	5.00	5.40	7.02	9.43	11.97	13.97	14.89	(67)
Appliances gains												
153.88	155.47	151.45	142.88	132.07	121.91	115.12	113.52	117.55	126.11	136.93	147.09	(68)
Cooking gains												
31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	-70.62	(71)
Water heating gains												
117.86	116.01	112.17	106.94	103.55	98.77	94.71	99.91	101.76	107.17	113.28	116.02	(72)
Total internal gains												
335.71	333.84	323.57	307.23	291.02	275.16	264.71	269.94	278.21	294.73	313.65	327.48	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.795 10.63	0.63 x 0.80	0.77	14.0944
2013 External Window New, Ground Floor Unit B8 2.06_Living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.136 10.63	0.63 x 0.80	0.77	11.6469
2013 External Window New, Ground Floor Unit B8 2.06				

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.79	0.80	0.80 x 0.83	1.81
2013 External Window New, Ground Floor Unit B8 2.06_Living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.14	0.80	0.80 x 0.83	1.50
2013 External Window New, Ground Floor Unit B8 2.06				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
112.54	113.51	114.50	119.68	120.78	126.57	126.57	127.79	124.19	120.78	118.61	116.52	
alpha												
8.50	8.57	8.63	8.98	9.05	9.44	9.44	9.52	9.28	9.05	8.91	8.77	
Utilisation factor for gains for living area												
0.99	0.98	0.94	0.80	0.59	0.39	0.28	0.32	0.53	0.84	0.97	0.99	(86)
Mean internal temperature in living area T1												
20.64	20.72	20.85	20.97	21.00	21.00	21.00	21.00	21.00	20.97	20.81	20.64	(87)
Temperature during heating periods in rest of dwelling Th2												
20.41	20.42	20.42	20.45	20.45	20.48	20.48	20.48	20.47	20.45	20.44	20.43	(88)
Utilisation factor for gains for rest of dwelling												
0.99	0.97	0.93	0.77	0.56	0.36	0.25	0.28	0.49	0.81	0.96	0.99	(89)
Mean internal temperature in the rest of dwelling T2												
19.93	20.05	20.24	20.42	20.45	20.48	20.48	20.48	20.47	20.42	20.21	19.96	(90)

Living area fraction (15.74 / 52.56) 0.30 (91)

Mean internal temperature (for the whole dwelling)

20.14	20.25	20.42	20.58	20.61	20.63	20.63	20.64	20.63	20.58	20.39	20.16	(92)
Apply adjustment to the mean internal temperature, where appropriate												
20.14	20.25	20.42	20.58	20.61	20.63	20.63	20.64	20.63	20.58	20.39	20.16	(93)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.98	0.97	0.93	0.78	0.57	0.37	0.26	0.29	0.51	0.82	0.96	0.99	(94)
Useful gains												
355.87	372.32	378.80	344.93	268.68	173.98	116.31	121.00	191.64	288.39	330.74	344.30	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
513.83	493.67	443.69	356.30	269.40	173.99	116.31	121.00	191.81	301.64	409.02	500.02	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
117.52	81.54	48.28	8.18	0.54	-	-	-	-	9.86	56.36	115.86	

Total space heating requirement per year (kWh/year) (October to May) 438.15 (98)
Space heating requirement per m² (kWh/m²/year) 8.34 (99)

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers												
-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W												
-	-	-	-	-	271.08	213.40	217.07	-	-	-	-	(100)
Utilisation factor for loss												
-	-	-	-	-	1.00	1.00	1.00	-	-	-	-	(101)
Useful loss W												
-	-	-	-	-	271.00	213.39	217.05	-	-	-	-	(102)
Internal gains W												
0.00	0.00	0.00	0.00	0.00	375.89	362.70	369.57	0.00	0.00	0.00	0.00	
Solar gains W												
0.00	0.00	0.00	0.00	0.00	226.32	211.30	167.64	0.00	0.00	0.00	0.00	
Gains W												
-	-	-	-	-	602.21	574.00	537.21	-	-	-	-	(103)
Fraction of month for cooling												
0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh												
-	-	-	-	-	12.46	2.15	0.00	-	-	-	-	(98)
Space cooling kWh												
-	-	-	-	-	238.47	268.29	238.20	-	-	-	-	(104)

Total 744.97 (104)
Cooled fraction 0.80 (105)

Intermittency factor												
-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month												
-	-	-	-	-	47.69	53.66	47.64	-	-	-	-	

Space cooling (June to August) 148.99 (107)
Space cooling requirement per m² (kWh/m²/year) 2.83 (108)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
Space heating			
Annual space heating requirement	438.15		(98)
Space heat from Boilers		460.06	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
Water heating			
Annual water heating requirement	1911.75		(64)
Water heat from Boilers		2007.34	(310a)
Other energy			
Cooling system energy efficiency ratio	5.81%		(314)
Space cooling		25.63	(315)
Electrical energy for heat distribution		24.67	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=0.60)		115.81	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		115.81	(331)
Electricity for lighting (100.00% fixed LEL)		255.85	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		2863.73	(338)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 97.90%				(367a)
CO2 emissions from Boilers	2520.32	0.2160	544.39	(368)
Electrical energy for heat distribution	24.67	0.5190	12.81	(372)
Total CO2 associated with community systems			557.20	(373)
Total CO2 associated with space and water heating			557.20	(376)
Space cooling	25.63	0.519	13.30	(377)
Electricity for pumps and fans	115.81	0.519	60.10	(378)
Electricity for lighting	255.85	0.519	132.79	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			763.39	(383)
			kg/m²/year	
Dwelling Carbon Dioxide Emission Rate (DER)			**14.52**	(384)

Project Information

Building type Mid-floor flat

Reference

Date 8 April 2016

Project NW1

SAP 2012 worksheet for notional dwelling - calculation of target emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Ground floor (2)	52.00	3.00	156.00	(3a)
Total floor area	52.00			(4)
Dwelling volume (m^3)			156.00	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	2	x 10	20.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.13	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.38	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.32	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	
												52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18	
												13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.41	0.40	0.39	0.35	0.35	0.31	0.31	0.30	0.32	0.35	0.36	0.38	
												4.22 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B15 3.03			**4.830**	**1.33 (1.40)**	6.40	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B15 3.03			**4.830**	**1.33 (1.40)**	6.40	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B15 3.03			**2.530**	**1.33 (1.40)**	3.35	(27)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B15 3.03_Living			13.72	0.13	1.78	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B15 3.03			15.85	0.13	2.06	(30)
Walls 2013 External Wall New, Ground Floor Unit B15 3.03_Living			13.29	0.18	2.39	(29)
Walls 2013 External Wall New, Ground Floor Unit B15 3.03			27.79	0.18	5.00	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B15 3.03_Living			38.37	0.00	0.00	
Internal wall 2013 Internal Partition, Ground Floor Unit B15 3.03			55.37	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B15 3.03_Living			23.37	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B15 3.03			88.39	0.00	0.00	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B15 3.03_Living			9.65	0.00	0.00	

Total area of external elements Sigma A, m²	82.84	(31)
Fabric heat loss, W/K	27.40	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	4.14	(36)
Total fabric heat loss	31.54	(37)

Ventilation heat loss calculated monthly

30.06	29.90	29.73	28.96	28.81	28.14	28.14	28.02	28.40	28.81	29.11	29.41	(38)

Heat transfer coefficient, W/K

61.61	61.44	61.27	60.50	60.36	59.68	59.68	59.56	59.94	60.36	60.65	60.95	
											60.50	(39)

Heat loss parameter (HLP), W/m²K

1.18	1.18	1.18	1.16	1.16	1.15	1.15	1.15	1.15	1.16	1.17	1.17	

HLP (average) 1.16 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K

Total area of external elements Sigma A, m²	82.84	(31)
Fabric heat loss, W/K	27.40	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	4.14	(36)
Total fabric heat loss	31.54	(37)

Ventilation heat loss calculated monthly

30.06	29.90	29.73	28.96	28.81	28.14	28.14	28.02	28.40	28.81	29.11	29.41	(38)

Heat transfer coefficient, W/K

61.61	61.44	61.27	60.50	60.36	59.68	59.68	59.56	59.94	60.36	60.65	60.95	
											60.50	(39)

Heat loss parameter (HLP), W/m²K

1.18	1.18	1.18	1.16	1.16	1.15	1.15	1.15	1.15	1.16	1.17	1.17	

HLP (average)	1.16	(40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N	1.75	(42)
Annual average hot water usage in litres per day Vd,average	75.74	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
83.31	80.28	77.26	74.23	71.20	68.17	68.17	71.20	74.23	77.26	80.28	83.31	(44)
Energy content of hot water used												
123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65	

Energy content (annual)	1191.69	(45)

Distribution loss

18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95	(46)

Cylinder volume, l	150.00	(47)
Manufacturer's declared cylinder loss factor (kWh/day)	1.39	(48)
Temperature Factor	0.5400	(49)
Energy lost from hot water cylinder (kWh/day)	0.75	(55)

Total storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

Net storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary loss

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

Total heat required for water heating calculated for each month

170.15	150.15	158.10	142.31	139.88	125.59	121.18	132.19	131.71	147.54	155.28	166.25	(62)

Output from water heater for each month, kWh/month

170.15	150.15	158.10	142.31	139.88	125.59	121.18	132.19	131.71	147.54	155.28	166.25	(64)
											1740.31	(64)

Heat gains from water heating, kWh/month

78.36	69.60	74.35	68.40	68.29	62.84	62.08	65.74	64.87	70.84	72.71	77.06	(65)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)
Lighting gains												
13.59	12.07	9.82	7.43	5.55	4.69	5.07	6.59	8.84	11.23	13.10	13.97	(67)
Appliances gains												
152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.70	(68)
Cooking gains												
31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
Water heating gains												
105.32	103.57	99.94	95.00	91.79	87.27	83.44	88.35	90.10	95.21	100.99	103.58	(72)
Total internal gains												
323.57	321.88	312.01	296.20	280.41	264.96	254.77	259.63	267.61	283.60	301.96	315.48	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.830	10.63	0.63 x 0.70	0.77	15.6961	
2013 External Window New, Ground Floor Unit B15 3.03						
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.830	10.63	0.63 x 0.70	0.77	15.6961	
2013 External Window New, Ground Floor Unit B15 3.03						
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.530	10.63	0.63 x 0.70	0.77	8.2217	
2013 External Window New, Ground Floor Unit B15 3.03						
Total solar gains, January					39.61	(83-1)

Solar gains

39.61	75.70	128.64	206.63	278.35	297.98	278.20	220.72	154.67	90.12	48.87	33.02	(83)
Total gains												
363.18	397.59	440.65	502.83	558.75	562.94	532.97	480.35	422.28	373.71	350.83	348.50	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.83	0.80	0.70 x 0.83	2.02
2013 External Window New, Ground Floor Unit B15 3.03				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.83	0.80	0.70 x 0.83	2.02
2013 External Window New, Ground Floor Unit B15 3.03				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.53	0.80	0.70 x 0.83	1.06
2013 External Window New, Ground Floor Unit B15 3.03				

SAP 2012 worksheet for notional dwelling - calculation of target emissions

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
58.62	58.78	58.93	59.69	59.83	60.51	60.51	60.63	60.24	59.83	59.54	59.24	
alpha												
4.91	4.92	4.93	4.98	4.99	5.03	5.03	5.04	5.02	4.99	4.97	4.95	
Utilisation factor for gains for living area												
1.00	0.99	0.98	0.95	0.83	0.64	0.49	0.56	0.82	0.97	0.99	1.00	(86)
Mean internal temperature in living area T1												
19.80	19.93	20.18	20.54	20.83	20.97	20.99	20.99	20.88	20.52	20.11	19.78	(87)
Temperature during heating periods in rest of dwelling Th2												
19.93	19.93	19.94	19.95	19.95	19.96	19.96	19.96	19.96	19.95	19.95	19.94	(88)
Utilisation factor for gains for rest of dwelling												
0.99	0.99	0.98	0.93	0.78	0.55	0.37	0.44	0.75	0.95	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2												
18.35	18.54	18.90	19.41	19.79	19.94	19.96	19.96	19.87	19.40	18.81	18.33	(90)

Living area fraction (23.37 / 52.00) 0.45 (91)

Mean internal temperature (for the whole dwelling)

19.00	19.17	19.48	19.92	20.26	20.40	20.42	20.42	20.32	19.90	19.39	18.98	(92)

Apply adjustment to the mean internal temperature, where appropriate

19.00	19.17	19.48	19.92	20.26	20.40	20.42	20.42	20.32	19.90	19.39	18.98	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.99	0.99	0.97	0.93	0.80	0.59	0.42	0.49	0.78	0.95	0.99	0.99	(94)
Useful gains												
360.72	393.10	429.61	465.60	446.23	334.02	226.39	235.83	328.58	355.75	346.39	346.56	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
905.80	876.52	795.27	666.69	516.46	346.20	228.23	239.48	372.98	561.58	745.51	901.03	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
405.54	324.86	272.05	144.79	52.25	-	-	-	-	153.13	287.37	412.53	

Total space heating requirement per year (kWh/year) (October to May) 2052.51 (98)

Space heating requirement per m² (kWh/m²/year) 39.47 (99)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

9a. Energy requirements

kWh/year

No secondary heating system selected
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main heating system 93.50% (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
405.54	324.86	272.05	144.79	52.25	-	-	-	-	153.13	287.37	412.53	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
433.73	347.44	290.96	154.85	55.88	-	-	-	-	163.78	307.35	441.20	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
170.15	150.15	158.10	142.31	139.88	125.59	121.18	132.19	131.71	147.54	155.28	166.25	(64)
Efficiency of water heater												79.80 (216)
87.05	86.82	86.25	84.86	82.45	79.80	79.80	79.80	79.80	84.91	86.43	87.14	(217)
Water heating fuel												
195.46	172.94	183.31	167.70	169.65	157.38	151.86	165.65	165.05	173.75	179.65	190.78	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	2195.20	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2073.16	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	239.98	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	4583.34	(238)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for notional dwelling - calculation of target emissions

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	2195.20	0.216	474.16	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2073.16	0.216	447.80	(264)
Space and water heating			921.96	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	239.98	0.519	124.55	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			1085.44	(272)

	kg/m²/year	
Emissions per m² for space and water heating	**17.73**	(272a)
Emissions per m² for lighting	**2.40**	(272b)
Emissions per m² for pumps and fans	**0.75**	(272c)
Target Carbon Dioxide Emission Rate (TER)	**20.87**	(273)

= (17.7301 x 1.00) + 2.3952 + 0.7486

Project Information
Building type Mid-floor flat

Reference
Date 8 April 2016
Project NW1

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Ground floor (2)	52.00	3.00	156.00	(3a)
Total floor area	52.00			(4)
Dwelling volume (m^3)			156.00	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	0	x 10	0.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.25	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.21	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	
											52.50	(22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18	
											13.13	(22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25	
											2.79	(22b)

air change rate through system	0.50	(23a)
efficiency in % allowing for in-use factor	79.90	(23c)

Ventilation : balanced whole house mechanical with heat recovery

Effective air change rate

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B15 3.03			**2.530**	**1.68 (1.80)**	4.25			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B15 3.03			**4.830**	**1.68 (1.80)**	8.11			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B15 3.03			**4.830**	**1.68 (1.80)**	8.11			(27)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B15 3.03			15.85	0.20	3.17	98.75	1565.29	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B15 3.03_Living			13.72	0.20	2.74	98.75	1354.55	(30)
Walls 2013 External Wall New, Ground Floor Unit B15 3.03_Living			13.29	0.14	1.86	21.95	291.65	(29)
Walls 2013 External Wall New, Ground Floor Unit B15 3.03			27.79	0.14	3.89	21.95	610.06	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B15 3.03			55.37	0.00	0.00	8.75	484.47	
Internal wall 2013 Internal Partition, Ground Floor Unit B15 3.03_Living			38.37	0.00	0.00	8.75	335.77	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B15 3.03_Living			23.37	0.00	0.00	95.00	2220.28	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B15 3.03			88.39	0.00	0.00	95.00	8396.71	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B15 3.03_Living			9.65	0.00	0.00	95.00	917.14	

Total area of external elements Sigma A, m²	82.84	(31)
Fabric heat loss, W/K	32.13	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	0.08	(36)
Total fabric heat loss	32.21	(37)

Ventilation heat loss calculated monthly

19.12	18.85	18.57	17.21	16.93	15.57	15.57	15.29	16.11	16.93	17.48	18.03

(38)

Heat transfer coefficient, W/K

51.33	51.06	50.79	49.42	49.15	47.78	47.78	47.51	48.33	49.15	49.69	50.24

49.35 (39)

Heat loss parameter (HLP), W/m²K

0.99	0.98	0.98	0.95	0.95	0.92	0.92	0.91	0.93	0.95	0.96	0.97

HLP (average) 0.95 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K

Total area of external elements Sigma A, m² 82.84 (31)
Fabric heat loss, W/K 32.13 (33)
Thermal mass parameter, kJ/m²K (user-specified TMP) 250.00 (35)
Effect of thermal bridges 0.08 (36)
Total fabric heat loss 32.21 (37)
Ventilation heat loss calculated monthly

19.12	18.85	18.57	17.21	16.93	15.57	15.57	15.29	16.11	16.93	17.48	18.03

(38)
Heat transfer coefficient, W/K

51.33	51.06	50.79	49.42	49.15	47.78	47.78	47.51	48.33	49.15	49.69	50.24

49.35 (39)
Heat loss parameter (HLP), W/m²K

0.99	0.98	0.98	0.95	0.95	0.92	0.92	0.91	0.93	0.95	0.96	0.97

HLP (average) 0.95 (40)
Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**
Assumed occupancy, N 1.75 (42)
Annual average hot water usage in litres per day Vd,average 79.73 (43)

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

Hot water usage in litres per day for each month

87.70	84.51	81.32	78.13	74.94	71.75	71.75	74.94	78.13	81.32	84.51	87.70

(44)
Energy content of hot water used

130.06	113.75	117.38	102.33	98.19	84.73	78.52	90.10	91.17	106.25	115.98	125.95

Energy content (annual) 1254.41 (45)
Distribution loss

19.51	17.06	17.61	15.35	14.73	12.71	11.78	13.51	13.68	15.94	17.40	18.89

(46)
Hot water storage volume (litres) 110.00 (50)
Hot water cylinder loss factor (kWh/day) 0.0152 (51)
Volume factor 1.0294 (52)
Temperature factor 0.6000 (53)
Energy lost from hot water cylinder (kWh/day) 1.03 (55)
Total storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(56)
Net storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(57)
Primary loss

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)
Total heat required for water heating calculated for each month

185.33	163.68	172.65	155.83	153.47	138.22	133.79	145.37	144.67	161.53	169.48	181.23

(62)
Output from water heater for each month, kWh/month

185.33	163.68	172.65	155.83	153.47	138.22	133.79	145.37	144.67	161.53	169.48	181.23

(64)
1905.25 (64)
Heat gains from water heating, kWh/month

87.46	77.76	83.25	76.82	76.87	70.97	70.33	74.18	73.11	79.55	81.36	86.10

(65)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)
Lighting gains												
13.59	12.07	9.82	7.43	5.55	4.69	5.07	6.59	8.84	11.23	13.10	13.97	(67)
Appliances gains												
152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.70	(68)
Cooking gains												
31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
Water heating gains												
117.56	115.72	111.89	106.70	103.32	98.57	94.53	99.70	101.54	106.92	113.00	115.73	(72)
Total internal gains												
332.81	331.03	320.97	304.90	288.94	273.25	262.86	267.98	276.06	292.31	310.97	324.63	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.530	10.63	0.63 x 0.80	0.77	9.3963
2013 External Window New, Ground Floor Unit B15 3.03					
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.830	10.63	0.63 x 0.80	0.77	17.9384
2013 External Window New, Ground Floor Unit B15 3.03					
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.830	10.63	0.63 x 0.80	0.77	17.9384
2013 External Window New, Ground Floor Unit B15 3.03					

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.53	0.80	0.80 x 0.83	1.21
2013 External Window New, Ground Floor Unit B15 3.03				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.83	0.80	0.80 x 0.83	2.31
2013 External Window New, Ground Floor Unit B15 3.03				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.83	0.80	0.80 x 0.83	2.31
2013 External Window New, Ground Floor Unit B15 3.03				

GL = 5.83 / 52.00 = 0.112
C1 = 0.500
C2 = 0.960
El = 240

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
70.34	70.72	71.10	73.07	73.48	75.58	75.58	76.01	74.72	73.48	72.67	71.88	
alpha												
5.69	5.71	5.74	5.87	5.90	6.04	6.04	6.07	5.98	5.90	5.84	5.79	
Utilisation factor for gains for living area												
0.99	0.99	0.97	0.89	0.71	0.49	0.36	0.42	0.70	0.94	0.99	1.00	(86)
Mean internal temperature in living area T1												
20.10	20.24	20.47	20.79	20.95	21.00	21.00	21.00	20.97	20.74	20.39	20.10	(87)
Temperature during heating periods in rest of dwelling Th2												
20.09	20.10	20.10	20.12	20.13	20.15	20.15	20.16	20.14	20.13	20.12	20.11	(88)
Utilisation factor for gains for rest of dwelling												
0.99	0.99	0.96	0.86	0.66	0.43	0.29	0.34	0.63	0.92	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2												
18.91	19.10	19.45	19.89	20.09	20.15	20.15	20.16	20.12	19.84	19.34	18.91	(90)

Living area fraction (23.37 / 52.00) 0.45 (91)

Mean internal temperature (for the whole dwelling)

19.45	19.61	19.91	20.29	20.48	20.53	20.53	20.53	20.50	20.24	19.81	19.44	(92)

Apply adjustment to the mean internal temperature, where appropriate

19.45	19.61	19.91	20.29	20.48	20.53	20.53	20.53	20.50	20.24	19.81	19.44	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.99	0.98	0.96	0.87	0.68	0.46	0.32	0.38	0.66	0.92	0.98	0.99	(94)
Useful gains												
374.85	410.96	449.51	471.17	412.99	281.87	187.75	196.08	298.61	363.78	360.23	359.85	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
777.48	751.32	680.99	562.93	431.38	283.31	187.89	196.41	309.41	473.91	631.49	765.84	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
299.56	228.72	172.22	66.07	13.68	-	-	-	-	81.93	195.30	302.06	

Total space heating requirement per year (kWh/year) (October to May) 1359.53 (98)

Space heating requirement per m² (kWh/m²/year) 26.14 (99)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers												
-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W												
-	-	-	-	-	449.13	353.57	361.04	-	-	-	-	(100)
Utilisation factor for loss												
-	-	-	-	-	0.98	0.99	0.99	-	-	-	-	(101)
Useful loss W												
-	-	-	-	-	441.78	351.28	356.81	-	-	-	-	(102)
Internal gains W												
0.00	0.00	0.00	0.00	0.00	372.75	359.62	366.23	0.00	0.00	0.00	0.00	
Solar gains W												
0.00	0.00	0.00	0.00	0.00	398.04	371.62	294.84	0.00	0.00	0.00	0.00	
Gains W												
-	-	-	-	-	770.79	731.24	661.07	-	-	-	-	(103)
Fraction of month for cooling												
0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh												
-	-	-	-	-	20.69	3.56	0.00	-	-	-	-	(98)
Space cooling kWh												
-	-	-	-	-	236.89	282.69	226.37	-	-	-	-	(104)
Total											745.95	(104)
Cooled fraction											0.80	(105)
Intermittency factor												
-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month												
-	-	-	-	-	47.38	56.54	45.27	-	-	-	-	
Space cooling (June to August)											149.19	(107)
Space cooling requirement per m² (kWh/m²/year)											2.87	(108)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
Space heating			
Annual space heating requirement	1359.53		(98)
Space heat from Boilers		1427.51	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
Water heating			
Annual water heating requirement	1905.25		(64)
Water heat from Boilers		2000.52	(310a)
Other energy			
Cooling system energy efficiency ratio	5.81%		(314)
Space cooling		25.67	(315)
Electrical energy for heat distribution		34.28	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=0.60)		114.57	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		114.57	(331)
Electricity for lighting (100.00% fixed LEL)		239.98	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3816.86	(338)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 97.90%				(367a)
CO2 emissions from Boilers	3501.56	0.2160	756.34	(368)
Electrical energy for heat distribution	34.28	0.5190	17.79	(372)
Total CO2 associated with community systems			774.13	(373)
Total CO2 associated with space and water heating			774.13	(376)
Space cooling	25.67	0.519	13.32	(377)
Electricity for pumps and fans	114.57	0.519	59.46	(378)
Electricity for lighting	239.98	0.519	124.55	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			971.46	(383)
			kg/m²/year	
Dwelling Carbon Dioxide Emission Rate (DER)			**18.68**	(384)

Project Information

Building type Mid-floor flat

Reference

Date 8 April 2016

Project NW1

SAP 2012 worksheet for notional dwelling - calculation of target emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Ground floor (2)	51.00	3.00	153.00	(3a)
Total floor area	51.00			(4)
Dwelling volume (m^3)			153.00	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	2	x 10	20.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.13	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.38	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.32	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	
												52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18	
												13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.41	0.40	0.40	0.36	0.35	0.31	0.31	0.30	0.32	0.35	0.36	0.38	
												4.25 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57	(25)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**1.580**	**1.33 (1.40)**	2.09	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**1.580**	**1.33 (1.40)**	2.09	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**0.350**	**1.33 (1.40)**	0.46	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**1.230**	**1.33 (1.40)**	1.63	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**1.580**	**1.33 (1.40)**	2.09	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**1.090**	**1.33 (1.40)**	1.45	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**1.090**	**1.33 (1.40)**	1.45	(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02_Living			**0.670**	**1.59 (1.70)**	1.07	(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**0.670**	**1.59 (1.70)**	1.07	(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**0.670**	**1.59 (1.70)**	1.07	(27)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**0.670**	**1.59 (1.70)**	1.07	(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**1.570**	**1.59 (1.70)**	2.50	(27)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B20 4.02_Living			18.25	0.13	2.37	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B20 4.02			20.48	0.13	2.66	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B20 4.02			34.62	0.13	4.50	(30)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02			52.14	0.18	9.38	(29)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02			16.39	0.18	2.95	(29)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02_Living			40.88	0.18	7.36	(29)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02			10.64	0.18	1.92	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B20 4.02			128.23	0.00	0.00	
Internal wall 2013 Internal Partition, Ground Floor Unit B20 4.02_Living			21.01	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B20 4.02			198.74	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B20 4.02_Living			17.77	0.00	0.00	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B20 4.02			6.03	0.00	0.00	

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K

Total area of external elements Sigma A, m²	206.14	(31)
Fabric heat loss, W/K	49.18	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	10.31	(36)
Total fabric heat loss	59.48	(37)

Ventilation heat loss calculated monthly

29.54	29.38	29.21	28.44	28.30	27.63	27.63	27.51	27.89	28.30	28.59	28.90	(38)

Heat transfer coefficient, W/K

89.03	88.86	88.70	87.93	87.78	87.11	87.11	86.99	87.37	87.78	88.07	88.38	

87.93 (39)

Heat loss parameter (HLP), W/m²K

1.75	1.74	1.74	1.72	1.72	1.71	1.71	1.71	1.71	1.72	1.73	1.73	

HLP (average) 1.72 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N	1.72	(42)
Annual average hot water usage in litres per day Vd,average	75.04	(43)

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

Hot water usage in litres per day for each month

82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	(44)

Energy content of hot water used

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

Energy content (annual) 1180.67 (45)

Distribution loss

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Cylinder volume, l	150.00	(47)
Manufacturer's declared cylinder loss factor (kWh/day)	1.39	(48)
Temperature Factor	0.5400	(49)
Energy lost from hot water cylinder (kWh/day)	0.75	(55)

Total storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

Net storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary loss

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

Total heat required for water heating calculated for each month

169.00	149.15	157.07	141.41	139.01	124.84	120.49	131.40	130.91	146.60	154.26	165.14	(62)

Output from water heater for each month, kWh/month

169.00	149.15	157.07	141.41	139.01	124.84	120.49	131.40	130.91	146.60	154.26	165.14	(64)

1729.29 (64)

Heat gains from water heating, kWh/month

77.98	69.27	74.01	68.10	68.00	62.59	61.85	65.47	64.61	70.53	72.37	76.69	(65)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	(66)
Lighting gains	13.36	11.86	9.65	7.30	5.46	4.61	4.98	6.47	8.69	11.03	12.88	13.73	(67)
Appliances gains	149.83	151.39	147.47	139.13	128.60	118.70	112.09	110.54	114.45	122.80	133.32	143.22	(68)
Cooking gains	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	(69)
Pumps and fans gains	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains	104.81	103.07	99.48	94.58	91.40	86.93	83.13	88.00	89.73	94.80	100.52	103.08	(72)
Total internal gains	319.79	318.12	308.38	292.81	277.26	262.04	251.99	256.80	264.67	280.42	298.51	311.82	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.580 10.63	0.63 x 0.70	0.77	5.1345
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.580 10.63	0.63 x 0.70	0.77	5.1345
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 0.350 10.63	0.63 x 0.70	0.77	1.1374
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.230 10.63	0.63 x 0.70	0.77	3.9971
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.580 10.63	0.63 x 0.70	0.77	5.1345
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.090 10.63	0.63 x 0.70	0.77	3.5422
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.090 10.63	0.63 x 0.70	0.77	3.5422
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02_Living	0.9 x 0.670 26.61	0.63 x 0.70	1.00	7.0755
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 0.670 26.61	0.63 x 0.70	1.00	7.0755
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 0.670 26.61	0.63 x 0.70	1.00	7.0755
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 0.670 26.61	0.63 x 0.70	1.00	7.0755

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 1.570 26.61	0.63 x 0.70	1.00	16.5798	
Total solar gains, January				72.50	(83-1)

Solar gains

72.50	143.53	246.48	384.35	498.92	524.43	493.56	404.28	293.97	172.43	90.56	59.60	(83)

Total gains

392.29	461.64	554.87	677.16	776.18	786.47	745.56	661.09	558.64	452.85	389.08	371.42	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.58	0.80	0.70 x 0.83	0.66
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.58	0.80	0.70 x 0.83	0.66
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 0.35	0.80	0.70 x 0.83	0.15
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.23	0.80	0.70 x 0.83	0.51
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.58	0.80	0.70 x 0.83	0.66
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.09	0.80	0.70 x 0.83	0.46
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.09	0.80	0.70 x 0.83	0.46
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02_Living	0.9 x 0.67	0.80	0.70 x 1.00	0.34
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 0.67	0.80	0.70 x 1.00	0.34
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 0.67	0.80	0.70 x 1.00	0.34
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 0.67	0.80	0.70 x 1.00	0.34
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 1.57	0.80	0.70 x 1.00	0.79

GL = 5.70 / 51.00 = 0.112
C1 = 0.500
C2 = 0.960
El = 236

SAP 2012 worksheet for notional dwelling - calculation of target emissions

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau											
39.78	39.86	39.93	40.28	40.35	40.66	40.66	40.71	40.54	40.35	40.21	40.07
alpha											
3.65	3.66	3.66	3.69	3.69	3.71	3.71	3.71	3.70	3.69	3.68	3.67
Utilisation factor for gains for living area											
0.99	0.99	0.97	0.92	0.81	0.64	0.49	0.56	0.82	0.96	0.99	1.00 (86)
Mean internal temperature in living area T1											
19.18	19.38	19.76	20.27	20.68	20.91	20.97	20.95	20.75	20.20	19.60	19.14 (87)
Temperature during heating periods in rest of dwelling Th2											
19.51	19.51	19.51	19.52	19.53	19.54	19.54	19.54	19.53	19.53	19.52	19.52 (88)
Utilisation factor for gains for rest of dwelling											
0.99	0.99	0.96	0.89	0.74	0.52	0.34	0.40	0.72	0.94	0.99	0.99 (89)
Mean internal temperature in the rest of dwelling T2											
17.16	17.46	18.00	18.72	19.24	19.48	19.53	19.52	19.35	18.65	17.79	17.12 (90)

Living area fraction (17.77 / 51.00) 0.35 (91)

Mean internal temperature (for the whole dwelling)

17.86	18.13	18.62	19.26	19.74	19.98	20.03	20.02	19.84	19.19	18.42	17.82 (92)

Apply adjustment to the mean internal temperature, where appropriate

17.86	18.13	18.62	19.26	19.74	19.98	20.03	20.02	19.84	19.19	18.42	17.82 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains											
0.99	0.98	0.95	0.89	0.75	0.56	0.39	0.46	0.74	0.93	0.98	0.99 (94)
Useful gains											
387.91	452.33	529.87	599.52	580.69	438.11	292.76	304.17	415.12	422.53	381.55	367.99 (95)
Monthly average external temperature											
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20 (96)
Heat loss rate for mean internal temperature											
1207.55	1175.39	1074.57	910.71	706.21	468.46	298.87	315.01	501.64	754.21	996.96	1203.97 (97)
Fraction of month for heating											
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00
Space heating requirement for each month, kWh/month											
609.81	485.90	405.26	224.06	93.39	-	-	-	-	246.77	443.10	621.97

Total space heating requirement per year (kWh/year) (October to May) 3130.25 (98)

Space heating requirement per m² (kWh/m²/year) 61.38 (99)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

9a. Energy requirements

kWh/year

No secondary heating system selected
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main heating system 93.50% (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
609.81	485.90	405.26	224.06	93.39	-	-	-	-	246.77	443.10	621.97	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
652.20	519.67	433.43	239.63	99.88	-	-	-	-	263.93	473.90	665.21	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
169.00	149.15	157.07	141.41	139.01	124.84	120.49	131.40	130.91	146.60	154.26	165.14	(64)
Efficiency of water heater												79.80 (216)
87.94	87.74	87.23	86.04	83.78	79.80	79.80	79.80	79.80	86.19	87.47	88.02	(217)
Water heating fuel												
192.18	169.99	180.06	164.36	165.93	156.44	151.00	164.66	164.04	170.09	176.35	187.61	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	3347.86	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2042.71	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	235.90	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	5701.46	(238)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for notional dwelling - calculation of target emissions

12a. Carbon dioxide emissions

	Energy kWh/year	**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating, main system 1	3347.86	0.216	723.14	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2042.71	0.216	441.22	(264)
Space and water heating			1164.36	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	235.90	0.519	122.43	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			1325.72	(272)

	kg/m²/year	
Emissions per m² for space and water heating	**22.83**	(272a)
Emissions per m² for lighting	**2.40**	(272b)
Emissions per m² for pumps and fans	**0.76**	(272c)
Target Carbon Dioxide Emission Rate (TER)	**25.99**	(273)

= (22.8306 x 1.00) + 2.4006 + 0.7632

Project Information

Building type Mid-floor flat

Reference

Date 8 April 2016

Project NW1

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Ground floor (2)	51.00	3.00	153.00	(3a)
Total floor area	51.00			(4)
Dwelling volume (m^3)			153.00	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	0	x 10	0.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.25	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.21	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	
												52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18	
												13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25	
												2.79 (22b)

air change rate through system	0.50	(23a)
efficiency in % allowing for in-use factor	79.90	(23c)

Ventilation : balanced whole house mechanical with heat recovery

Effective air change rate

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**3.754**	**1.33 (1.40)**	4.98			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**1.076**	**1.33 (1.40)**	1.43			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**4.830**	**1.33 (1.40)**	6.40			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**4.830**	**1.33 (1.40)**	6.40			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**3.335**	**1.33 (1.40)**	4.42			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**3.335**	**1.33 (1.40)**	4.42			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02			**4.830**	**1.33 (1.40)**	6.40			(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02_Living			**2.054**	**1.45 (1.54)**	2.98			(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**4.817**	**1.45 (1.54)**	6.99			(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**2.054**	**1.45 (1.54)**	2.98			(27)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**2.054**	**1.45 (1.54)**	2.98			(27)
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02			**2.054**	**1.45 (1.54)**	2.98			(27)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B20 4.02_Living			18.25	0.20	3.65	98.75	1801.99	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B20 4.02			34.62	0.20	6.92	98.75	3418.92	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit B20 4.02			20.48	0.20	4.10	98.75	2022.10	(30)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02			52.14	0.14	7.30	21.95	1144.43	(29)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02			10.64	0.14	1.49	21.95	233.59	(29)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02_Living			40.88	0.14	5.72	21.95	897.21	(29)
Walls 2013 External Wall New, Ground Floor Unit B20 4.02			16.39	0.14	2.29	21.95	359.72	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit B20 4.02			128.23	0.00	0.00	8.75	1122.05	
Internal wall 2013 Internal Partition, Ground Floor Unit B20 4.02_Living			21.01	0.00	0.00	8.75	183.88	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B20 4.02_Living			17.77	0.00	0.00	95.00	1688.18	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit B20 4.02			198.74	0.00	0.00	95.00	18880.52	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit B20 4.02			6.03	0.00	0.00	95.00	572.68	

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K

Total area of external elements Sigma A, m² 232.41 (31)
Fabric heat loss, W/K 84.83 (33)
Thermal mass parameter, kJ/m²K (user-specified TMP) 250.00 (35)
Effect of thermal bridges 0.08 (36)
Total fabric heat loss 84.91 (37)
Ventilation heat loss calculated monthly

18.75	18.49	18.22	16.88	16.61	15.27	15.27	15.00	15.80	16.61	17.14	17.68

(38)
Heat transfer coefficient, W/K

103.67	103.40	103.13	101.79	101.52	100.18	100.18	99.91	100.72	101.52	102.06	102.59

101.72 (39)
Heat loss parameter (HLP), W/m²K

2.03	2.03	2.02	2.00	1.99	1.96	1.96	1.96	1.97	1.99	2.00	2.01

HLP (average) 1.99 (40)
Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N 1.72 (42)
Annual average hot water usage in litres per day Vd,average 78.99 (43)

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

Hot water usage in litres per day for each month

86.89	83.73	80.57	77.41	74.25	71.09	71.09	74.25	77.41	80.57	83.73	86.89

(44)
Energy content of hot water used

128.85	112.70	116.29	101.39	97.28	83.95	77.79	89.26	90.33	105.27	114.91	124.79

Energy content (annual) 1242.81 (45)
Distribution loss

19.33	16.90	17.44	15.21	14.59	12.59	11.67	13.39	13.55	15.79	17.24	18.72

(46)
Hot water storage volume (litres) 110.00 (50)
Hot water cylinder loss factor (kWh/day) 0.0152 (51)
Volume factor 1.0294 (52)
Temperature factor 0.6000 (53)
Energy lost from hot water cylinder (kWh/day) 1.03 (55)
Total storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(56)
Net storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01

(57)
Primary loss

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)
Total heat required for water heating calculated for each month

184.13	162.62	171.57	154.88	152.56	137.44	133.07	144.54	143.82	160.55	168.41	180.06

(62)
Output from water heater for each month, kWh/month

184.13	162.62	171.57	154.88	152.56	137.44	133.07	144.54	143.82	160.55	168.41	180.06

(64)
1893.65 (64)
Heat gains from water heating, kWh/month

87.06	77.41	82.89	76.51	76.57	70.71	70.09	73.90	72.83	79.22	81.00	85.71

(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	(66)
Lighting gains												
13.36	11.86	9.65	7.30	5.46	4.61	4.98	6.47	8.69	11.03	12.88	13.73	(67)
Appliances gains												
149.83	151.39	147.47	139.13	128.60	118.70	112.09	110.54	114.45	122.80	133.32	143.22	(68)
Cooking gains												
31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains												
117.02	115.20	111.41	106.26	102.91	98.20	94.20	99.33	101.15	106.48	112.50	115.21	(72)
Total internal gains												
329.00	327.24	317.32	301.48	285.77	270.31	260.07	265.13	273.09	289.11	307.50	320.95	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.754	10.63 0.63 x 0.80	0.77	13.9422
2013 External Window New, Ground Floor Unit B20 4.02				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 1.076	10.63 0.63 x 0.80	0.77	3.9962
2013 External Window New, Ground Floor Unit B20 4.02				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.830	10.63 0.63 x 0.80	0.77	17.9384
2013 External Window New, Ground Floor Unit B20 4.02				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.830	10.63 0.63 x 0.80	0.77	17.9384
2013 External Window New, Ground Floor Unit B20 4.02				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.335	10.63 0.63 x 0.80	0.77	12.3860
2013 External Window New, Ground Floor Unit B20 4.02				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.335	10.63 0.63 x 0.80	0.77	12.3860
2013 External Window New, Ground Floor Unit B20 4.02				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.830	10.63 0.63 x 0.80	0.77	17.9384
2013 External Window New, Ground Floor Unit B20 4.02				
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a)	0.9 x 2.054	26.61 0.63 x 0.80	1.00	24.7874
2013 Rooflight New, Ground Floor Unit B20 4.02_Living				
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a)	0.9 x 4.817	26.61 0.63 x 0.80	1.00	58.1329
2013 Rooflight New, Ground Floor Unit B20 4.02				
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a)	0.9 x 2.054	26.61 0.63 x 0.80	1.00	24.7874
2013 Rooflight New, Ground Floor Unit B20 4.02				
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a)	0.9 x 2.054	26.61 0.63 x 0.80	1.00	24.7874
2013 Rooflight New, Ground Floor Unit B20 4.02				

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 2.054 26.61	0.63 x 0.80	1.00	24.7874

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 3.75	0.80	0.80 x 0.83	1.79
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 1.08	0.80	0.80 x 0.83	0.51
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 4.83	0.80	0.80 x 0.83	2.31
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 4.83	0.80	0.80 x 0.83	2.31
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 3.33	0.80	0.80 x 0.83	1.59
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 3.33	0.80	0.80 x 0.83	1.59
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit B20 4.02	0.9 x 4.83	0.80	0.80 x 0.83	2.31
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02_Living	0.9 x 2.05	0.80	0.80 x 1.00	1.18
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 4.82	0.80	0.80 x 1.00	2.77
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 2.05	0.80	0.80 x 1.00	1.18
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 2.05	0.80	0.80 x 1.00	1.18
Rooflight at 70° or less - Double-glazed, air-filled, low-E, En=0.1, soft coat (n/a) 2013 Rooflight New, Ground Floor Unit B20 4.02	0.9 x 2.05	0.80	0.80 x 1.00	1.18

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau											
34.16	34.25	34.34	34.79	34.89	35.35	35.35	35.45	35.16	34.89	34.70	34.52
alpha											
3.28	3.28	3.29	3.32	3.33	3.36	3.36	3.36	3.34	3.33	3.31	3.30
Utilisation factor for gains for living area											
0.98	0.95	0.85	0.65	0.44	0.30	0.22	0.27	0.50	0.83	0.96	0.99 (86)
Mean internal temperature in living area T1											
19.16	19.60	20.21	20.74	20.93	20.99	21.00	20.99	20.93	20.50	19.70	19.09 (87)
Temperature during heating periods in rest of dwelling Th2											
19.31	19.32	19.32	19.34	19.34	19.36	19.36	19.36	19.35	19.34	19.33	19.33 (88)
Utilisation factor for gains for rest of dwelling											
0.97	0.93	0.81	0.58	0.37	0.23	0.14	0.18	0.39	0.77	0.95	0.98 (89)
Mean internal temperature in the rest of dwelling T2											
17.02	17.64	18.46	19.09	19.29	19.35	19.36	19.36	19.31	18.86	17.80	16.92 (90)

Living area fraction (17.77 / 51.00) 0.35 (91)

Mean internal temperature (for the whole dwelling)

17.76	18.33	19.07	19.67	19.87	19.92	19.93	19.93	19.88	19.43	18.46	17.67 (92)

Apply adjustment to the mean internal temperature, where appropriate

17.76	18.33	19.07	19.67	19.87	19.92	19.93	19.93	19.88	19.43	18.46	17.67 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains											
0.97	0.92	0.80	0.60	0.40	0.25	0.17	0.21	0.43	0.77	0.94	0.97 (94)
Useful gains											
562.94	760.46	946.01	981.33	803.54	529.11	332.70	351.07	559.43	687.89	584.67	515.60 (95)
Monthly average external temperature											
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20 (96)
Heat loss rate for mean internal temperature											
1395.66	1388.20	1296.64	1095.88	828.94	533.07	333.39	352.53	581.87	896.73	1159.33	1382.41 (97)
Fraction of month for heating											
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00
Space heating requirement for each month, kWh/month											
619.54	421.84	260.86	82.48	18.89	-	-	-	-	155.37	413.76	644.90

Total space heating requirement per year (kWh/year) (October to May) 2617.65 (98)

Space heating requirement per m² (kWh/m²/year) 51.33 (99)

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers												
-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W												
-	-	-	-	-	941.69	741.33	759.33	-	-	-	-	(100)
Utilisation factor for loss												
-	-	-	-	-	0.97	0.98	0.97	-	-	-	-	(101)
Useful loss W												
-	-	-	-	-	914.25	728.42	737.06	-	-	-	-	(102)
Internal gains W												
0.00	0.00	0.00	0.00	0.00	368.32	355.38	361.92	0.00	0.00	0.00	0.00	
Solar gains W												
0.00	0.00	0.00	0.00	0.00	1958.34	1842.16	1506.03	0.00	0.00	0.00	0.00	
Gains W												
-	-	-	-	-	2326.7	2197.5	1867.95	-	-	-	-	(103)
Fraction of month for cooling												
0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh												
-	-	-	-	-	43.78	7.48	0.05	-	-	-	-	(98)
Space cooling kWh												
-	-	-	-	-	1016.94	1093.03	841.39	-	-	-	-	(104)
Total											2951.35	(104)
Cooled fraction											0.80	(105)
Intermittency factor												
-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month												
-	-	-	-	-	203.39	218.61	168.28	-	-	-	-	
Space cooling (June to August)											590.27	(107)
Space cooling requirement per m² (kWh/m²/year)											11.57	(108)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
Space heating			
Annual space heating requirement	2617.65		(98)
Space heat from Boilers		2748.53	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
Water heating			
Annual water heating requirement	1893.65		(64)
Water heat from Boilers		1988.33	(310a)
Other energy			
Cooling system energy efficiency ratio	5.81%		(314)
Space cooling		101.55	(315)
Electrical energy for heat distribution		47.37	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=0.60)		112.37	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		112.37	(331)
Electricity for lighting (100.00% fixed LEL)		235.90	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		5132.50	(338)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 97.90%				(367a)
CO2 emissions from Boilers	4838.47	0.2160	1045.11	(368)
Electrical energy for heat distribution	47.37	0.5190	24.58	(372)
Total CO2 associated with community systems			1069.69	(373)
Total CO2 associated with space and water heating			1069.69	(376)
Space cooling	101.55	0.519	52.71	(377)
Electricity for pumps and fans	112.37	0.519	58.32	(378)
Electricity for lighting	235.90	0.519	122.43	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			1303.15	(383)
			kg/m²/year	
Dwelling Carbon Dioxide Emission Rate (DER)			**25.55**	(384)

Project Information

Building type Top-floor flat

Reference

Date 8 April 2016

Project NW1

SAP 2012 worksheet for notional dwelling - calculation of target emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Second floor	60.94	3.00	182.82	(3a)
Total floor area	60.94			(4)
Dwelling volume (m^3)			182.82	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	2	x 10	20.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

		Air changes per hour	
Infiltration due to chimneys, fans and flues		0.11	(8)
Pressure test, result q50	5.00		(17)
Air permeability		0.36	(18)
Number of sides on which sheltered		2.00	(19)
Shelter factor		0.85	(20)
Infiltration rate incorporating shelter factor		0.31	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18

13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.39	0.38	0.37	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.34	0.36

4.01 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13_Living			**3.090**	**1.33 (1.40)**	4.10	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13_Living			**3.090**	**1.33 (1.40)**	4.10	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13			**3.090**	**1.33 (1.40)**	4.10	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13			**3.090**	**1.33 (1.40)**	4.10	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13			**2.890**	**1.33 (1.40)**	3.83	(27)
Walls 2013 External Wall New, Ground Floor Unit D1 1.13_Living			23.57	0.18	4.24	(29)
Walls 2013 External Wall New, Ground Floor Unit D1 1.13			26.78	0.18	4.82	(29)
Walls 2013 External Wall New, Ground Floor Unit D1 1.13			0.98	0.18	0.18	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit D1 1.13			33.50	0.00	0.00	
Internal wall 2013 Internal Partition, Ground Floor Unit D1 1.13_Living			33.50	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D1 1.13_Living			52.69	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D1 1.13			35.47	0.00	0.00	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit D1 1.13			33.72	0.00	0.00	

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K

Total area of external elements Sigma A, m²	66.58	(31)
Fabric heat loss, W/K	29.46	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	3.33	(36)
Total fabric heat loss	32.79	(37)

Ventilation heat loss calculated monthly

34.74	34.56	34.39	33.57	33.42	32.71	32.71	32.57	32.98	33.42	33.73	34.05	(38)

Heat transfer coefficient, W/K

67.53	67.35	67.18	66.36	66.20	65.49	65.49	65.36	65.77	66.20	66.51	66.84	

66.36 (39)

Heat loss parameter (HLP), W/m²K

1.11	1.11	1.10	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.10	

HLP (average) 1.09 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N	2.01	(42)
Annual average hot water usage in litres per day Vd,average	81.89	(43)

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

Hot water usage in litres per day for each month

90.08	86.81	83.53	80.25	76.98	73.70	73.70	76.98	80.25	83.53	86.81	90.08	(44)

Energy content of hot water used

133.59	116.84	120.57	105.11	100.86	87.03	80.65	92.54	93.65	109.14	119.13	129.37	

Energy content (annual) 1288.48 (45)

Distribution loss

20.04	17.53	18.08	15.77	15.13	13.05	12.10	13.88	14.05	16.37	17.87	19.41	(46)

Cylinder volume, l	150.00	(47)
Manufacturer's declared cylinder loss factor (kWh/day)	1.39	(48)
Temperature Factor	0.5400	(49)
Energy lost from hot water cylinder (kWh/day)	0.75	(55)

Total storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

Net storage loss

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary loss

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

Total heat required for water heating calculated for each month

180.18	158.92	167.16	150.20	147.45	132.12	127.24	139.14	138.74	155.73	164.23	175.97	(62)

Output from water heater for each month, kWh/month

180.18	158.92	167.16	150.20	147.45	132.12	127.24	139.14	138.74	155.73	164.23	175.97	(64)

1837.10 (64)

Heat gains from water heating, kWh/month

81.69	72.52	77.36	71.02	70.81	65.01	64.09	68.05	67.21	73.56	75.69	80.29	(65)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	(66)
Lighting gains												
15.63	13.88	11.29	8.55	6.39	5.39	5.83	7.58	10.17	12.91	15.07	16.06	(67)
Appliances gains												
175.31	177.13	172.55	162.79	150.47	138.89	131.15	129.33	133.92	143.68	156.00	167.58	(68)
Cooking gains												
33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	(71)
Water heating gains												
109.80	107.91	103.98	98.64	95.18	90.29	86.14	91.46	93.35	98.88	105.12	107.92	(72)
Total internal gains												
356.87	355.05	343.94	326.10	308.15	290.70	279.25	284.49	293.56	311.59	332.31	347.68	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.090	10.63	0.63 x 0.70	0.77	10.0416	
2013 External Window New, Ground Floor Unit D1 1.13_Living						
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.090	10.63	0.63 x 0.70	0.77	10.0416	
2013 External Window New, Ground Floor Unit D1 1.13_Living						
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.090	10.63	0.63 x 0.70	0.77	10.0416	
2013 External Window New, Ground Floor Unit D1 1.13						
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.090	10.63	0.63 x 0.70	0.77	10.0416	
2013 External Window New, Ground Floor Unit D1 1.13						
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.890	10.63	0.63 x 0.70	0.77	9.3916	
2013 External Window New, Ground Floor Unit D1 1.13						
Total solar gains, January					49.56	(83-1)

Solar gains

49.56	94.71	160.93	258.50	348.22	372.78	348.04	276.12	193.49	112.74	61.14	41.31	(83)

Total gains

406.42	449.75	504.87	584.60	656.37	663.48	627.28	560.62	487.05	424.32	393.44	388.99	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.09	0.80	0.70 x 0.83	1.29
2013 External Window New, Ground Floor Unit D1 1.13_Living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.09	0.80	0.70 x 0.83	1.29
2013 External Window New, Ground Floor Unit D1 1.13_Living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.09	0.80	0.70 x 0.83	1.29
2013 External Window New, Ground Floor Unit D1 1.13				

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.09	0.80	0.70 x 0.83	1.29
2013 External Window New, Ground Floor Unit D1 1.13				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.89	0.80	0.70 x 0.83	1.21
2013 External Window New, Ground Floor Unit D1 1.13				

GL = 6.38 / 60.94 = 0.105
C1 = 0.500
C2 = 0.960
El = 276

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)
Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau											
62.67	62.84	63.00	63.78	63.92	64.62	64.62	64.75	64.35	63.92	63.63	63.32
alpha											
5.18	5.19	5.20	5.25	5.26	5.31	5.31	5.32	5.29	5.26	5.24	5.22
Utilisation factor for gains for living area											
1.00	0.99	0.98	0.94	0.81	0.61	0.46	0.53	0.81	0.97	0.99	1.00 (86)
Mean internal temperature in living area T1											
19.88	20.01	20.26	20.61	20.87	20.98	21.00	20.99	20.91	20.57	20.17	19.86 (87)
Temperature during heating periods in rest of dwelling Th2											
19.99	20.00	20.00	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20.00 (88)
Utilisation factor for gains for rest of dwelling											
1.00	0.99	0.98	0.92	0.76	0.53	0.36	0.42	0.73	0.95	0.99	1.00 (89)
Mean internal temperature in the rest of dwelling T2											
18.50	18.70	19.06	19.55	19.89	20.01	20.02	20.02	19.95	19.51	18.94	18.48 (90)

Living area fraction (26.35 / 60.94) 0.43 (91)
Mean internal temperature (for the whole dwelling)

19.10	19.27	19.58	20.01	20.32	20.43	20.44	20.44	20.36	19.97	19.47	19.07 (92)
Apply adjustment to the mean internal temperature, where appropriate											
19.10	19.27	19.58	20.01	20.32	20.43	20.44	20.44	20.36	19.97	19.47	19.07 (93)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.99	0.99	0.98	0.92	0.78	0.56	0.40	0.47	0.76	0.95	0.99	1.00	(94)
Useful gains												
404.13	445.19	492.42	537.82	509.35	372.74	250.44	261.50	371.64	404.28	389.10	387.22	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
999.27	967.48	878.47	737.17	570.37	381.62	251.63	264.07	411.79	620.25	822.80	994.20	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
442.79	350.98	287.23	143.53	45.40	-	-	-	-	160.69	312.26	451.59	

Total space heating requirement per year (kWh/year) (October to May) 2194.45 (98)

Space heating requirement per m² (kWh/m²/year) 36.01 (99)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

9a. Energy requirements

kWh/year

No secondary heating system selected
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main heating system 93.50% (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
442.79	350.98	287.23	143.53	45.40	-	-	-	-	160.69	312.26	451.59	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
473.57	375.38	307.19	153.51	48.55	-	-	-	-	171.86	333.97	482.98	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
180.18	158.92	167.16	150.20	147.45	132.12	127.24	139.14	138.74	155.73	164.23	175.97	(64)
Efficiency of water heater												79.80 (216)
87.12	86.87	86.25	84.69	82.08	79.80	79.80	79.80	79.80	84.90	86.50	87.22	(217)
Water heating fuel												
206.82	182.94	193.82	177.35	179.63	165.57	159.45	174.36	173.86	183.44	189.85	201.75	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	2347.01	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2188.85	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	276.02	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	4886.87	(238)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for notional dwelling - calculation of target emissions

12a. Carbon dioxide emissions

	Energy kWh/year	**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating, main system 1	2347.01	0.216	506.95	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2188.85	0.216	472.79	(264)
Space and water heating			979.75	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	276.02	0.519	143.25	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			1161.92	(272)

	kg/m²/year	
Emissions per m² for space and water heating	**16.08**	(272a)
Emissions per m² for lighting	**2.35**	(272b)
Emissions per m² for pumps and fans	**0.64**	(272c)
Target Carbon Dioxide Emission Rate (TER)	**19.07**	(273)

= (16.0772 x 1.00) + 2.3507 + 0.6387

Project Information
Building type Top-floor flat

Reference
Date 8 April 2016
Project NW1

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

1. Overall dwelling dimensions

	Area (m^2)	**Av. Storey height (m)**	**Volume (m^3)**	
Second floor	60.94	3.00	182.82	(3a)
Total floor area	60.94			(4)
Dwelling volume (m^3)			182.82	(5)

2. Ventilation rate

	main + seondary + other heating		**m^3 per hour**	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	0	x 10	0.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.25	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.21	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	
												52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18	
												13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25	
												2.79 (22b)

air change rate through system	0.50	(23a)
efficiency in % allowing for in-use factor	79.90	(23c)

Ventilation : balanced whole house mechanical with heat recovery

Effective air change rate

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13			**4.480**	**1.33 (1.40)**	5.94			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13			**4.480**	**1.33 (1.40)**	5.94			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13			**4.200**	**1.33 (1.40)**	5.57			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13_Living			**4.480**	**1.33 (1.40)**	5.94			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D1 1.13_Living			**4.480**	**1.33 (1.40)**	5.94			(27)
Walls 2013 External Wall New, Ground Floor Unit D1 1.13			26.78	0.15	4.02	21.95	587.82	(29)
Walls 2013 External Wall New, Ground Floor Unit D1 1.13			0.98	0.15	0.15	21.95	21.51	(29)
Walls 2013 External Wall New, Ground Floor Unit D1 1.13_Living			23.57	0.15	3.54	21.95	517.30	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit D1 1.13_Living			33.50	0.00	0.00	8.75	293.13	
Internal wall 2013 Internal Partition, Ground Floor Unit D1 1.13			33.50	0.00	0.00	8.75	293.13	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D1 1.13_Living			52.69	0.00	0.00	95.00	5005.81	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D1 1.13			35.47	0.00	0.00	95.00	3369.59	
Internal ceiling 2013 Internal Ceiling/Floor, Ground Floor Unit D1 1.13			33.72	0.00	0.00	95.00	3203.60	

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K

Total area of external elements Sigma A, m²	73.45	(31)
Fabric heat loss, W/K	37.02	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	0.08	(36)
Total fabric heat loss	37.10	(37)

Ventilation heat loss calculated monthly

22.41	22.09	21.77	20.17	19.84	18.24	18.24	17.92	18.88	19.84	20.49	21.13	(38)

Heat transfer coefficient, W/K

59.51	59.19	58.87	57.27	56.95	55.35	55.35	55.03	55.99	56.95	57.59	58.23	

57.19 (39)

Heat loss parameter (HLP), W/m²K

0.98	0.97	0.97	0.94	0.93	0.91	0.91	0.90	0.92	0.93	0.95	0.96	

HLP (average) 0.94 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N	2.01	(42)
Annual average hot water usage in litres per day Vd,average	86.20	(43)

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

Hot water usage in litres per day for each month

94.82	91.37	87.93	84.48	81.03	77.58	77.58	81.03	84.48	87.93	91.37	94.82	(44)

Energy content of hot water used

140.62	122.99	126.91	110.64	106.17	91.61	84.89	97.42	98.58	114.88	125.41	136.18	

Energy content (annual) 1356.29 (45)

Distribution loss

21.09	18.45	19.04	16.60	15.92	13.74	12.73	14.61	14.79	17.23	18.81	20.43	(46)

Hot water storage volume (litres)	110.00	(50)
Hot water cylinder loss factor (kWh/day)	0.0152	(51)
Volume factor	1.0294	(52)
Temperature factor	0.6000	(53)
Energy lost from hot water cylinder (kWh/day)	1.03	(55)

Total storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

Net storage loss

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary loss

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

Total heat required for water heating calculated for each month

195.90	172.91	182.19	164.14	161.44	145.11	140.17	152.69	152.07	170.16	178.90	191.46	(62)

Output from water heater for each month, kWh/month

195.90	172.91	182.19	164.14	161.44	145.11	140.17	152.69	152.07	170.16	178.90	191.46	(64)

2007.13 (64)

Heat gains from water heating, kWh/month

90.98	80.83	86.42	79.58	79.52	73.26	72.45	76.61	75.57	82.42	84.49	89.50	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	100.40	(66)
Lighting gains												
15.63	13.88	11.29	8.55	6.39	5.39	5.83	7.58	10.17	12.91	15.07	16.06	(67)
Appliances gains												
175.31	177.13	172.55	162.79	150.47	138.89	131.15	129.33	133.92	143.68	156.00	167.58	(68)
Cooking gains												
33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	-80.32	(71)
Water heating gains												
122.28	120.29	116.15	110.53	106.88	101.74	97.38	102.97	104.96	110.78	117.35	120.30	(72)
Total internal gains												
366.34	364.42	353.11	334.99	316.86	299.15	287.48	293.00	302.17	320.49	341.54	357.06	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.480 10.63	0.63 x 0.80	0.77	16.6385
2013 External Window New, Ground Floor Unit D1 1.13				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.480 10.63	0.63 x 0.80	0.77	16.6385
2013 External Window New, Ground Floor Unit D1 1.13				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.200 10.63	0.63 x 0.80	0.77	15.5986
2013 External Window New, Ground Floor Unit D1 1.13				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.480 10.63	0.63 x 0.80	0.77	16.6385
2013 External Window New, Ground Floor Unit D1 1.13_Living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.480 10.63	0.63 x 0.80	0.77	16.6385
2013 External Window New, Ground Floor Unit D1 1.13_Living				

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.48	0.80	0.80 x 0.83	2.14
2013 External Window New, Ground Floor Unit D1 1.13				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.48	0.80	0.80 x 0.83	2.14
2013 External Window New, Ground Floor Unit D1 1.13				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.20	0.80	0.80 x 0.83	2.01
2013 External Window New, Ground Floor Unit D1 1.13				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.48	0.80	0.80 x 0.83	2.14
2013 External Window New, Ground Floor Unit D1 1.13_Living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.48	0.80	0.80 x 0.83	2.14
2013 External Window New, Ground Floor Unit D1 1.13_Living				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
71.11	71.49	71.88	73.89	74.31	76.46	76.46	76.91	75.59	74.31	73.48	72.67	
alpha												
5.74	5.77	5.79	5.93	5.95	6.10	6.10	6.13	6.04	5.95	5.90	5.84	
Utilisation factor for gains for living area												
0.99	0.99	0.95	0.81	0.58	0.39	0.28	0.34	0.61	0.91	0.99	1.00	(86)
Mean internal temperature in living area T1												
20.13	20.30	20.58	20.88	20.98	21.00	21.00	21.00	20.99	20.79	20.42	20.11	(87)
Temperature during heating periods in rest of dwelling Th2												
20.10	20.11	20.11	20.13	20.14	20.16	20.16	20.16	20.15	20.14	20.13	20.12	(88)
Utilisation factor for gains for rest of dwelling												
0.99	0.98	0.94	0.77	0.53	0.34	0.23	0.28	0.54	0.88	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2												
18.95	19.20	19.60	20.01	20.13	20.16	20.16	20.16	20.14	19.92	19.39	18.94	(90)

Living area fraction (26.35 / 60.94) 0.43 (91)

Mean internal temperature (for the whole dwelling)

19.46	19.68	20.02	20.39	20.50	20.52	20.52	20.53	20.51	20.30	19.83	19.45	(92)

Apply adjustment to the mean internal temperature, where appropriate

19.46	19.68	20.02	20.39	20.50	20.52	20.52	20.53	20.51	20.30	19.83	19.45	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.99	0.98	0.94	0.78	0.55	0.36	0.25	0.30	0.57	0.89	0.98	0.99	(94)
Useful gains												
444.38	510.42	580.47	599.34	493.84	327.41	217.12	226.93	353.19	451.44	433.64	422.52	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
902.13	874.67	796.10	657.86	500.97	327.80	217.15	227.03	358.73	552.13	733.35	887.93	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
340.57	244.78	160.43	42.13	5.30	-	-	-	-	74.92	215.79	346.27	

Total space heating requirement per year (kWh/year) (October to May) 1430.19 (98)

Space heating requirement per m² (kWh/m²/year) 23.47 (99)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers												
-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W												
-	-	-	-	-	520.26	409.57	418.20	-	-	-	-	(100)
Utilisation factor for loss												
-	-	-	-	-	1.00	1.00	1.00	-	-	-	-	(101)
Useful loss W												
-	-	-	-	-	517.82	408.85	416.57	-	-	-	-	(102)
Internal gains W												
0.00	0.00	0.00	0.00	0.00	411.74	396.92	404.17	0.00	0.00	0.00	0.00	
Solar gains W												
0.00	0.00	0.00	0.00	0.00	722.29	674.35	535.01	0.00	0.00	0.00	0.00	
Gains W												
-	-	-	-	-	1134.03	1071.27	939.18	-	-	-	-	(103)
Fraction of month for cooling												
0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh												
-	-	-	-	-	23.92	4.12	0.00	-	-	-	-	(98)
Space cooling kWh												
-	-	-	-	-	443.67	492.84	388.82	-	-	-	-	(104)
Total											1325.33	(104)
Cooled fraction											0.80	(105)
Intermittency factor												
-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month												
-	-	-	-	-	88.73	98.57	77.76	-	-	-	-	
Space cooling (June to August)											265.07	(107)
Space cooling requirement per m² (kWh/m²/year)											4.35	(108)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
Space heating			
Annual space heating requirement	1430.19		(98)
Space heat from Boilers		1501.70	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
Water heating			
Annual water heating requirement	2007.13		(64)
Water heat from Boilers		2107.49	(310a)
Other energy			
Cooling system energy efficiency ratio	5.81%		(314)
Space cooling		45.60	(315)
Electrical energy for heat distribution		36.09	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=0.60)		134.27	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		134.27	(331)
Electricity for lighting (100.00% fixed LEL)		276.02	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		4055.56	(338)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 97.90%				(367a)
CO2 emissions from Boilers	3686.61	0.2160	796.31	(368)
Electrical energy for heat distribution	36.09	0.5190	18.73	(372)
Total CO2 associated with community systems			815.04	(373)
Total CO2 associated with space and water heating			815.04	(376)
Space cooling	45.60	0.519	23.67	(377)
Electricity for pumps and fans	134.27	0.519	69.69	(378)
Electricity for lighting	276.02	0.519	143.25	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			1051.64	(383)
			kg/m²/year	
Dwelling Carbon Dioxide Emission Rate (DER)			**17.26**	(384)

Project Information

Building type Mid-floor flat

Reference

Date 8 April 2016

Project NW1

SAP 2012 worksheet for notional dwelling - calculation of target emissions

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Third floor	61.09	3.83	233.97	(3a)
Total floor area	61.09			(4)
Dwelling volume (m^3)			233.97	(5)

2. Ventilation rate

	main + seondary + other heating		m^3 per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	2	x 10	20.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

		Air changes per hour	
Infiltration due to chimneys, fans and flues		0.09	(8)
Pressure test, result q50	5.00		(17)
Air permeability		0.34	(18)
Number of sides on which sheltered		2.00	(19)
Shelter factor		0.85	(20)
Infiltration rate incorporating shelter factor		0.29	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18

13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.36	0.36	0.35	0.31	0.31	0.27	0.27	0.26	0.29	0.31	0.32	0.34

3.74 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	(25)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10			**3.100**	**1.33 (1.40)**	4.11	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10_living			**2.770**	**1.33 (1.40)**	3.67	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10_living			**2.770**	**1.33 (1.40)**	3.67	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10			**3.310**	**1.33 (1.40)**	4.39	(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10			**3.310**	**1.33 (1.40)**	4.39	(27)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit D2 2.10			37.80	0.13	4.91	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit D2 2.10_living			32.81	0.13	4.27	(30)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10			0.98	0.18	0.18	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10			18.69	0.18	3.36	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10_living			14.64	0.18	2.63	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10_living			10.44	0.18	1.88	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10			12.34	0.18	2.22	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit D2 2.10_living			52.06	0.00	0.00	
Internal wall 2013 Internal Partition, Ground Floor Unit D2 2.10			52.27	0.00	0.00	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D2 2.10_living			27.15	0.00	0.00	

SAP 2012 worksheet for notional dwelling - calculation of target emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D2 2.10			0.22	0.00	0.00
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D2 2.10			33.72	0.00	0.00

Total area of external elements Sigma A, m²	142.97	(31)
Fabric heat loss, W/K	39.69	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	7.15	(36)
Total fabric heat loss	46.84	(37)

Ventilation heat loss calculated monthly

43.71	43.51	43.32	42.40	42.23	41.44	41.44	41.29	41.75	42.23	42.58	42.94	(38)

Heat transfer coefficient, W/K

90.54	90.35	90.15	89.24	89.07	88.27	88.27	88.13	88.58	89.07	89.41	89.78	
											89.24	(39)

Heat loss parameter (HLP), W/m²K

1.48	1.48	1.48	1.46	1.46	1.44	1.44	1.44	1.45	1.46	1.46	1.47	
HLP (average)											1.46	(40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

SAP 2012 worksheet for notional dwelling - calculation of target emissions

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N 2.01 (42)

Annual average hot water usage in litres per day Vd,average 81.99 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
90.19	86.91	83.63	80.35	77.07	73.79	73.79	77.07	80.35	83.63	86.91	90.19	(44)
Energy content of hot water used												
133.75	116.98	120.71	105.24	100.98	87.14	80.75	92.66	93.76	109.27	119.28	129.53	

Energy content (annual) 1290.05 (45)

Distribution loss												
20.06	17.55	18.11	15.79	15.15	13.07	12.11	13.90	14.06	16.39	17.89	19.43	(46)

Cylinder volume, l 150.00 (47)

Manufacturer's declared cylinder loss factor (kWh/day) 1.39 (48)

Temperature Factor 0.5400 (49)

Energy lost from hot water cylinder (kWh/day) 0.75 (55)

Total storage loss												
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
Net storage loss												
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
180.35	159.06	167.31	150.33	147.57	132.23	127.34	139.25	138.86	155.87	164.37	176.12	(62)
Output from water heater for each month, kWh/month												
180.35	159.06	167.31	150.33	147.57	132.23	127.34	139.25	138.86	155.87	164.37	176.12	(64)

1838.67 (64)

Heat gains from water heating, kWh/month												
81.75	72.56	77.41	71.07	70.85	65.05	64.12	68.08	67.25	73.61	75.73	80.34	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	(66)
Lighting gains												
15.66	13.91	11.31	8.57	6.40	5.41	5.84	7.59	10.19	12.94	15.10	16.10	(67)
Appliances gains												
175.69	177.51	172.92	163.14	150.79	139.19	131.43	129.61	134.21	143.99	156.33	167.94	(68)
Cooking gains												
33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	(71)
Water heating gains												
109.88	107.98	104.05	98.70	95.23	90.34	86.19	91.51	93.40	98.94	105.19	107.99	(72)
Total internal gains												
357.41	355.59	344.46	326.59	308.61	291.12	279.65	284.90	293.98	312.05	332.80	348.21	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.100 10.63	0.63 x 0.70	0.77	10.0741
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.770 10.63	0.63 x 0.70	0.77	9.0017
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.770 10.63	0.63 x 0.70	0.77	9.0017
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.310 10.63	0.63 x 0.70	0.77	10.7565
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.310 10.63	0.63 x 0.70	0.77	10.7565
2013 External Window New, Ground Floor Unit D2 2.10				
Total solar gains, January				49.59 (83-1)

Solar gains

49.59	94.77	161.04	258.67	348.45	373.02	348.27	276.30	193.62	112.81	61.18	41.34

(83)

Total gains

407.00	450.36	505.50	585.25	657.06	664.14	627.91	561.20	487.60	424.86	393.98	389.55

(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.10	0.80	0.70 x 0.83	1.30
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.77	0.80	0.70 x 0.83	1.16
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 2.77	0.80	0.70 x 0.83	1.16
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.31	0.80	0.70 x 0.83	1.38
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.31	0.80	0.70 x 0.83	1.38
2013 External Window New, Ground Floor Unit D2 2.10				

GL = 6.38 / 61.09 = 0.104
C1 = 0.500
C2 = 0.960
El = 277

SAP 2012 worksheet for notional dwelling - calculation of target emissions

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
46.85	46.96	47.06	47.54	47.63	48.06	48.06	48.14	47.89	47.63	47.45	47.26	
alpha												
4.12	4.13	4.14	4.17	4.18	4.20	4.20	4.21	4.19	4.18	4.16	4.15	
Utilisation factor for gains for living area												
1.00	0.99	0.99	0.96	0.89	0.74	0.58	0.66	0.89	0.98	0.99	1.00	(86)
Mean internal temperature in living area T1												
19.40	19.54	19.83	20.25	20.64	20.89	20.97	20.95	20.74	20.26	19.76	19.37	(87)
Temperature during heating periods in rest of dwelling Th2												
19.70	19.70	19.71	19.72	19.72	19.73	19.73	19.73	19.73	19.72	19.71	19.71	(88)
Utilisation factor for gains for rest of dwelling												
1.00	0.99	0.98	0.95	0.84	0.63	0.43	0.51	0.82	0.97	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2												
17.60	17.81	18.23	18.84	19.37	19.66	19.72	19.71	19.51	18.86	18.14	17.57	(90)

Living area fraction (27.14 / 61.09) 0.44 (91)

Mean internal temperature (for the whole dwelling)

18.40	18.58	18.94	19.47	19.94	20.21	20.27	20.26	20.06	19.48	18.86	18.37	(92)

Apply adjustment to the mean internal temperature, where appropriate

18.40	18.58	18.94	19.47	19.94	20.21	20.27	20.26	20.06	19.48	18.86	18.37	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.99	0.99	0.98	0.94	0.85	0.67	0.50	0.57	0.84	0.96	0.99	0.99	(94)
Useful gains												
404.51	445.91	495.05	552.04	557.49	448.11	314.23	322.64	408.55	409.58	389.82	387.56	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
1276.52	1235.90	1121.56	942.96	733.61	494.82	324.31	340.23	527.64	791.15	1051.81	1272.39	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
648.78	530.87	466.12	281.46	131.03	-	-	-	-	283.89	476.63	658.32	

Total space heating requirement per year (kWh/year) (October to May) 3477.10 (98)

Space heating requirement per m² (kWh/m²/year) 56.92 (99)

SAP 2012 worksheet for notional dwelling - calculation of target emissions

9a. Energy requirements

kWh/year

No secondary heating system selected
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main heating system 93.50% (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
648.78	530.87	466.12	281.46	131.03	-	-	-	-	283.89	476.63	658.32	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
693.88	567.78	498.52	301.03	140.14	-	-	-	-	303.63	509.77	704.08	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
180.35	159.06	167.31	150.33	147.57	132.23	127.34	139.25	138.86	155.87	164.37	176.12	(64)
Efficiency of water heater												79.80 (216)
87.94	87.79	87.40	86.46	84.50	79.80	79.80	79.80	79.80	86.39	87.49	88.01	(217)
Water heating fuel												
205.09	181.20	191.42	173.87	174.65	165.70	159.58	174.50	174.00	180.41	187.87	200.12	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	3718.83	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2168.40	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	276.61	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	6238.84	(238)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for notional dwelling - calculation of target emissions

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	3718.83	0.216	803.27	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2168.40	0.216	468.38	(264)
Space and water heating			1271.64	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	276.61	0.519	143.56	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			1454.13	(272)

	kg/m²/year	
Emissions per m² for space and water heating	**20.82**	(272a)
Emissions per m² for lighting	**2.35**	(272b)
Emissions per m² for pumps and fans	**0.64**	(272c)
Target Carbon Dioxide Emission Rate (TER)	**23.80**	(273)

= (20.8159 x 1.00) + 2.3500 + 0.6372

Project Information
Building type Mid-floor flat

Reference
Date 8 April 2016
Project NW1

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

1. Overall dwelling dimensions

	Area (m^2)	**Av. Storey height (m)**	**Volume (m^3)**	
Third floor	61.09	3.83	233.97	(3a)
Total floor area	61.09			(4)
Dwelling volume (m^3)			233.97	(5)

2. Ventilation rate

	main + seondary + other heating		**m^3 per hour**	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	0	x 10	0.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(8)
Pressure test, result q50		5.00		(17)
Air permeability			0.25	(18)
Number of sides on which sheltered			2.00	(19)
Shelter factor			0.85	(20)
Infiltration rate incorporating shelter factor			0.21	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

52.50 (22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18

13.13 (22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25

2.79 (22b)

air change rate through system	0.50	(23a)
efficiency in % allowing for in-use factor	79.90	(23c)

Ventilation : balanced whole house mechanical with heat recovery

Effective air change rate

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10			**4.480**	**1.33 (1.40)**	5.94			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10			**4.480**	**1.33 (1.40)**	5.94			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10_living			**3.750**	**1.33 (1.40)**	4.97			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10_living			**3.750**	**1.33 (1.40)**	4.97			(27)
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North) 2013 External Window New, Ground Floor Unit D2 2.10			**4.200**	**1.33 (1.40)**	5.57			(27)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit D2 2.10			37.80	0.20	7.56	98.75	3733.24	(30)
Pitched roofs insulated between joists 2013 Roof New, Ground Floor Unit D2 2.10_living			32.81	0.20	6.56	98.75	3239.99	(30)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10			18.69	0.15	2.80	21.95	410.27	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10			12.34	0.15	1.85	21.95	270.88	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10_living			14.64	0.15	2.20	21.95	321.28	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10_living			10.44	0.15	1.57	21.95	229.22	(29)
Walls 2013 External Wall New, Ground Floor Unit D2 2.10			0.98	0.15	0.15	21.95	21.51	(29)
Internal wall 2013 Internal Partition, Ground Floor Unit D2 2.10			52.27	0.00	0.00	8.75	457.36	
Internal wall 2013 Internal Partition, Ground Floor Unit D2 2.10_living			52.06	0.00	0.00	8.75	455.57	
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D2 2.10_living			27.15	0.00	0.00	95.00	2578.78	

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D2 2.10			33.72	0.00	0.00	95.00	3203.60
Internal floor 2013 Internal Ceiling/Floor, Ground Floor Unit D2 2.10			0.22	0.00	0.00	95.00	21.03

Total area of external elements Sigma A, m²	148.37	(31)
Fabric heat loss, W/K	50.08	(33)
Thermal mass parameter, kJ/m²K (user-specified TMP)	250.00	(35)
Effect of thermal bridges	0.08	(36)
Total fabric heat loss	50.16	(37)

Ventilation heat loss calculated monthly

28.68	28.27	27.86	25.81	25.40	23.35	23.35	22.94	24.17	25.40	26.22	27.04	(38)

Heat transfer coefficient, W/K

78.84	78.43	78.02	75.96	75.55	73.50	73.50	73.09	74.32	75.55	76.38	77.20	
											75.86	(39)

Heat loss parameter (HLP), W/m²K

1.29	1.28	1.28	1.24	1.24	1.20	1.20	1.20	1.22	1.24	1.25	1.26	

HLP (average) 1.24 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements

kWh/year

Assumed occupancy, N 2.01 (42)

Annual average hot water usage in litres per day Vd,average 86.31 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
94.94	91.49	88.03	84.58	81.13	77.68	77.68	81.13	84.58	88.03	91.49	94.94	(44)
Energy content of hot water used												
140.79	123.14	127.07	110.78	106.29	91.72	85.00	97.53	98.70	115.02	125.56	136.35	

Energy content (annual) 1357.94 (45)

Distribution loss												
21.12	18.47	19.06	16.62	15.94	13.76	12.75	14.63	14.80	17.25	18.83	20.45	(46)

Hot water storage volume (litres) 110.00 (50)

Hot water cylinder loss factor (kWh/day) 0.0152 (51)

Volume factor 1.0294 (52)

Temperature factor 0.6000 (53)

Energy lost from hot water cylinder (kWh/day) 1.03 (55)

Total storage loss												
32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
Net storage loss												
32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
196.07	173.06	182.34	164.27	161.57	145.22	140.27	152.81	152.19	170.30	179.05	191.62	(62)
Output from water heater for each month, kWh/month												
196.07	173.06	182.34	164.27	161.57	145.22	140.27	152.81	152.19	170.30	179.05	191.62	(64)

2008.78 (64)

Heat gains from water heating, kWh/month												
91.03	80.88	86.47	79.63	79.56	73.29	72.48	76.65	75.61	82.47	84.54	89.56	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	100.61	(66)
Lighting gains												
15.66	13.91	11.31	8.57	6.40	5.41	5.84	7.59	10.19	12.94	15.10	16.10	(67)
Appliances gains												
175.69	177.51	172.92	163.14	150.79	139.19	131.43	129.61	134.21	143.99	156.33	167.94	(68)
Cooking gains												
33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	33.06	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	-80.49	(71)
Water heating gains												
122.36	120.36	116.22	110.60	106.94	101.80	97.42	103.03	105.02	110.84	117.42	120.37	(72)
Total internal gains												
366.89	364.97	353.64	335.48	317.32	299.57	287.88	293.41	302.60	320.95	342.04	357.59	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.480 10.63	0.63 x 0.80	0.77	16.6385
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.480 10.63	0.63 x 0.80	0.77	16.6385
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.750 10.63	0.63 x 0.80	0.77	13.9273
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.750 10.63	0.63 x 0.80	0.77	13.9273
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.200 10.63	0.63 x 0.80	0.77	15.5986
2013 External Window New, Ground Floor Unit D2 2.10				

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.48	0.80	0.80 x 0.83	2.14
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.48	0.80	0.80 x 0.83	2.14
2013 External Window New, Ground Floor Unit D2 2.10				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.75	0.80	0.80 x 0.83	1.79
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 3.75	0.80	0.80 x 0.83	1.79
2013 External Window New, Ground Floor Unit D2 2.10_living				
Window - Double-glazed, air-filled, low-E, En=0.1, soft coat (North)	0.9 x 4.20	0.80	0.80 x 0.83	2.01
2013 External Window New, Ground Floor Unit D2 2.10				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 1.00

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
53.81	54.09	54.38	55.85	56.15	57.72	57.72	58.04	57.08	56.15	55.55	54.96	
alpha												
4.59	4.61	4.63	4.72	4.74	4.85	4.85	4.87	4.81	4.74	4.70	4.66	
Utilisation factor for gains for living area												
1.00	0.99	0.97	0.90	0.74	0.52	0.39	0.46	0.76	0.96	0.99	1.00	(86)
Mean internal temperature in living area T1												
19.69	19.87	20.18	20.62	20.89	20.98	21.00	20.99	20.91	20.53	20.05	19.68	(87)
Temperature during heating periods in rest of dwelling Th2												
19.85	19.85	19.86	19.89	19.89	19.92	19.92	19.92	19.91	19.89	19.88	19.87	(88)
Utilisation factor for gains for rest of dwelling												
0.99	0.99	0.96	0.87	0.67	0.44	0.29	0.36	0.67	0.93	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2												
18.13	18.39	18.85	19.46	19.79	19.91	19.92	19.92	19.84	19.36	18.68	18.13	(90)

Living area fraction (27.14 / 61.09) 0.44 (91)

Mean internal temperature (for the whole dwelling)

18.82	19.04	19.44	19.97	20.28	20.39	20.40	20.40	20.32	19.88	19.29	18.82	(92)

Apply adjustment to the mean internal temperature, where appropriate

18.82	19.04	19.44	19.97	20.28	20.39	20.40	20.40	20.32	19.88	19.29	18.82	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.99	0.98	0.96	0.88	0.70	0.48	0.34	0.40	0.70	0.93	0.98	0.99	(94)
Useful gains												
440.09	503.70	579.13	644.20	595.62	418.60	278.09	290.01	423.75	463.07	430.01	418.87	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
1144.68	1109.22	1009.47	841.16	648.34	425.26	279.05	292.16	462.12	701.10	930.72	1128.32	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
524.21	406.91	320.17	141.80	39.22	-	-	-	-	177.09	360.51	527.83	

Total space heating requirement per year (kWh/year) (October to May) 2497.76 (98)

Space heating requirement per m² (kWh/m²/year) 40.89 (99)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers												
-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W												
-	-	-	-	-	690.94	543.93	555.51	-	-	-	-	(100)
Utilisation factor for loss												
-	-	-	-	-	0.96	0.98	0.96	-	-	-	-	(101)
Useful loss W												
-	-	-	-	-	660.82	531.91	534.34	-	-	-	-	(102)
Internal gains W												
0.00	0.00	0.00	0.00	0.00	412.38	397.53	404.79	0.00	0.00	0.00	0.00	
Solar gains W												
0.00	0.00	0.00	0.00	0.00	674.62	629.84	499.70	0.00	0.00	0.00	0.00	
Gains W												
-	-	-	-	-	1087.00	1027.37	904.49	-	-	-	-	(103)
Fraction of month for cooling												
0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh												
-	-	-	-	-	32.15	5.49	0.04	-	-	-	-	(98)
Space cooling kWh												
-	-	-	-	-	306.85	368.62	275.39	-	-	-	-	(104)
Total											950.86	(104)
Cooled fraction											0.80	(105)
Intermittency factor												
-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month												
-	-	-	-	-	61.37	73.72	55.08	-	-	-	-	
Space cooling (June to August)											190.17	(107)
Space cooling requirement per m² (kWh/m²/year)											3.11	(108)

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
Space heating			
Annual space heating requirement	2497.76		(98)
Space heat from Boilers		2622.64	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
Water heating			
Annual water heating requirement	2008.78		(64)
Water heat from Boilers		2109.22	(310a)
Other energy			
Cooling system energy efficiency ratio	5.81%		(314)
Space cooling		32.72	(315)
Electrical energy for heat distribution		47.32	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=0.60)		171.84	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		171.84	(331)
Electricity for lighting (100.00% fixed LEL)		276.61	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		5227.63	(338)

10a. Does not apply

11a. Does not apply

SAP 2012 worksheet for New dwelling as designed - calculation of dwelling emissions

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 97.90%				(367a)
CO2 emissions from Boilers	4833.37	0.2160	1044.01	(368)
Electrical energy for heat distribution	47.32	0.5190	24.56	(372)
Total CO2 associated with community systems			1068.57	(373)
Total CO2 associated with space and water heating			1068.57	(376)
Space cooling	32.72	0.519	16.98	(377)
Electricity for pumps and fans	171.84	0.519	89.19	(378)
Electricity for lighting	276.61	0.519	143.56	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			1318.29	(383)
			kg/m²/year	
Dwelling Carbon Dioxide Emission Rate (DER)			**21.58**	(384)

Appendix E – Thermal Comfort Report

metropolis pd as green

Green

THERMAL COMFORT REPORT

44 Gloucester Avenue, Camden, London NW1 8JD

On behalf of
Project and Building Consultancy

26/04/2016
Job Ref: 5385

Produced By	Position	Date
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Planning
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Renewable Energy
Sustainable Development

CONTENTS

1.0 INTRODUCTION

1.1 This report provides results of the overheating analysis undertaken by Metropolis Green in order to assess performance of the proposed 44 Gloucester Avenue development in the London Borough of Camden, against CIBSE TM52 standards.

1.2 The proposed mixed-use development at 44 Gloucester Avenue comprises the refurbishment, extension and conversion of the existing non-domestic buildings on the site, which include 40 nos. 1 to 3 bedroom residential units, of which 22 units will be located in the newly constructed buildings. The commercial space is comprised of approximately 698m² of floor area at the basement and ground floor levels.

1.3 Dynamic Simulation Modelling (DSM) of the building has been carried out to determine the likelihood of overheating within the proposed 44 Gloucester Avenue development. A sample of the expected worst performing residential units were selected (i.e. all mid and top floor residential units) and all commercial areas were simulated considering all aspects of occupancy, solar gain, and predicted heat gains.

1.4 The calculation results show that none of the residential units overheat in the summer months, however the commercial areas demonstrated non-compliance against at least two of the three CIBSE TM52 overheating criteria. Even though additional measures were specified, the results demonstrated that overheating within the commercial areas cannot be resolved using only passive design measures and as such there is a need for comfort cooling to be provided within these areas.

2.0 CIBSE TM52 REQUIREMENTS

2.1 Overheating is assessed using CIBSE TM52. The following three criteria, taken together, provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe. A room or building that fails any two of the three criteria is classed as overheating.

2.2 CIBSE recommends that new buildings, major refurbishments and adaptation strategies should conform to Category II in BS EN 15251 (BSI, 2007), which sets a maximum acceptable temperature of 3 °C above the comfort temperature for buildings in free-running mode. For such buildings the maximum acceptable temperature (Tmax) can be calculated from the running mean of the outdoor temperature (Trm) using the formula:

$$Tmax = 0.33\ Trm + 21.8$$

2.3 The criteria are all defined in terms of ΔT, the difference between the actual operative temperature in the room at any time (Top), and Tmax the limiting maximum acceptable temperature. ΔT is calculated as:

$$\Delta T = Top - Tmax$$

- ***Criterion 1: Hours of Exceedence (He):***

  The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September).

  The number of hours (He) during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.

- ***Criterion 2: Daily Weighted Exceedence (We):***

  The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.

  The weighted exceedence (We) shall be less than or equal to 6 in any one day where:

  $$We = (\sum he) \times WF = (he0 \times 0) + (he1 \times 1) + (he2 \times 2) + (he3 \times 3)$$

  where the weighting factor wf = 0 if $\Delta T \leq 0$, otherwise

  $WF = \Delta T$, and hey is the time (h) when WF = y

- ***Criterion 3: Upper Limit Temperature (Tupp)***

  The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

  To set an absolute maximum value for the indoor operative temperature the value of ΔT shall not exceed 4 K. The absolute maximum value of the indoor operative temperature is expressed as Tupp

  $$Tupp = Tmax + 4$$

2.4 In order to demonstrate that the proposed development is not at risk of overheating, all of the assessed areas, must comply with at least two of the three assessed criteria.

2.5 The weather data used for the thermal comfort analysis is the projected increase future summer temperature CIBSE Design Summer Year, London 2050MH. The simulation period is from 1st May to the 30th September.

3.0 DYNAMIC SIMULATION MODEL

3.1 The analysis was carried out using IES Virtual Environment software, version 2015. The following modules of the software were used in the study;

- ModelIT – to create the building model data such as geometry, site and location.
- Apache – to assign construction materials, internal gains, occupancy patterns etc.
- SunCast – to calculate the solar shading patterns to provide data for the thermal calculations.
- Apache-Sim – to calculate indoor summer temperature.

3.2 The 3D model is based on the architectural drawings and other specifications, provided by 21st Architecture.

4.0 MODEL INPUTS AND METHODOLOGY

4.1 The dynamic simulation model was created for all blocks within the proposed 44 Gloucester Avenue. The selected sample areas include:

- Typical mid floor (Figure 1) and typical top floor residential units (Figure 2), and
- All commercial areas in basement and ground floor (Figures 3 and 4)

Figure 1 - Typical Mid Floor Residential Units

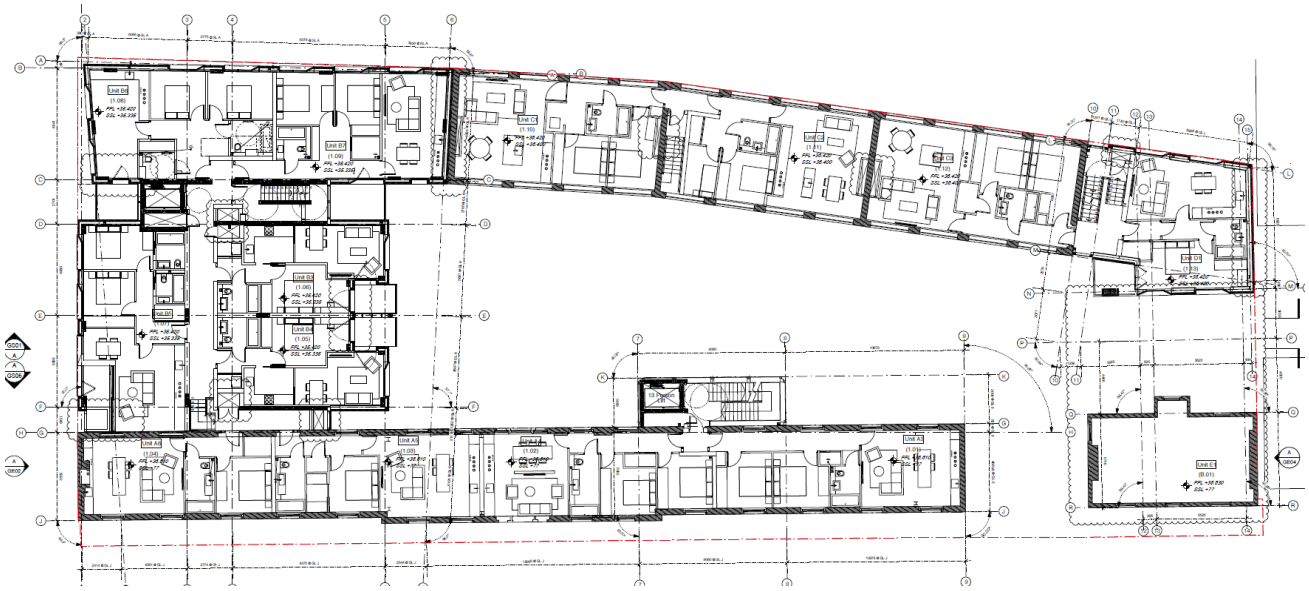

Figure 2 - Typical Top Floor Residential Units