

TEMPLAR HOUSE ENERGY STRATEGY JULY 2015



# Northwood Investors

# **Templar House**

Site Wide Energy Statement

ARUP-TH-RP-0012

Final | 15 July 2015

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 237116



# **Document Verification**



Document title Sit		Templar House  Site Wide Energy Statement		Job number 237116 File reference		
						ARUP-TH-
		Revision	Date	Filename	Site Wide Energy Statement – Templar House.docx	
DRAFT 10 July 2015		Description	DRAFT			
			Prepared by	Checked by	Approved by	
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		Signature				
Final	15 July	Filename	Site Wide Energy Statement – Templar House.docx			
	2015	Description	Final	2000	W 120 W 1 W 1 W 1	
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		Name				
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# **Contents**

			Page
Exec	utive Sun	ımary	1
1	Introd	luction	4
	1.1	Planning Context	4
	1.2	The London Borough of Camden	6
2	Notio	nal Building Energy Demand and Carbon Dioxide Em	issions 8
3	Reduc	eing Carbon Dioxide Emissions	10
	3.1	Passive Design (Be Lean)	10
	3.2	Energy Efficient Building Systems (Be Green)	14
	3.3	Renewable energy technologies (Be Clean)	21
4	Concl	usion	28
5	Appei	ndices	29

# **Executive Summary**

Templar House aims to be as energy efficient as practicable and generate its own energy where this is feasible. The location and nature of the buildings will naturally lead to certain energy requirements which cannot be avoided such as lighting, heating and cooling.

The residential, commercial and retail areas were modelled using Government-approved software and the notional building Target Emission Rates (TER) were calculated. Energy efficiency measures were introduced for each building, and all renewable energy technologies were considered.

For the residential building, a combination of photovoltaic modules and air source heat pumps are considered to be the most feasible technologies for the development. In addition to this a water to water heat pump allows heat recovery from the commercial building's chilled water loop. This provides additional heat to the residential building that would normally be rejected to atmosphere.

For the commercial building, an air cooled chilled water system, incorporating highly efficient screw compressors was found to meet the office cooling demand most effectively. The office building's energy performance is bolstered by an optimised facade, efficient air handling plant, LED lighting with daylight control and photovoltaic modules. These are considered the best mix of technologies for the development.

CHP was deemed not feasible, although capped pipework to the site boundary would be in place such that a future connection to a low carbon district heating network can be facilitated when it becomes available.

Templar House includes retail spaces at ground level. Services to these areas will be installed as part of the future tenant fit out works. As a result, only the baseline Part L 2013 carbon dioxide emissions have been calculated for the retail areas as part of this energy statement. Future tenancy fit-outs will need to comply with this benchmark as a minimum.

The following tables summarise the site wide percentage improvements on Part L 2013 carbon emissions that are achieved by the current energy strategy. This shows significant improvements in carbon emissions given the constraints of the site and its location.

Commercial and Residential Combined CO <sub>2</sub> Emissions				
Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annu				
	Regulated	Unregulated		
Baseline: Part L 2013 of the	449.6	423.7		
Building Regulations				
Compliant Development				
Passive Design	394.6	423.7		
Efficient Technology	386.9	423.7		
Energy Generation	368.2	423.7		
Regulated Carbon dioxide savings				
	Tonnes CO <sub>2</sub> per annum	% improvement		
Savings from demand	55.0	12.2%		
reduction				
Savings from efficient	7.7	1.9%		
technology				
Savings from renewable	18.7	4.8%		
energy				
Total Cumulative Savings	81.4	18.1%		

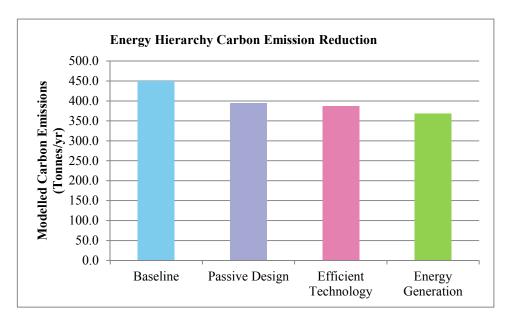


Figure 1 Reduction in Carbon Emissions

The following table indicates the baseline 2013 Part L carbon emissions target for the retail areas.

Retail CO <sub>2</sub> Emissions			
Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)			
Regulated Unregulated		Unregulated	
Baseline: Part L 2013 of			
the Building Regulations	24.8	6.1	
Compliant Development			

The graph below demonstrates the percentage of baseline carbon emissions attributed to each of the site uses at Templar House. It can be seen that retail accounts approximately 5% of the development's regulated base line emissions.

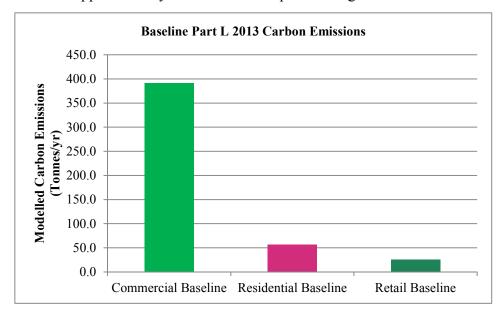


Figure 3 Part L 2013 baseline carbon emissions

The following table summarises the total improvement upon the baseline 2013 Part L carbon emissions that is achieved by the proposed energy strategy for the entire Templar House development (commercial, residential and retail).

Site-wide CO <sub>2</sub> Emissions				
	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)			
	Regulated	Unregulated		
Baseline: Part L 2013 of				
the Building Regulations	474.4	429.8		
Compliant Development				
Clean energy strategy	393.0	429.8		
Regulated Carbon dioxide savings				
	Tonnes CO <sub>2</sub> per annum	% improvement		
Total Target Saving	166.0	35		
Annual Shortfall	84.6			
25 year cumulative	2115.9			
shortfall				

## 1 Introduction

This report outlines the energy strategy that has been developed for Templar House to address the planning requirements of the Mayor of London's "London Plan" and the policies of the London Borough of Camden.

The project involves the demolition of an existing building and erection of two new buildings to provide a mix of uses comprising office, up to 48 residential units and retail together with, landscaping works, public realm improvements, plant, car and cycle parking and other ancillary works. The development is referred to in this report as 'Templar House'.

The existing Templar House building was constructed in 1959 and stretches from Eagle Street to the north to High Holborn to the south. The existing building is largely relying on ageing plant, equipment and out-dated building fabric.

The new buildings will incorporate efficient plant and equipment, well insulated building fabric to minimise heat loss/gains, and high performing glazing to maximise daylight whilst minimising building energy consumption.

The vision for Templar House is to be as low energy dependent as practicable. This report outlines how this will be achieved.

# 1.1 Planning Context

The London Plan, with revised early minor alterations and the Draft Further Alterations (2015), is the Spatial Development Strategy for London published by the Greater London Authority (GLA) and covers all 32 London Boroughs and includes the City of London Corporation. The Plan contains a number of policies which are relevant to Energy:

# Policy 5.2: Minimising carbon dioxide emissions

"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.

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Residential buildings: Year Improvement on 2010 Building Regulations 2010 – 2013 25 per cent (Code for Sustainable Homes level 4*)
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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"

### Also highlighted in this Policy is:

"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."

\*Following the conclusion of the governments technical housing standards review on the 27<sup>th</sup> March 2015, the government has withdrawn the Code for Sustainable Homes. While the CfSH energy targets can no longer be mandated by planning, the scheme will still target carbon dioxide emissions equivalent to a CfSH level 4 development.

\*\*Since 6 April 2014 the 2013 changes to Part L of the Building Regulations have come into effect. As outlined in the Sustainable, Design and Construction SPG, from 6 April 2014 the Mayor will apply a 35 per cent carbon reduction target beyond Part L 2013 of the Building Regulations - this is deemed to be broadly equivalent to the 40 per cent target beyond Part L 2010 of the Building Regulations, as specified in Policy 5.2 of the London Plan for 2013-2016.

The 35% reduction target against 2013 Part L carbon emissions is used for comparison in this report.

## Policy 5.3: Sustainable design and construction

"Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process."

# Policy 5.6: Decentralised energy in development proposals

"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."

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

- Connection to existing heating or cooling networks
- Site wide CHP network
- Communal heating and cooling."

## Policy 5.7: Renewable energy

"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."

# 1.2 The London Borough of Camden

Camden's 'Core Strategy' sets out the key elements of the Council's planning vision and strategy for the borough. 'Camden Development Policies', (adopted on 8<sup>th</sup> November 2010) sets out the detailed planning policies that the Council will use when determining applications for planning permission in the borough to achieve the vision and objectives of the Core Strategy.

# Policy DP22 Promoting Sustainable Design and Construction

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 below, 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:

- c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;\*
- d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;
- 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
- *i)* not locating vulnerable uses in basements in flood-prone areas

<sup>\*</sup>As discussed, Code for Sustainable Homes has been withdrawn however the scheme will target carbon emissions equivalent to a CfSH level 4.

# National and regional planning documentation

The National Planning Policy Framework (NPPF) was published in March 2012 and sets out the Government's planning policies for England and how these are expected to be applied. There are three dimensions to sustainable development: economic, social and environmental. These dimensions give rise to the need for the planning system to perform a number of roles, one of which is the environmental role – contributing to protecting and enhancing our natural, built and historic environment and mitigating and adapting to climate change including moving to a low carbon economy. At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development.

Supporting the NPPF are guidance document which provide further clarification of how the NPPF can be interpreted. Air quality, pollution and Climate Change are of specific relevance to the energy report.

As the proposed development is being carried out in London, the 2014 Supplementary Planning Guidance (SPG): Sustainable Design and Construction is also to be considered within this report; namely those instances relating to sustainable design, a low carbon future and designed for future climate change.

# 2 Notional Building Energy Demand and Carbon Dioxide Emissions

In order to establish the Part L compliant notional carbon dioxide emissions at Templar House (known as the Target Emission Rate), Government-approved software was used to model the commercial and residential buildings.

A commercial building energy model was realised using IES software and massing geometry received from the architect to establish the 2013 Part L Target Emissions Rate (TER). The TER sets a minimum carbon emissions baseline which the commercial building must improve upon in order to comply with Part L 2013. IES software was also used to produce notional building carbon estimates for the retail areas.

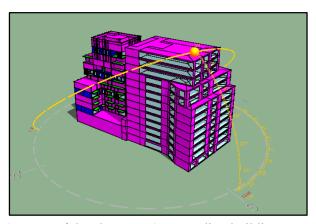


Figure 4 Image of development (surrounding buildings not shown)

The Residential building 2013 Part L TER was formulated using NHER Plan Assessor software. Version 6.0.1.1 provided the 2013 Part L carbon emissions baseline.

Assumptions regarding the types of plant and fabric performance that were inputted into the notional building models were established by SAP 2012 (residential developments) and NCM 2013 (commercial developments). The section below outlines these as well as the assumptions-used by the software to calculate the TER for the residential, commercial and retail areas.

#### Notional building software assumptions: Residential Building

• Treated Area (m<sup>2</sup>): 3369

Opening Areas: 25% of total floor area

Roof U-Values: 0.13 W/m².K
External Wall U-Values: 0.18 W/m².K
Floor U-Values: 0.13 W/m².K
Glazing U-values: 1.4 W/m².K
g-values: 0.63

• Thermal Mass: Medium  $(TMP = 250kJ/m^2K)$ 

• Shading and orientation: All glazing orientated E/W with average overshading

• Living Area: Same as actual dwelling

• Number of sheltered sides: Same as actual dwelling

• Allowance for thermal bridging:  $y = 0.05 \text{ W/m}^2\text{K}$ 

• Ventilation System: Natural Ventilation with intermittent extract fans

• Air permeability: 5 m3/h per m2 of envelope area at 50Pa

• Extract Fans: 2 extract fans for total floor area up to  $70\text{m}^2$ , 3 for total floor area  $> 70\text{m}^2$  and up to  $100\text{m}^2$ , 4 for total floor area  $> 100\text{m}^2$ 

• Main heating fuel (space and water): Mains gas

• Boiler efficiency: 89.5%

- Heating system controls: Time and temperature zone control, boiler interlock and weather compensation.
- Hot water system: Heated by boiler. Separate time control for space and water heating.
- Hot water cylinder: 150 litre cylinder. Heat loss factor 1.39kWh/day
- Primary water heating losses: Fully insulated primary pipework. Cylinder temperature controlled by thermostat. Cylinder in heated space
- Water use limited to 125 litres per person per day: Yes
- Secondary space heating: None
- Low energy light fittings: 100% of fixed outlets.

• Air conditioning: None

## Notional building software assumptions: Commercial Building

Treated Area (m²):
Boiler Efficiency:
Specific Fan Power:
Roof U-Values:
Wall U-Values:
Glazing U-values:
16585 m²
0.81 (SCoP)
1.6 W/l/s
0.18 W/m².K
0.26 W/m².K

• g-values: 0.4

• Main Heating System: Gas fired boiler

• Main Cooling system: Water cooled chillers and FCU

• Cooling Efficiency: 4.5 (SEER)

• Domestic hot water: Same as main heating system

• Heat recovery: 70%

• Lighting efficacy: 60 lumens/W

Lighting control: Daylight dimming, manual-on-auto-off
 Air Permeability: 3 m³/h per m² of envelope area at 50Pa

#### Notional building software assumptions: Retail Spaces

Treated Area (m²): 578 m²
Boiler Efficiency: 0.86 (SCoP)
Specific Fan Power: 1.8 W/l/s
Roof U-Values: 0.18 W/m².K
Wall U-Values: 0.26 W/m².K
Glazing U-values: 1.8 W/m².K

• g-values: 0.4

• Main Heating System: Air Source Heat Pumps (electric)

• Main Cooling system: Split/multi-split system

• Cooling Efficiency: 2.84 (SEER)

• Domestic hot water: Same as main heating system

• Heat recovery: 70%

Lighting efficacy: 60 lumens/W

• Display lamp efficacy: 22 lumens/W (efficient lamps)

• Lighting control: manual-on-auto-off

#### **Carbon Dioxide Emissions of Notional Buildings**

Based on the notional building assumptions above, the 2013 Part L baseline carbon dioxide emissions are as follows:

Site	Tonnes CO <sub>2</sub> /yr	
Notional Residential Demise	56.5	
Notional Commercial Demise	393.1	
Residential/Commercial Subtotal	449.6	
Notional Retail Demise	24.8	
Development Total	474.4	

The total baseline emissions for the residential and commercial areas are 449.6 tonnes of CO2 per annum. The total site baseline emissions (including commercial, residential and retail accommodation) are 474.4 tonnes of CO<sub>2</sub> per annum

The following section outlines how Templar House improves upon the notional 2013 Part L compliant building assumptions.

The retail units will be offered on a shell and core basis and the fit-out will be the responsibility of the tenants. All units will be subject to the building control regulations at the time of fit out. As such, no further energy improvement can be taken over and above compliance with the current building regulations Part L 2013.

# **3 Reducing Carbon Dioxide Emissions**

It is proposed to follow the Mayor's hierarchy for reducing carbon emissions. This involves:

- Reducing energy consumption though architectural passive design (Be Lean);
- Using low energy technologies and efficient building systems (Be Green);
- Generating energy where feasible on site from renewable energy technologies (Be Clean).

# 3.1 Passive Design (Be Lean)

The starting point for the Templar House energy strategy is to "design out" energy consumption as much as possible. Passive design is the most effective means, both in carbon dioxide and financial terms, to ensure Templar House is inherently low in energy usage.

There are a range of energy-efficiency measures that have been applied to Templar House as an integral part of the design process:

- Enhanced thermal envelope performance. This reduces the heating and cooling load for the development.
- The building form has been considered to ensure that glazed areas have been optimised for daylight while limiting heat gains and heat losses.

- External shading on a number of apartments reduces the direct solar gains they receive. The office building also provides self-shading to the residential building, reducing the solar gain and therefore reducing the cooling requirements throughout the year. It should be noted that the National Calculation Methodology does not allow this self-shading benefit to be considered in the models. The office south-facing Portland stone façade incorporates recessed windows for additional shading benefit. The depth of the window recess increases up the building so that the higher solar exposure at upper levels is matched with deeper shade protection.
- Glazed areas of facade incorporate high efficiency glazing throughout. The glazing performance serves to reduce the heat gain and heat loss at the building perimeter, which reduces the heating energy consumption.
- Envelope air tightness has been enhanced by approximately 50% over standard facades, leading to savings in heating and cooling energy consumption throughout the year, and optimising the potential for heat recovery.
- Passive Solar Gain allows solar gain to offset the perimeter heat loss in winter. The active building controls will automatically adjust the amount of heating in each zone, thereby reducing the energy demand of the heating system.
- LED lighting has been introduced to reduce both lighting input power and internal cooling loads.
- Overheating analysis has been conducted and this has led to the following features being incorporated to the lean building design:
  - High performance solar control on the facades that require it
  - Beneficial self-shading on the south facade from external terraces during peak summer conditions
  - Window recesses on the south-facing office façade as described above

Note: The commercial and residential elements of Templar House comply with Part L Criterion 3. The BRUKL and a sample of the SAP calculations have been included in Appendix A. Further to this, overheating analysis has been performed over and above the requirements of Part L: Criterion 3. This analysis has informed the façade design in order to minimise Templar House cooling loads.

The following improvements to the notional building fabric and lighting parameters were modelled to optimise passive design and minimise energy consumption.

## Lean Building: Residential Building

Treated Area (m<sup>2</sup>): 3369 m<sup>2</sup>

Opening Areas: 25% of total floor area

0.13 W/m<sup>2</sup>.K Roof U-Values: External Wall U-Values: 0.18 W/m<sup>2</sup>.K  $0.13 \text{ W/m}^2 \text{ K}$ Floor U-Values:

• Glazing U-values: 1.1 W/m<sup>2</sup>.K

• g-values: 0.4

• Thermal Mass: Medium  $(TMP = 250kJ/m^2K)$ 

Shading and orientation: Apartment specific
 Living Area: Apartment specific

Number of sheltered sides: Apartment specific
 Allowance for thermal bridging: y = 0.15 W/m<sup>2</sup>K

• Low energy light fittings: 100% of fixed outlets.

### Lean Building: Commercial Building

Area (m²): 16585 m²
Boiler Efficiency: 0.91
Specific Fan Power: 1.6 W/l/s
Roof U-Values: 0.18 W/m².K
Wall U-Values: 0.2 W/m².K
Glazing U-values: 1.49 W/m².K

• g-values (levels 1-9): 0.17

• g-values (levels 10-13): 0.15 total façade g-value including interstitial blinds

Lighting efficacy: 70 lumens/W (LED lighting throughout)
 Lighting control: Daylight dimming, manual-on-auto-off

#### Lean Site-wide Results

The following tables summarise the percentage improvements on 2013 Part L carbon emissions that are achieved by the lean building strategy described above. The results indicate that passive design features introduced to the residential building: like triple glazing and efficient lighting, provide a marginal reduction (6.4%) in carbon dioxide emissions. This is likely due to the fact that the notional building fabric performances specified by the Standard Assessment Procedure (SAP) are relatively efficient by current industry standards. Only moderate building fabric improvements are achievable against the notional building benchmark.

A greater reduction in carbon emissions (13.1%) is achieved by the commercial building, largely due to the introduction of LED lighting in the lean building model. LED lighting has been incorporated into the passive building design as it contributes to a twofold reduction in energy demand: both by limiting lighting power draw and internal heat gains.

Residential CO2 Emissions				
	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)			
	Regulated	Unregulated		
Baseline: Part L 2013 of	56.5	60.7		
the Building Regulations				
Compliant Development				
Passive design	52.9	60.7		
Regulated Carbon dioxide savings				
	Tonnes CO <sub>2</sub> per annum	% improvement		
Savings from demand	3.6	6.4%		
reduction	3.0	0.470		

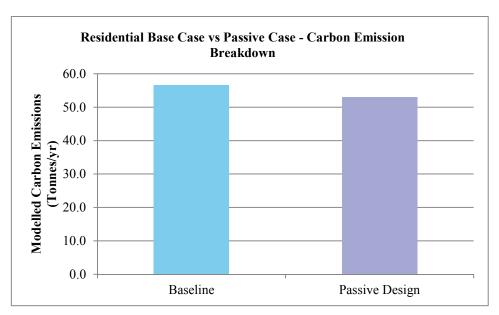


Figure 5 Residential reduction in carbon emissions

Commercial Building				
	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)			
	Regulated Unregulated			
Baseline: Part L 2013 of				
the Building Regulations	393.1	363.1		
Compliant Development				
Passive design	341.7	363.1		
Regulated Carbon dioxide savings				
	Tonnes CO <sub>2</sub> per annum	% improvement		
Savings from demand reduction	51.4	13.1%		

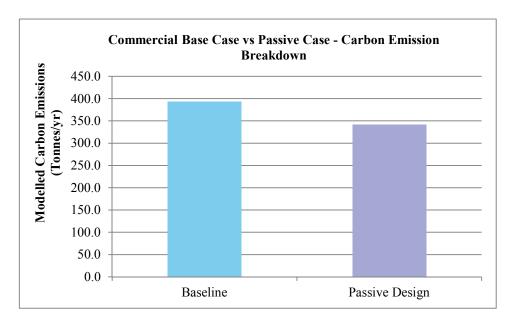


Figure 6 Commercial building reductions in carbon emissions

# 3.2 Energy Efficient Building Systems (Be Green)

The previous section indicates that passive design elements can achieve a valuable reduction in site wide carbon emissions at Templar House. To reduce carbon emissions further, the following improvements to internal fittings and plant performance were introduced:

- High efficiency air-cooled chillers have been specified to meet the commercial building's cooling requirements.
- High efficiency air handling plant with efficient thermal wheels have been specified for the commercial building.
- Daylight dimming has been incorporated in the commercial building's design.
- Low-flow sanitary fittings have been specified, to reduce the commercial and residential buildings' domestic hot water demand.
- A water-water heat pump system has been specified to recover waste heat from the commercial building to preheat domestic hot water in the residential building.

These measures will be implemented in the holistic approach to the design and will be used whenever appropriate. The following improvements to plant and equipment efficiencies were modelled in combination with the passive design features mentioned previously, to simulate the 'green' building's energy performance.

### **Green Building: Residential**

- Ventilation System: Balanced mechanical ventilation with heat recovery. MVHR SFP 0.72 W/l/s. Heat recovery efficiency 86%
- Air permeability: 2.5 m3/h per m2 of envelope area at 50Pa
- Extract Fans: local mechanical ventilation heat recovery unit.
- Main heating fuel (space and water): Air source heat pumps (ASHP)
- Heating system controls: Charging system linked to use, programmer and TRVs
- Hot water system\*: Air source heat pumps and gas fired boilers
- Space heating WWHP efficiency\*: 17% demand SCOP = 4
- Water heating WWHP efficiency\*: 22% demand SCoP = 4
- Water heating boiler efficiency: 93%
- Hot water cylinder: No storage within apartment
- Primary water heating losses: Fully insulated primary pipework.
- Water use limited to 125 litres per person per day: Yes
- Secondary space heating: None
- Low energy light fittings: 100% of fixed outlets.
- Cooling Efficiency: 4.86 (SEER)
- \*WWHP technology was simulated in NHER by ASHPs to approximate carbon offset benefits of the site-wide heat recovery system

### **Green Building: Commercial**

- Main Heating System: Gas fired boiler
- Main Cooling system: Air cooled chillers. Semi-hermetic, single screw compressor.

• Cooling Efficiency: 5.1 (SEER)

• Domestic hot water: Same as main heating system

• Heat recovery Efficiency: 0.8

#### Lean and Green Site-wide Results

The following tables summarise the percentage improvement on 2013 Part L carbon dioxide emissions that are generated by the lean and green building strategies described above.

Further to the carbon emission reductions achieved by passive design (detailed above), the introduction of efficient condensing gas fired boilers and the site wide heat recovery system are estimated to reduce the residential building carbon emissions by 8.2%.

The heat recovery system proposed for Templar House is especially suited because it capitalises on the complimentary heating and cooling profiles of the residential and commercial buildings. The high domestic hot water demand of the residential building provides a suitable heat sink to deliver waste heat that is rejected by the commercial building's cooling plant. A water-water heat pump will recover this waste energy to preheat domestic hot water and reduce the load on residential boilers. Buffer vessels at basement level store the recovered heat ready for use.

Energy simulations estimate the commercial building's carbon emissions to reduce by 1% due to the introduction of highly efficient air cooled chiller plant. This is a conservative figure and in practice, the carbon savings generated by efficient technology are expected to be greater, on account of the site-wide energy recovery system. The water-water heat pump technology which supplies waste heat from the office to preheat residential domestic hot water will have a residual benefit for the office cooling plant by reducing the chiller's heat rejection load. The lower chilled water return temperatures that are a residual benefit of the water-water heat recovery system improves the efficiency of chiller plant by reducing input power to the compressor and allowing the chiller to operate at more efficient part-load performance.

Since chilled water return temperatures fluctuate and dependent on the residential domestic hot water demand, a conservative modelling approach was adopted that did not simulate this residual efficiency uplift.

Energy efficient technologies, in combination with passive building design have enabled the 'lean and green' Templar House design to improve upon the Part L 2013 baseline by 14.1% for the residential building and 13.9% for the commercial building.

Residential Building				
	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)			
Regulated Unregulated				
Baseline: Part L 2013 of				
the Building Regulations	56.5	60.7		
Compliant Development				
Passive design	52.9	60.7		
Efficient technology	48.6	60.7		
Regulated Carbon dioxide savings				

	Tonnes CO <sub>2</sub> per annum	% improvement
Savings from demand reduction	3.6	6.4%
Savings from efficient technology	4.4	8.2%
Total Cumulative Savings	8	14.1%

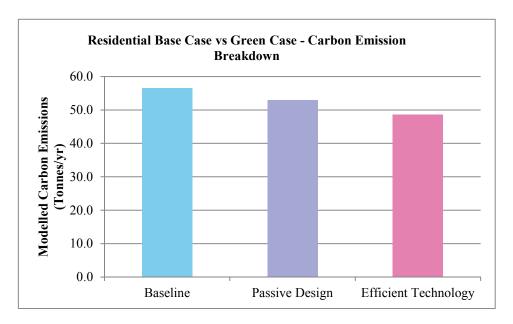


Figure 7 Residential building reduction in carbon emissions achieved through passive design and efficient technologies

Commercial Building				
	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)			
	Regulated	Unregulated		
Baseline: Part L 2013 of				
the Building Regulations	393.1	363.1		
Compliant Development				
Passive design	341.7	363.1		
Efficient technology	338.3	363.1		
Reg	ulated Carbon dioxide savin	ıgs		
	Tonnes CO <sub>2</sub> per annum	% improvement		
Savings from demand	51.4	13.1%		
reduction	31.4	13.170		
Savings from efficient	3.3	1.0%		
technology	3.3	1.070		
Total Cumulative Savings	54.7	13.9%		

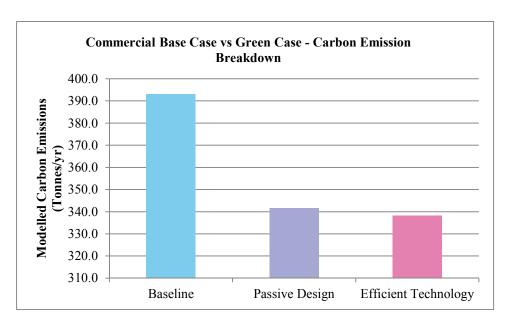


Figure 8 Commercial building reduction in carbon emissions achieved through passive design and efficient technology

## 3.2.1 Combined Heat and Power (CHP)

Combined heat and power generates electricity with the by-product of useful heat. Whenever the unit operates, grid-electricity is displaced while the heat-generated can be used either directly, stored for use later or converted into cooling through absorption chillers. The low carbon nature of the CHP plant is attributed to the generation of electricity on site (so incurring no transmission losses) and the use of heat which would ordinarily be lost to atmosphere.



Figure 9: Example CHP engine

The improvements to the buildings highlighted in the preceding section have led to a reduction in the requirements for both space heating and domestic hot water. The strategy for providing the heat required in the development follows the following hierarchy.

- Reduce the heating and domestic hot water requirements
- Utilisation of waste heat from the commercial building

- Provision of heat via high efficiency air source heat pumps
- Finally, provide high temperature hot water via efficient gas fire boilers.

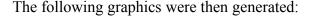
It should be borne in mind, therefore, that in any consideration of CHP, the hourly loads which may be expected would directly conflict with the 'waste' heat being provided by the commercial office. In turn this would drastically reduce the number of run hours of the CHP Unit.

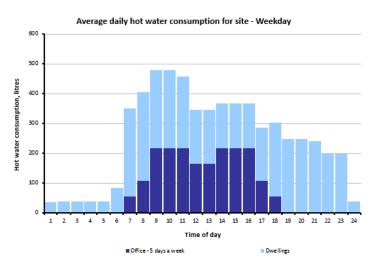
Section 10.25 of the GLA guidance on preparing energy assessments (April 2015), states 'there may be particular circumstances where CHP is justified in smaller mixed developments (e.g 350 units) where there is a more substantial non-domestic building space'. There are 48 apartments proposed for the Templar House residential demise and any CHP system designed to meet domestic hot water demand is expected to be very small. In spite of this, the scheme is mixed use with 16585m² of office to provide a consistent on-site energy demand which could be supplied by CHP if it were proven viable. As a result, the following feasibility assessment for a site-wide CHP energy centre at Templar House was conducted:

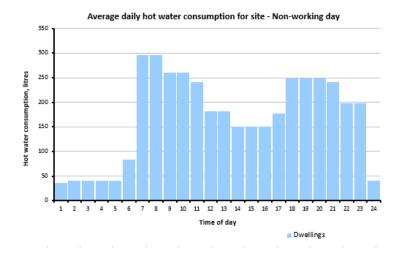
It is widely accepted that CHP should run for at least 4500 hours per year to be economically feasible. This means that the CHP system would need to running during the summer and therefore it is usual to size the system on the domestic hot water consumption. The daily profile of water use is not flat and therefore periods would occur when the CHP system is operating and there is more heat than required; the excess can be put in a thermal store for later use.

The number of days a typical office is occupied per annum is circa 253, with 104 days accounted as weekends and 8 days as bank holidays. Any consideration of CHP should therefore consider that for over 30% of the year, there is no heat requirement attributed to commercial premises.

For the Templar House site, an estimate of the likely hot water demand was made. The estimate of the residential domestic hot water requirement and its variation over 24-hours and weekends and weekdays was derived from *Becker*, *B.R.* and *K.E. Stogsdill*, 1990. "Development of Hot Water Use Data Base." ASHRAE Transactions, Vol.96, Part 2, pp. 422-427. Americal Society of Heating, Refrigerating. The office hot water requirement was derived from the Part L profiles assumed for offices.







An analysis of the suitable thermal capacity for the CHP unit was undertaken. Assuming that a CHP unit should operate for the longest time possible (for financial viability as cited earlier), a weekday running time of 17 hours was modelled. This led to a thermal capacity of the CHP to be 361 kWh/day divided by 17 leading to 21 kW<sub>th</sub>. To meet the demand on a non-working day, the 21 kW<sub>th</sub> unit would operate for a little under 10 hours per day. The total operating hours would be 5730 per annum.

The thermal capacity of circa 21 kW is incredibly small and would be based on a reciprocating engine. According to DECC's annually published data in the annual Digest of UK energy statistics (DUKES), Table 7D, the average electrical efficiency of reciprocating CHP is 25% and thermally 49%. If these values are used to calculate the primary energy savings and the associated carbon dioxide emissions with CHP, there is a net increase in CO<sub>2</sub> emissions for the use of such a small CHP unit and there are no primary energy savings. In line with the EU Directive on CHP, the employment of CHP for the Templar House Site would not meet the requirements of a 10% reduction in CO<sub>2</sub> and a positive primary energy saving.

It is therefore considered that CHP is not feasible for this development.

# 3.2.2 District Heating networks

At the time of compiling this report, there is currently no district heating network to which the proposed development could connect immediately.

Inquiries have been made to the operators of the Citigen district heating network, which was initially regarded as a feasible energy source due to its proximity to the Templar House site. The team have subsequently been advised that connection to the Citigen network would not be a feasible solution due to the size of the scheme and technical complexities in extending the network further west beyond Farringdon Road. This correspondence has been provided in Appendix B.

In order to future proof the scheme, capped pipe work would be installed to the boundary of the site to facilitate connection to any future, low carbon district heating source. Therefore, if the Citigen network were ever extended or an alternative network became available within close proximity to the site, we would commit to connecting to it.

The entire basement of the site is occupied by plant and this will also constitute the location of the centralised site-wide energy system. The diagram below indicates potential locations for any future district heating connections.

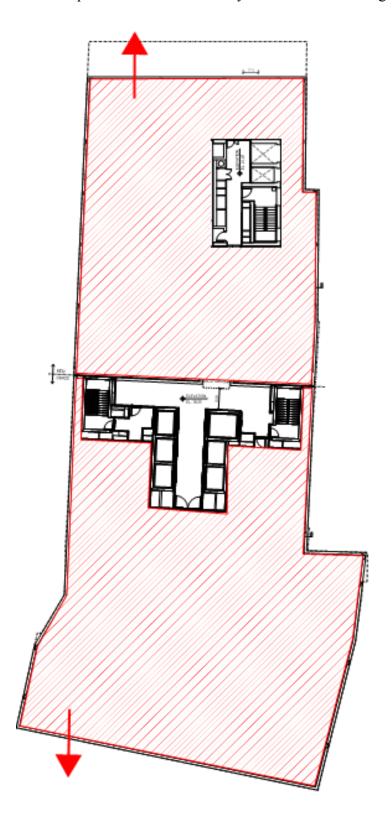


Figure 10 Site-wide energy centre with future connection to district heating scheme

# 3.3 Renewable energy technologies (Be Clean)

There are many technologies which generate energy from renewable resources. Here follows a list of commercially viable, proven technologies in the UK:

- Large scale wind (greater than 100 kW) turbines
- Small scale wind turbines
- Hydro electric
- Photovoltaics
- Solar thermal for hot water
- Biomass heating
- Ground source heating and cooling
- Air source heating and cooling

Some of the above can be discounted immediately, such as hydro-electric as there are no rivers on the site.

The technologies that have been considered are as follows:

### **Wind Turbines**

Wind turbines harness the kinetic energy in the wind and convert this to electrical energy through a mechanical turbine. The efficacy of wind turbines depends heavily on the (i) wind speed and (ii) the swept area of the turbine's blades.

In the urban environment, wind is generally very turbulent owing to the buildings obstructing its path; this leads to low, 'gusty' wind speeds. Large scale wind turbines need a considerable wind speed to even start operating, while smaller machines can cope with lower 'start up' speeds.

The physical constraints of the site preclude the use of large-scale wind turbines as these should be mounted on the ground; in addition, the wind speed is not suitable for such machines.

Small-scale wind turbines have been employed in the urban environment in recent years. Studies have indicated however that their performance is very poor unless they are sited well above the surrounding buildings. In the case of the proposed building, the roof-space is constrained and the area that is available to renewable energy infrastructure is considered more suited to PV installations; additionally, wind turbines would not enhance the building visually and contribute virtually no energy to the development.

It is therefore deemed that wind turbines are not feasible for this project.

# **Photovoltaics (PV)**

Photovoltaics are semiconductors which convert incident sunlight into electricity. They are an excellent technology in the urban-context; there are many roofs in London which are ideal for PV.

Key to the efficacy of PV is shading. If shading occurs on an individual module, the electrical output of the whole array is reduced. This tends to mean that the optimum siting of modules should be completely un-shaded. Where this is unavoidable, bespoke electrical wiring can be made to arrays to ensure that the maximum output can be achieved even when particular modules are shaded.

The majority of plant and equipment at Templar House is housed at basement level, which has made space at roof level available for photovoltaic installations. The roof areas are generally not shaded by the surrounding buildings.

It is therefore deemed that photovoltaics are feasible for this project.

## Solar thermal for hot water

Solar panels can be used to good effect to raise the temperature of water when the sun shines. Both flat plate and evacuated tubes are available in the UK and there are many installation examples.

Flat panels should be orientated towards the sun and inclined at a suitable angle which is driven by the hot water requirement of a building. Evacuated tubes can be rotated to optimise the efficiency and therefore are able to be mounted at almost any angle.

While there could be space at roof level made available for a solar thermal array, it is believed that PV installations would provide a greater carbon offset benefit for the site. Low-grade heat is already generated by air-source heat pumps and the site-wide heat recovery system. A third heating system would add further complication to system controls with little returns in energy savings.

It is therefore suggested that solar thermal is not feasible for this project.

# **Biomass Heating**

Biomass heating tends to use woodchip or wood pellets as a fuel source. These are then combusted at high efficiency to generate heat.

The heat loads for the proposed development are not expected to be large enough to make biomass heating a feasible option. In addition to this, combustion of biomass in a location such as Templar House will inevitably lead to a degradation in air quality – indeed, recent publications from the Mayor of London's office advise that biomass installations below 500 kW thermal capacity should not be considered. Added to this would be the delivery of biomass to the site and the storage thereof; both of which are not favourable for Templar House.

It is deemed therefore that biomass heating is not feasible for the project.

# Ground source heating and cooling

There is much debate as to whether this technology should really be considered "renewable" as electricity is still required to operate the components constituting a heat pump. That said, the technology does indeed utilise temperature differentials owing directly to the sun.

There a number of ways in which the ground can be used: horizontal pipes in the ground; vertical boreholes, and; putting the pipe work in piles. In all cases, the system is closed and the working fluid is pumped around. Open loop systems tend to use an aquifer deep underground to act as a heat sink; this technology is not widely used in the UK and various trial installations in London are not performing as designed.

In London, the ground make-up is such that clay is found in the tens of metres under the surface; unfortunately clay does not allow for the dissipation of heat effectively as it does not allow the free movement of water. If heat cannot be effectively moved, the use of heat pumps should be such that the net heat which is extracted and re-introduced to the ground over a year is equal i.e. the amount of heating and cooling supplied by the technology should be equal.

Templar House does have complimentary heating and cooling demands that could suit heat pump technology, although an air-source option is considered more appropriate due to the constraints of the site.

# Air-source heating

The Greater London Authority recognises air source heat pumps as a renewable energy source, as these systems operate by receiving and rejecting heat from the surrounding air.

A gas supply will not be provided to the residential building due to site restrictions. This, as well as the need for individual metering of tenant utilities, has led to the provision of heat pumps to undertake heating and cooling within the residential building.

Air source heat pump technologies are deemed feasible for Templar House.

## 3.3.1 Photovoltaic system sizing

Roof areas above both the residential and commercial buildings that are not occupied by mechanical plant or BMU equipment have been designated for PV. These PV areas are favourably orientated, not shaded significantly by surrounding buildings and do not detract from the architectural vision for the development as they will not interrupt townscape views. The area proposed is 150 m² of active PV area. This equates to approximately 250m2 of total PV area, including access and spacing to prevent self-shading.

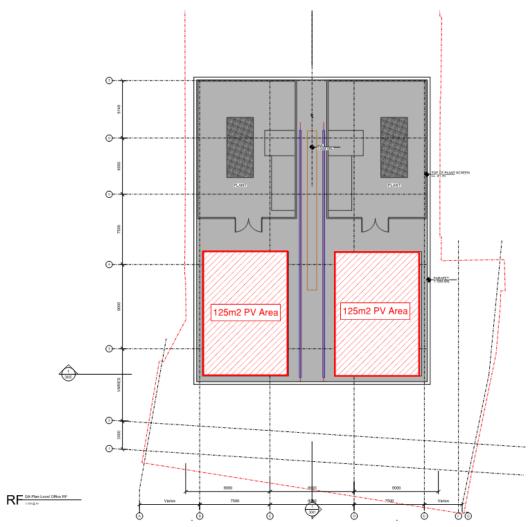


Figure 10 Roof plan showing location of photovoltaics

At Templar House, a suitable area has been designated for PV which (i) maintains the architectural vision and (ii) is un-shaded all year round. Based on the indicative PV areas outlined above, the likely carbon dioxide savings for the site would be approximately 8.3 tonnes per annum. The precise value will depend on the technology-selected and the balance of system components.

The following tables summarise the percentage improvement on 2013 Part L carbon dioxide emissions that are generated by the lean, green and clean building strategies described above.

Residential Building				
	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)			
	Regulated	Unregulated		
Baseline: Part L 2013 of				
the Building Regulations	56.5	60.7		
Compliant Development				
Passive design	52.9	60.7		
Efficient technology	48.6	60.7		
Renewable Energy	38.2	60.7		
Regulated Carbon dioxide savings				
	Tonnes CO <sub>2</sub> per annum	% improvement		

Savings from demand reduction	3.6	6.4%
Savings efficient technology	4.4	8.2%
Savings from renewable energy	10.4	21.5%
Total Cumulative Savings	18.4	32.5%

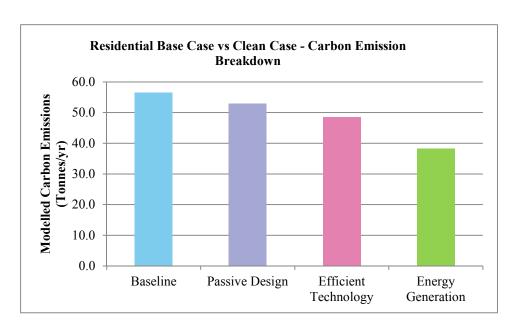


Figure 11 Residential building reduction in carbon emissions achieved through passive design, efficient technologies and on-site energy generation

Commercial Building								
	Carbon dioxide emissions (	Tonnes CO <sub>2</sub> per annum)						
	Regulated	Unregulated						
Baseline: Part L 2013 of	393.1	363.1						
the Building Regulations								
Compliant Development								
Passive design	341.7	363.1						
Efficient technology	338.3	363.1						
Renewable Energy	330.0	363.1						
Reg	gulated Carbon dioxide savin	gs						
Tonnes CO <sub>2</sub> per annum % improvement								
Savings from demand	51.4	13.1%						
reduction								
Savings from efficient	3.3	1.0%						
technology								
Savings from renewable	8.3	2.5%						
energy								
Total Cumulative Savings	63.0	16.0%						

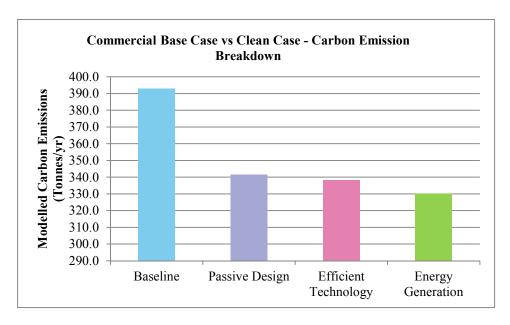


Figure 12 Commercial building reductions in carbon emissions achieved through passive design, efficient technologies and onsite energy generation

#### 3.3.2 Clean Conclusion

Of the renewable technologies available, photovoltaics for the commercial building and a combination of photovoltaics and air source heat pumps for the residential building are considered the most practical and feasible. In addition to this, a site wide energy system which uses water-water heat pumps to recover energy rejected from the commercial building's cooling plant to preheat residential domestic hot water is proposed. It is estimated that approximately 18.7 tonnes of CO<sub>2</sub> could be abated on-site by the renewable technologies and 7.7 tonnes of CO<sub>2</sub> by the introduction of efficient technologies like air cooled chillers. In total, the energy efficient strategy is able to achieve an 18.1% reduction in carbon emissions against the Part L 2013 baseline.

Commercial and Residential CO2 Emissions							
	Carbon dioxide emissions (	Tonnes CO <sub>2</sub> per annum)					
	Regulated	Unregulated					
Baseline: Part L 2013 of							
the Building Regulations	449.6	423.7					
Compliant Development							
Passive Design	394.6	423.7					
Efficient Technology	386.9	423.7					
Energy Generation	368.2	423.7					
Reg	ulated Carbon dioxide savin	gs					
	Tonnes CO <sub>2</sub> per annum	% improvement					
Savings from demand	55.0	12.2%					
reduction	33.0	12.270					
Savings from air cooled							
chillers and site-wide heat	7.7	1.9%					
recovery							

Savings from renewable energy	18.7	4.8%
Total Cumulative Savings	81.4	18.1%

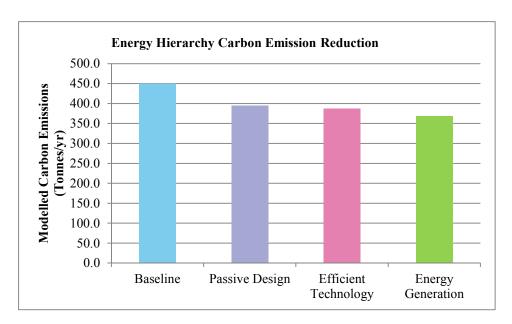


Figure 13 Commercial and residential reduction in carbon emissions achieved through passive design, efficient technologies and onsite energy generation

# 4 Conclusion

Templar House aims to be as energy efficient as practicable and generate its own energy where this is feasible. The location and nature of the development will naturally lead to certain energy requirements which cannot be avoided such as lighting, heating and cooling.

Templar House was modelled using Government-approved software and the notional building Target Emission Rates were calculated for each building. Energy efficiency measures were employed for each building, and all available renewable energy technologies were considered.

Photovoltaic modules across the site and air source heat pumps serving the residential building space heating and domestic hot water were found to be the most feasible renewable technologies. In addition to this a water to water heat pump system that recovers waste heat from the commercial building's cooling system to preheat residential domestic hot water is the preferred site-wide energy strategy. CHP and CCHP were deemed to be unfeasible, although capped pipework to the site boundary would be in place such that a future connection to the district heating and cooling could be facilitated.

The energy efficiency measures and renewable energy technologies lead to a combined 18.1% improvement in regulated carbon dioxide emissions for the commercial and residential areas, above Part L 2013 requirements. This equates to a 17.1% improvement across the Templar House site including baseline retail emissions. This is considered the maximum feasible and viable reduction within the constraints of the site and its location.

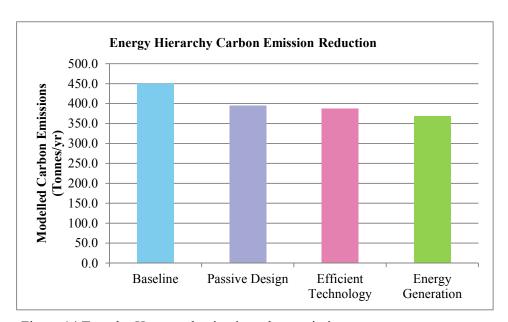


Figure 14 Templar House reduction in carbon emissions

# 5 Appendices

# 5.1 Appendix A – BRUKL Report and Sample SAP

# 



Compliance with England Building Regulations Part L 2013

## Project name

# **Templar House**

As designed

Date: Tue Jul 14 17:29:00 2015

#### Administrative information

**Building Details** 

Address: High Holborn, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2 BRUKL compliance check version: v5.2.b.1

#### **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 CO₂ emission rate for the building should not exceed the target

1.1	CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum	23.7
1.2	Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	23.7
1.3	Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	20.6
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	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 which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

#### 2.a Building fabric

Element	<b>U</b> a-Limit	U <sub>a-Calc</sub>	U <sub>i-Calc</sub>	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	LV000000:Surf[1]
Floor	0.25	0.2	0.2	LV000000:Surf[0]
Roof	0.25	0.18	0.18	LV000001:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.36	1.49	LV00000C:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
Ua-Limit = Limiting area-weighted average U-values [W Ua-Calc = Calculated area-weighted average U-values			Ui-Calc = C	alculated maximum individual element U-values [W/(m²K)]

<sup>\*</sup> There might be more than one surface where the maximum U-value occurs.

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 <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa	10	3				

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

<sup>\*\*\*</sup> Display windows and similar glazing are excluded from the U-value check.

#### 2.b 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- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency				
This system	0.91	2.7	0	1.6	0.65				
Standard value	0.91*	2.7	N/A	1.6	0.65				
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.									

<sup>&</sup>quot;No HWS in project, or hot water is provided by HVAC system"

#### Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
Α	Local supply or extract ventilation units serving a single area
В	Zonal supply system where the fan is remote from the zone
С	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
Е	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
Н	Fan coil units
1	Zonal extract system where the fan is remote from the zone with grease filter

Zone name		SFP [W/(I/s)]							UD officiency		
ID of system type	Α	В	С	D	E	F	G	Н	ı	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
G Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A

Standard value         A         B         C         D         E         F         G         H         I           L2 P8         -         -         -         -         0.4         -         -         1.6         -         -           L2 Central         -         -         -         0.4         -         -         1.6         -         -           L3 P1         -         -         -         0.4         -         -         1.6         -         -         -           L3 P2         -         -         0.4         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -         -         1.6         -         -	N/A
L2 P8       -       -       -       0.4       -       -       1.6       -       -         L2 Central       -       -       -       0.4       -       -       1.6       -       -         L3 P1       -       -       -       0.4       -       -       1.6       -       -         L3 P2       -       -       -       0.4       -       -       1.6       -       -         L3 P3       -       -       -       0.4       -       -       1.6       -       -         L3 P4       -       -       0.4       -       -       1.6       -       -         L3 P5       -       -       -       0.4       -       -       1.6       -       -         L3 P6       -       -       -       0.4       -       -       1.6       -       -         L3 P7       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L4 P1       -       -       0.4       -	N/A
L2 Central       -       -       -       0.4       -       -       1.6       -       -         L3 P1       -       -       -       0.4       -       -       1.6       -       -         L3 P2       -       -       0.4       -       -       1.6       -       -         L3 P3       -       -       0.4       -       -       1.6       -       -         L3 P4       -       -       0.4       -       -       1.6       -       -         L3 P5       -       -       0.4       -       -       1.6       -       -         L3 P6       -       -       0.4       -       -       1.6       -       -         L3 P7       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L4 P1       -       -       0.4       -       -       1.6       -       -         L4 P2       -       -       0.4       -       -       1.6       -       -	N/A
L3 P1       -       -       -       0.4       -       -       1.6       -       -         L3 P2       -       -       -       0.4       -       -       1.6       -       -         L3 P3       -       -       -       0.4       -       -       1.6       -       -         L3 P4       -       -       -       0.4       -       -       1.6       -       -         L3 P5       -       -       -       0.4       -       -       1.6       -       -         L3 P6       -       -       -       0.4       -       -       1.6       -       -         L3 P7       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L3 Central       -       -       0.4       -       -       1.6       -       -         L4 P1       -       -       -       0.4       -       -       1.6       -       -         L4 P2       -       -       0.4       -	N/A N/A N/A N/A N/A N/A N/A N/A N/A
L3 P2       -       -       -       0.4       -       -       1.6       -       -         L3 P3       -       -       -       0.4       -       -       1.6       -       -         L3 P4       -       -       -       0.4       -       -       1.6       -       -         L3 P5       -       -       -       0.4       -       -       1.6       -       -         L3 P6       -       -       -       0.4       -       -       1.6       -       -         L3 P7       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L4 P1       -       -       0.4       -       -       1.6       -       -         L4 P2       -       -       -       0.4       -       -       1.6 </td <td>N/A N/A N/A N/A N/A N/A</td>	N/A N/A N/A N/A N/A N/A
L3 P3       -       -       -       0.4       -       -       1.6       -       -         L3 P4       -       -       -       0.4       -       -       1.6       -       -         L3 P5       -       -       0.4       -       -       1.6       -       -         L3 P6       -       -       0.4       -       -       1.6       -       -         L3 P7       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L3 Central       -       -       0.4       -       -       1.6       -       -         L4 P1       -       -       0.4       -       -       1.6       -       -         L4 P2       -       -       0.4       -       -       1.6       -       -         L4 P3       -       -       0.4       -       -       1.6       -       -         L4 P4       -       -       0.4       -       -       1.6       -       -	N/A N/A N/A N/A N/A N/A
L3 P4       -       -       -       0.4       -       -       1.6       -       -         L3 P5       -       -       -       0.4       -       -       1.6       -       -         L3 P6       -       -       0.4       -       -       1.6       -       -         L3 P7       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       0.4       -       -       1.6       -       -         L3 Central       -       -       0.4       -       -       1.6       -       -         L4 P1       -       -       0.4       -       -       1.6       -       -         L4 P2       -       -       0.4       -       -       1.6       -       -         L4 P3       -       -       0.4       -       -       1.6       -       -         L4 P4       -       -       0.4       -       -       1.6       -       -	N/A N/A N/A N/A
L3 P5 L3 P6 L3 P7 L3 P8	N/A N/A N/A N/A
L3 P6 L3 P7	N/A N/A N/A
L3 P7       -       -       -       0.4       -       -       1.6       -       -         L3 P8       -       -       -       0.4       -       -       1.6       -       -         L3 Central       -       -       0.4       -       -       1.6       -       -         L4 P1       -       -       -       0.4       -       -       1.6       -       -         L4 P2       -       -       -       0.4       -       -       1.6       -       -         L4 P3       -       -       0.4       -       -       1.6       -       -         L4 P4       -       -       -       0.4       -       -       1.6       -       -         L4 P5       -       -       0.4       -       -       1.6       -       -         L4 P6       -       -       0.4       -       -       1.6       -       -         L4 P8       -       -       0.4       -       -       1.6       -       -         L4 P8       -       -       0.4       -       -       1.6 <t< td=""><td>N/A N/A</td></t<>	N/A N/A
L3 P8 L3 Central	N/A
L3 Central  L4 P1	
L4 P1       -       -       -       0.4       -       -       1.6       -       -         L4 P2       -       -       -       0.4       -       -       1.6       -       -         L4 P3       -       -       -       0.4       -       -       1.6       -       -         L4 P4       -       -       -       0.4       -       -       1.6       -       -         L4 P5       -       -       -       0.4       -       -       1.6       -       -         L4 P6       -       -       -       0.4       -       -       1.6       -       -         L4 P7       -       -       -       0.4       -       -       1.6       -       -         L4 P8       -       -       -       0.4       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       -       1.6       -       -         L5 P3       -<	NI/A
L4 P2       -       -       -       0.4       -       -       -       1.6       -       -         L4 P3       -       -       -       0.4       -       -       -       1.6       -       -         L4 P4       -       -       -       0.4       -       -       1.6       -       -         L4 P5       -       -       -       0.4       -       -       1.6       -       -         L4 P6       -       -       -       0.4       -       -       1.6       -       -         L4 P7       -       -       0.4       -       -       1.6       -       -         L4 P8       -       -       0.4       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       -       1.6       -       -         L5 P3       -<	N/A
L4 P3       -       -       -       0.4       -       -       -       1.6       -       -         L4 P4       -       -       -       0.4       -       -       1.6       -       -         L4 P5       -       -       -       0.4       -       -       1.6       -       -         L4 P6       -       -       -       0.4       -       -       1.6       -       -         L4 P7       -       -       -       0.4       -       -       1.6       -       -         L4 P8       -       -       -       0.4       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       -       1.6       -       -         L5 P3       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L4 P3       -       -       -       0.4       -       -       1.6       -       -         L4 P4       -       -       -       0.4       -       -       1.6       -       -         L4 P5       -       -       -       0.4       -       -       1.6       -       -         L4 P6       -       -       -       0.4       -       -       1.6       -       -         L4 P7       -       -       -       0.4       -       -       -       1.6       -       -         L4 P8       -       -       -       0.4       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L4 P4       -       -       -       0.4       -       -       1.6       -       -         L4 P5       -       -       -       0.4       -       -       1.6       -       -         L4 P6       -       -       -       0.4       -       -       1.6       -       -         L4 P7       -       -       -       0.4       -       -       1.6       -       -         L4 P8       -       -       -       0.4       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       1.6       -       -         L5 P3       -       -       -       0.4       -       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       -       1.6       -       -         L5 P5<	N/A
L4 P5       -       -       -       0.4       -       -       -       1.6       -       -         L4 P6       -       -       -       0.4       -       -       1.6       -       -         L4 P7       -       -       -       0.4       -       -       1.6       -       -         L4 P8       -       -       -       0.4       -       -       1.6       -       -         L4 Central       -       -       0.4       -       -       1.6       -       -         L5 P1       -       -       0.4       -       -       1.6       -       -         L5 P2       -       -       0.4       -       -       1.6       -       -         L5 P3       -       -       0.4       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       1.6       -       -         L5 P5       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L4 P6       -       -       -       0.4       -       -       -       1.6       -       -         L4 P7       -       -       -       0.4       -       -       -       1.6       -       -         L4 P8       -       -       -       0.4       -       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       1.6       -       -         L5 P3       -       -       -       0.4       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       -       1.6       -       -         L5 P5       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L4 P7       -       -       -       0.4       -       -       -       1.6       -       -         L4 P8       -       -       -       0.4       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       1.6       -       -         L5 P3       -       -       -       0.4       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       1.6       -       -         L5 P5       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L4 P8       -       -       -       0.4       -       -       -       1.6       -       -         L4 Central       -       -       -       0.4       -       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       -       1.6       -       -         L5 P3       -       -       -       0.4       -       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       -       1.6       -       -         L5 P5       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L4 Central       -       -       -       0.4       -       -       -       1.6       -       -         L5 P1       -       -       -       0.4       -       -       -       1.6       -       -         L5 P2       -       -       -       0.4       -       -       1.6       -       -         L5 P3       -       -       -       0.4       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       1.6       -       -         L5 P5       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L5 P1	N/A
L5 P2       -       -       -       0.4       -       -       -       1.6       -       -         L5 P3       -       -       -       0.4       -       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       -       1.6       -       -         L5 P5       -       -       0.4       -       -       -       1.6       -       -	N/A
L5 P3       -       -       -       0.4       -       -       -       1.6       -       -         L5 P4       -       -       -       0.4       -       -       -       1.6       -       -         L5 P5       -       -       -       0.4       -       -       -       1.6       -       -	N/A
L5 P4 0.4 1.6 L5 P5 0.4 1.6	N/A
L5 P5 0.4 1.6	N/A
	N/A
L5 P6	N/A
L5 P7 0.4 1.6	N/A
L5 P8 0.4 1.6	N/A
L5 Central 0.4 1.6	N/A
L6 P1 0.4 1.6	N/A
L6 P2 0.4 1.6	N/A
L6 P3 0.4 1.6	N/A
L6 P4 0.4 1.6	N/A
L6 P5 0.4 1.6	N/A
L6 P6 0.4 1.6	N/A
L6 P7 0.4 1.6	N/A
L6 P8 0.4 1.6	N/A
L6 Central 0.4 1.6	N/A
L6 Core 0.4 1.6	N/A
L5 Core	N/A
L4 Core 0.4 1.6	N/A
L3 Core 0.4 1.6	
L2 Core 0.4 1.6	N/A

Zone name	SFP [W/(I/s)]							HR efficiency			
ID of system type	Α	В	С	D	E	F	G	Н	I	ппе	eniciency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L7 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P2	-	ļ_	ļ_	0.4	-	-	-	1.6	-	-	N/A
L9 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
podium level 1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P4	-	_	-	0.4	-	_	_	1.6	_	-	N/A
L12 Core	_	_	_	0.4	_	_	_	1.6	_	_	N/A
L12 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
LILIZ				0.4				1.0			13/74

Zone name		SFP [W/(I/s)]				HR efficiency					
ID of system type	Α	В	С	D	E	F	G	Н	I	пке	miciency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L12 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
G Office Lobby Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
G Office Lobby P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A

General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
G Core	70	-	-	2211
L1 Core	70	-	-	2185
L1 P1	70	-	-	902
L1 P2	70	-	-	773
L1 P3	70	-	-	378
L1 P4	70	-	-	437
L1 P5	70	-	-	410
L1 P6	70	-	-	1477
L1 P7	70	-	-	242
L1 P8	70	-	-	423
L1 Central	70	-	-	3210
L2 P1	70	-	-	902
L2 P2	70	-	-	773
L2 P3	70	-	-	378
L2 P4	70	-	-	437
L2 P5	70	-	-	410
L2 P6	70	-	-	1477
L2 P7	70	-	-	242
L2 P8	70	-	-	423
L2 Central	70	-	-	3210
L3 P1	70	-	-	902
L3 P2	70	-	-	773
L3 P3	70	-	-	378
L3 P4	70	-	-	437
L3 P5	70	-	-	410
L3 P6	70	-	-	1477
L3 P7	70	-	-	242
L3 P8	70	-	-	423

General lighting and display lighting	Lumino	ous effic			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W	
Standard value	60	60	22		
L3 Central	70	-	-	3210	
L4 P1	70	-	-	902	
L4 P2	70	-	-	773	
L4 P3	70	-	-	378	
L4 P4	70	-	-	437	
L4 P5	70	-	-	410	
L4 P6	70	-	-	1477	
L4 P7	70	-	-	242	
L4 P8	70	-	-	423	
L4 Central	70	-	-	3210	
L5 P1	70	-	-	902	
L5 P2	70	-	-	773	
L5 P3	70	-	-	378	
L5 P4	70	-	-	437	
L5 P5	70	-	-	410	
L5 P6	70	-	-	1477	
L5 P7	70	-	-	242	
L5 P8	70	-	-	423	
L5 Central	70	-	-	3210	
L6 P1	70	-	-	902	
L6 P2	70	-	-	773	
L6 P3	70	-	-	378	
L6 P4	70	-	-	437	
L6 P5	70	-	-	410	
L6 P6	70	-	-	1477	
L6 P7	70	-	-	242	
L6 P8	70	-	-	423	
L6 Central	70	-	-	3210	
L6 Core	70	-	-	2161	
L5 Core	70	-	-	2161	
L4 Core	70	-	-	2161	
L3 Core	70	-	-	2161	
L2 Core	70	-	-	2161	
L7 Core	70	-	-	2161	
L7 P1	70	-	-	902	
L7 P2	70	-	-	771	
L7 P3	70	-	-	195	
L7 P4	70	-	-	731	
L7 P5	70	-	-	423	
L7 P6	70	-	-	231	
L7 Central	70	-	-	2789	
L7 P7	70	-	-	1412	
L8 Core	70	-	-	2161	
<u></u>	1		I	I - · - ·	

eneral lighting [W]
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:1
'89
12
61
2
5
1
3
1
789
12
i02
30
'9
577
4
38
'36
802
30
'9
577
'4
38
02
30
9
77
'4
38
02
30
'9
577
'4
38

General lighting and display lighting	Lumino	us effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
G Office Lobby P1	70	-	-	476

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

G Core	Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L1 P1	G Core	N/A	N/A
L1 P2	L1 Core	N/A	N/A
L1 P3	L1 P1	NO (-89.6%)	NO
L1 P4	L1 P2	NO (-88.5%)	NO
Li P5	L1 P3	NO (-98.3%)	NO
Li   P6	L1 P4	NO (-99.1%)	NO
L1 P7 NO (-96.1%) NO L1 P8 NO (-97.5%) NO L1 Central NO (-97.5%) NO L2 P1 NO (-89.4%) NO L2 P2 NO (-87.9%) NO L2 P3 NO (-98.3%) NO L2 P4 NO (-99.1%) NO L2 P6 NO (-81.5%) NO L2 P7 NO (-96.7%) NO L2 P8 NO (-97.7%) NO L2 P8 NO (-97.6%) NO L3 P1 NO (-98.8%) NO L3 P1 NO (-98.8%) NO L3 P2 NO (-98.8%) NO L3 P2 NO (-98.9%) NO L3 P2 NO (-98.9%) NO L3 P3 NO (-98.9%) NO L3 P3 NO (-98.9%) NO L3 P4 NO (-99.1%) NO L3 P6 NO (-97.4%) NO L3 P7 NO (-98.8%) NO L3 P8 NO (-97.9%) NO L3 P6 NO (-97.9%) NO L3 P7 NO (-98.8%) NO L3 P8 NO (-97.4%) NO L4 P1 NO (-88.4%) NO L4 P2 NO (-88.4%) NO L4 P2 NO (-88.4%) NO L4 P4 NO (-98.8%) NO L4 P6 NO (-97.9%) NO L4 P6 NO (-97.9%) NO L4 P6 NO (-98.8%) NO L4 P6 NO (-98.8%) NO L4 P7 NO (-98.8%) NO L4 P8 NO (-97.9%) NO	L1 P5	NO (-97.2%)	NO
L1 P8         NO (-97.5%)         NO           L1 Central         NO (-97.3%)         NO           L2 P1         NO (-88.4%)         NO           L2 P2         NO (-87.9%)         NO           L2 P3         NO (-99.1%)         NO           L2 P4         NO (-99.1%)         NO           L2 P5         NO (-97.7%)         NO           L2 P6         NO (-81.5%)         NO           L2 P7         NO (-96.7%)         NO           L2 P8         NO (-97.6%)         NO           L3 P1         NO (-97.4%)         NO           L3 P2         NO (-88%)         NO           L3 P2         NO (-88%)         NO           L3 P3         NO (-98.1%)         NO           L3 P4         NO (-99.8%)         NO           L3 P5         NO (-97.3%)         NO           L3 P6         NO (-77.9%)         NO           L3 P7         NO (-96.2%)         NO           L3 P8         NO (-97.4%)         NO           L3 P8         NO (-97.4%)         NO           L4 P1         NO (-98.4%)         NO           L4 P2         NO (-98.4%)         NO           L4 P3         <	L1 P6	NO (-81.2%)	NO
L1 Central         NO (-97.3%)         NO           L2 P1         NO (-89.4%)         NO           L2 P2         NO (-87.9%)         NO           L2 P3         NO (-98.3%)         NO           L2 P4         NO (-99.1%)         NO           L2 P5         NO (-97.7%)         NO           L2 P6         NO (-81.5%)         NO           L2 P7         NO (-96.7%)         NO           L2 P8         NO (-97.6%)         NO           L2 Central         NO (-97.4%)         NO           L3 P1         NO (-89.2%)         NO           L3 P2         NO (-88.92%)         NO           L3 P3         NO (-98.1%)         NO           L3 P4         NO (-99%)         NO           L3 P5         NO (-99.1%)         NO           L3 P6         NO (-77.9%)         NO           L3 P7         NO (-96.2%)         NO           L3 P8         NO (-97.4%)         NO           L4 P1         NO (-98.4%)         NO           L4 P2         NO (-97.1%)         NO           L4 P2         NO (-96.9%)         NO           L4 P3         NO (-96.9%)         NO           L4 P6	L1 P7	NO (-96.1%)	NO
L2 P1         NO (-89.4%)         NO           L2 P2         NO (-87.9%)         NO           L2 P3         NO (-98.3%)         NO           L2 P4         NO (-99.1%)         NO           L2 P5         NO (-97.7%)         NO           L2 P6         NO (-81.5%)         NO           L2 P7         NO (-96.7%)         NO           L2 P8         NO (-97.6%)         NO           L2 Central         NO (-97.4%)         NO           L3 P1         NO (-89.2%)         NO           L3 P2         NO (-86%)         NO           L3 P3         NO (-98.1%)         NO           L3 P4         NO (-99.9%)         NO           L3 P5         NO (-97.3%)         NO           L3 P6         NO (-77.9%)         NO           L3 P7         NO (-96.2%)         NO           L3 P8         NO (-97.4%)         NO           L3 P8         NO (-97.4%)         NO           L4 P1         NO (-98.4%)         NO           L4 P2         NO (-98.4%)         NO           L4 P3         NO (-96.8%)         NO           L4 P6         NO (-96.9%)         NO           L4 P6	L1 P8	NO (-97.5%)	NO
L2 P2         NO (-87.9%)         NO           L2 P3         NO (-98.3%)         NO           L2 P4         NO (-99.1%)         NO           L2 P5         NO (-97.7%)         NO           L2 P6         NO (-81.5%)         NO           L2 P7         NO (-96.7%)         NO           L2 P8         NO (-97.6%)         NO           L2 P8         NO (-97.4%)         NO           L2 Central         NO (-97.4%)         NO           L3 P1         NO (-88.92%)         NO           L3 P2         NO (-86%)         NO           L3 P3         NO (-98.1%)         NO           L3 P4         NO (-99.81%)         NO           L3 P5         NO (-97.3%)         NO           L3 P6         NO (-97.3%)         NO           L3 P7         NO (-97.9%)         NO           L3 P8         NO (-97.4%)         NO           L3 P8         NO (-97.4%)         NO           L4 P1         NO (-88.4%)         NO           L4 P2         NO (-88.4%)         NO           L4 P3         NO (-97.7%)         NO           L4 P5         NO (-96.9%)         NO           L4 P6	L1 Central	NO (-97.3%)	NO
L2 P3         NO (-98.3%)         NO           L2 P4         NO (-99.1%)         NO           L2 P5         NO (-97.7%)         NO           L2 P6         NO (-81.5%)         NO           L2 P7         NO (-96.7%)         NO           L2 P8         NO (-97.6%)         NO           L2 Central         NO (-97.4%)         NO           L3 P1         NO (-89.2%)         NO           L3 P2         NO (-86%)         NO           L3 P3         NO (-98.1%)         NO           L3 P4         NO (-99%)         NO           L3 P5         NO (-97.3%)         NO           L3 P6         NO (-77.9%)         NO           L3 P7         NO (-96.2%)         NO           L3 P8         NO (-97.4%)         NO           L3 Central         NO (-97.4%)         NO           L4 P1         NO (-88.4%)         NO           L4 P2         NO (-82.1%)         NO           L4 P3         NO (-97.7%)         NO           L4 P4         NO (-98.8%)         NO           L4 P5         NO (-96.9%)         NO           L4 P6         NO (-95.3%)         NO           L4 P8	L2 P1	NO (-89.4%)	NO
L2 P4         NO (-99.1%)         NO           L2 P5         NO (-97.7%)         NO           L2 P6         NO (-81.5%)         NO           L2 P7         NO (-96.7%)         NO           L2 P8         NO (-97.6%)         NO           L2 Central         NO (-97.4%)         NO           L3 P1         NO (-89.2%)         NO           L3 P2         NO (-86%)         NO           L3 P3         NO (-98.1%)         NO           L3 P4         NO (-99.81%)         NO           L3 P5         NO (-97.3%)         NO           L3 P6         NO (-97.3%)         NO           L3 P7         NO (-96.2%)         NO           L3 P8         NO (-97.4%)         NO           L3 Central         NO (-97.1%)         NO           L4 P1         NO (-88.4%)         NO           L4 P2         NO (-97.7%)         NO           L4 P3         NO (-97.7%)         NO           L4 P4         NO (-98.8%)         NO           L4 P5         NO (-96.9%)         NO           L4 P6         NO (-95.3%)         NO           L4 P6         NO (-96.6%)         NO           L4 P8	L2 P2	NO (-87.9%)	NO
L2 P5         NO (-97.7%)         NO           L2 P6         NO (-81.5%)         NO           L2 P7         NO (-96.7%)         NO           L2 P8         NO (-97.6%)         NO           L2 Central         NO (-97.4%)         NO           L3 P1         NO (-89.2%)         NO           L3 P2         NO (-86%)         NO           L3 P3         NO (-98.1%)         NO           L3 P4         NO (-99.3%)         NO           L3 P5         NO (-97.3%)         NO           L3 P6         NO (-77.9%)         NO           L3 P7         NO (-96.2%)         NO           L3 P8         NO (-97.4%)         NO           L3 Central         NO (-97.1%)         NO           L4 P1         NO (-88.4%)         NO           L4 P2         NO (-88.4%)         NO           L4 P3         NO (-97.7%)         NO           L4 P3         NO (-96.9%)         NO           L4 P6         NO (-96.9%)         NO           L4 P6         NO (-96.9%)         NO           L4 P8         NO (-96.6%)         NO	L2 P3	NO (-98.3%)	NO
L2 P6       NO (-81.5%)       NO         L2 P7       NO (-96.7%)       NO         L2 P8       NO (-97.6%)       NO         L2 Central       NO (-97.4%)       NO         L3 P1       NO (-89.2%)       NO         L3 P2       NO (-86%)       NO         L3 P3       NO (-98.1%)       NO         L3 P4       NO (-99%)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-96.6%)       NO         L4 Central       NO (-96.6%)       NO	L2 P4	NO (-99.1%)	NO
L2 P7       NO (-96.7%)       NO         L2 P8       NO (-97.6%)       NO         L2 Central       NO (-97.4%)       NO         L3 P1       NO (-88.2%)       NO         L3 P2       NO (-86%)       NO         L3 P3       NO (-98.1%)       NO         L3 P4       NO (-99%)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-96.6%)       NO         L4 Central       NO (-96.6%)       NO	L2 P5	NO (-97.7%)	NO
L2 P8       NO (-97.6%)       NO         L2 Central       NO (-97.4%)       NO         L3 P1       NO (-89.2%)       NO         L3 P2       NO (-86%)       NO         L3 P3       NO (-98.1%)       NO         L3 P4       NO (-99.8)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-88.4%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-95.3%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-96.6%)       NO         L4 Central       NO (-96.6%)       NO	L2 P6	NO (-81.5%)	NO
L2 Central       NO (-97.4%)       NO         L3 P1       NO (-89.2%)       NO         L3 P2       NO (-86%)       NO         L3 P3       NO (-98.1%)       NO         L3 P4       NO (-99%)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-96.6%)       NO         L4 Central       NO (-96.6%)       NO	L2 P7	NO (-96.7%)	NO
L3 P1       NO (-89.2%)       NO         L3 P2       NO (-86%)       NO         L3 P3       NO (-98.1%)       NO         L3 P4       NO (-99%)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-95.3%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-96.6%)       NO         L4 Central       NO (-96.6%)       NO	L2 P8	NO (-97.6%)	NO
L3 P2       NO (-86%)       NO         L3 P3       NO (-98.1%)       NO         L3 P4       NO (-99%)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L2 Central	NO (-97.4%)	NO
L3 P3       NO (-98.1%)       NO         L3 P4       NO (-99%)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 P8       NO (-96.6%)       NO	L3 P1	NO (-89.2%)	NO
L3 P4       NO (-99%)       NO         L3 P5       NO (-97.3%)       NO         L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 P8       NO (-96.6%)       NO	L3 P2	NO (-86%)	NO
NO (-97.3%)   NO	L3 P3	NO (-98.1%)	NO
L3 P6       NO (-77.9%)       NO         L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 P8       NO (-96.6%)       NO	L3 P4	NO (-99%)	NO
L3 P7       NO (-96.2%)       NO         L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L3 P5	NO (-97.3%)	NO
L3 P8       NO (-97.4%)       NO         L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L3 P6	NO (-77.9%)	NO
L3 Central       NO (-97.1%)       NO         L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L3 P7	NO (-96.2%)	NO
L4 P1       NO (-88.4%)       NO         L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L3 P8	NO (-97.4%)	NO
L4 P2       NO (-82.1%)       NO         L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L3 Central	NO (-97.1%)	NO
L4 P3       NO (-97.7%)       NO         L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L4 P1	NO (-88.4%)	NO
L4 P4       NO (-98.8%)       NO         L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L4 P2	NO (-82.1%)	NO
L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L4 P3	NO (-97.7%)	NO
L4 P5       NO (-96.9%)       NO         L4 P6       NO (-73.6%)       NO         L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L4 P4	NO (-98.8%)	NO
L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L4 P5		NO
L4 P7       NO (-95.3%)       NO         L4 P8       NO (-97.1%)       NO         L4 Central       NO (-96.6%)       NO	L4 P6		NO
L4 Central NO (-96.6%) NO	L4 P7		NO
	L4 P8	NO (-97.1%)	NO
	L4 Central	NO (-96.6%)	NO
	L5 P1		NO

L5 P2	Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L5 P4 NO (+98.7%) NO ( L5 P5 NO (+96.6%) NO ( L5 P6 NO (+71.5%) NO ( L5 P7 NO (+94.9%) NO ( L5 P8 NO (+96.8%) NO ( L6 P1 NO (+95.9%) NO ( L6 P1 NO (+95.9%) NO ( L6 P2 NO (+95.9%) NO ( L6 P2 NO (+96.8%) NO ( L6 P3 NO (+96.8%) NO ( L6 P5 NO (+96.8%) NO ( L6 P6 NO (+96.9%) NO ( L6 P6 NO (+96.9%) NO ( L6 P7 NO (+96.9%) NO ( L6 P7 NO (+94.1%) NO ( L6 P8 NO (+96.9%) NO ( L6 P8 NO (+96.9%) NO ( L6 Core NA NA NA NA ( L5 Core NA NA NA ( L5 Core NA NA NA ( L7 Core NA (NA NA ( L2 Core NA (NA ( L2 Core NA (NA ( L7 P1 ( L7 Core NA (NA ( L7 P1 ( L7 P2 ( L7 P2 ( L7 P3 ( L7 P3 ( L7 P4 ( L7 P4 ( L7 P5 (	L5 P2	NO (-75.6%)	NO
L5 P5 NO (-96.8%) NO (-71.5%) NO L5 P6 NO (-71.5%) NO NO L5 P6 NO (-71.5%) NO NO L5 P7 NO (-94.9%) NO NO L5 P8 NO (-96.8%) NO (-96.8%) NO L5 Central NO (-96.8%) NO (-96.8%) NO L6 Central NO (-96.8%) NO NO L6 P1 NO (-96.8%) NO NO L6 P2 NO (-96.8%) NO (-96.8%) NO NO L6 P2 NO (-96.8%) NO (-96.8%) NO NO L6 P3 NO (-96.9%) NO NO L6 P5 NO (-96.9%) NO NO L6 P6 NO (-96.9%) NO NO L6 Central NO (-95.1%) NO NO L6 Central NO (-95.9%) NO	L5 P3	NO (-97.2%)	NO
L5 P6	L5 P4	NO (-98.7%)	NO
L5 P7 NO (-94.9%) NO (-96.8%) NO (-58.6%) NO (-68.6%) NO (-69.6%) NO (-68.6%) NO (-69.9%) NO (-68.6%)	L5 P5		NO
L5 P7	L5 P6	, ,	NO
L5 Central  NO (-95.1%) L6 P1  NO (-85.8%) NO L6 P2  NO (-85.8%) NO L6 P3  NO (-96.4%) NO L6 P3  NO (-96.4%) NO L6 P4  NO (-96.4%) NO L6 P5  NO (-96.2%) NO L6 P6  NO (-96.3%) NO L6 P7  NO (-96.3%) NO L6 P8  NO (-96.4%) NO L6 P7  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P7  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P8  NO (-95.1%) NO L6 Core  NA NA NA NA L5 Core  NA NA NA NA L5 Core  NA NA NA NA L2 Core NA NA NA NA NA L2 Core NA NA NA NA NA NA L7 Core NA NA NA NA NA NA NA L7 Core NA	L5 P7		NO
L5 Central  L6 P1  NO (+96.1%) NO  L6 P2  NO (+85.8%) NO  L6 P3  NO (+96.4%) NO  L6 P4  NO (+96.4%) NO  L6 P5  NO (+96.2%) NO  L6 P6  NO (+96.3%) NO  L6 P7  NO (+96.3%) NO  L6 P8  NO (+96.4%) NO  L6 P8  NO (+96.4%) NO  L6 P8  NO (+96.4%) NO  L6 Core  NA  NA  NA  L5 Core  NA  NA  NA  L3 Core  NA  NA  NA  L2 Core  NA  NA  NA  NA  L7 Core  NA  NO (+91.2%) NO  L7 P2  NO (+90.7%) NO  L7 P5  NO (+91.7%) NO  L7 P6  NO (+91.5%) NO  NO  L8 P1  NO (+91.5%) NO  NO  L7 P6  NO (+91.5%) NO  NO  L8 P1  NO (+91.5%) NO  NO  L7 P7  NO (-91.5%) NO  NO  L7 P7  NO (-91.5%) NO  NO  L7 P8  NO (-91.5%) NO  NO  L8 P9  NO (-91.5%) NO  NO  L8 P1  NO (-91.5%) NO  NO  L8 P2  NO (-93.5%) NO  NO  L8 P4  NO (-93.5%) NO  NO  L8 P6  NO (-91.2%) NO	L5 P8	NO (-96.8%)	NO
L6 P2 NO (-95.3%) NO L6 P3 NO (-95.4%) NO L6 P4 NO (-96.4%) NO L6 P5 NO (-96.2%) NO L6 P6 NO (-96.2%) NO L6 P6 NO (-96.3%) NO L6 P7 NO (-96.4%) NO L6 P8 NO (-96.4%) NO L6 P8 NO (-96.4%) NO L6 Central NO (-95.4%) NO L6 Core N/A NA L6 Core N/A NA L7 Core N/A NA L7 P1 NO (-81.2%) NO L7 P2 NO (-58.7%) NO L7 P5 NO (-94.7%) NO L7 P5 NO (-94.7%) NO L7 P7 NO (-95.3%) NO L8 P1 NO (-96.5%) NO L7 P7 NO (-96.5%) NO L7 P7 NO (-96.5%) NO L8 P1 NO L8 P1 NO (-96.5%) NO L8 P1 NO L9 P5 NO L8 P1 NO (-96.5%) NO L9 P5 NO L8 P1 NO (-96.5%) NO L9 P2 NO (-96.5%) NO L9 P3 NO (-97.7%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-96.5%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6	L5 Central		NO
L6 P3	L6 P1	NO (-85.8%)	NO
L6 P4         NO (-98.4%)         NO           L6 P5         NO (-96.2%)         NO           L6 P6         NO (-96.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-96.4%)         NO           L6 Cental         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-75.9%)         NO           L8 P2         NO (-59.9%)         NO           L8 P3         NO (-90.9%) <td< td=""><td>L6 P2</td><td>NO (-65.3%)</td><td>NO</td></td<>	L6 P2	NO (-65.3%)	NO
L6 P5         NO (-96.2%)         NO           L6 P6         NO (-98.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-95.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-80.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L8 Core         N/A         N/A           L8 Core         N/A         N/A           L8 P1         NO (-91.9%)         NO           L8 P2         NO (-95.8%)         NO           L8 P3         NO (-95.8%) <t< td=""><td>L6 P3</td><td>NO (-96.4%)</td><td>NO</td></t<>	L6 P3	NO (-96.4%)	NO
L6 P6         NO (-69.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 P1         NO (-91.9%)         NO           L8 P2         NO (-95.9%)         NO           L8 P3         NO (-90.2%)         NO           L8 P4         NO (-90.2%)         NO           L8 P6         NO (-90.9%)	L6 P4	NO (-98.4%)	NO
L6 P7         NO (-94.1%)         NO           L6 P8         NO (-95.4%)         NO           L6 Central         NO (-95.4%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 P7         NO (-73.5%)         NO           L8 P2         NO (-73.5%)         NO           L8 P3         NO (-59.%)         NO           L8 P3         NO (-50.8%)         NO           L8 P6         NO (-91.2%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)	L6 P5		NO
L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-94.7%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L7 P7         NO (-65.3%)         NO           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59.9%)         NO           L8 P4         NO (-50.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-50.8%)	L6 P6	NO (-69.3%)	NO
L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-94.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-94.7%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-75.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-68.2%)         NO           L8 P4         NO (-59.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-68.7%)	L6 P7		NO
L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-60.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Contral         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-66.8%)         NO <td>L6 P8</td> <td></td> <td>NO</td>	L6 P8		NO
L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-59.7%)         NO           L7 P4         NO (-60.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Contral         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-66.8%)         NO	L6 Central		NO
L4 Core         N/A         N/A           L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59.9%)         NO           L8 P4         NO (-50.9%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P3         NO (-60.3%)         NO           L9 P4         NO (-50.8%)         NO           L9 P5         NO (-50.9%)	L6 Core		N/A
L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-93.9%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-65.8%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-56.9%)         NO           L9 P6         NO (-90.6%)	L5 Core	N/A	N/A
L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-58%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-56.8%)         NO           L9 P5         NO (-90.6%)	L4 Core	N/A	N/A
L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-96.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-66.8%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-65.9%)         NO           L9 P4         NO (-	L3 Core	N/A	N/A
L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-63.7%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-79.7%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-96.5%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6	L2 Core	N/A	N/A
L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-63.7%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-79.7%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-96.5%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6	L7 Core	N/A	N/A
L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-60.8%)         NO           L9 P1         NO (-66.8%)         NO           L9 P2         NO (-66.8%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-65.9%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6         NO (-90.6%)         NO           L9 P6         NO (-90.6%)         NO		NO (-81.2%)	NO
L7 P3       NO (-80.7%)       NO         L7 P4       NO (-66.2%)       NO         L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-93.9%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-60.8%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-64.4%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P2		NO
L7 P4       NO (-66.2%)       NO         L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-93.9%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P3		NO
L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.6%)       NO	L7 P4		NO
L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 P7       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 P0       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P5		NO
L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P6	NO (-91.9%)	NO
L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 Central         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 Core         NO (-100%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-65.9%)         NO           L9 P5         NO (-93.1%)         NO           L9 P6         NO (-90.6%)         NO           L9 Central         NO (-90.1%)         NO	L7 Central	NO (-91.5%)	NO
L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P7	NO (-65.3%)	NO
L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 Core	N/A	N/A
L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P1	NO (-73.5%)	NO
L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P2		NO
L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P3	NO (-80.2%)	NO
L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P4		NO
L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P5	NO (-93.9%)	NO
L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P6		NO
L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 Central		NO
L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		, ,	NO
L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L9 Core		NO
L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			NO
L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		1	
L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			
L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		, ,	
L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			
L9 Central NO (-90.1%) NO			
		1 1	
	L9 P7	NO (-62.1%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L10 Core	N/A	N/A
L10 P1	NO (-58.4%)	NO
L10 P2	NO (-57.1%)	NO
L10 Central	NO (-83.3%)	NO
L10 P3	NO (-80.8%)	NO
L10 P4	NO (-70%)	NO
podium level 1	NO (-94.8%)	NO
L11 Core	N/A	N/A
L11 P1	NO (-69.1%)	NO
L11 P2	NO (-56.8%)	NO
L11 Central	NO (-84.6%)	NO
L11 P3	NO (-79.7%)	NO
L11 P4	NO (-67.6%)	NO
L12 Core	N/A	N/A
L12 P1	NO (-56.4%)	NO
L12 P2	NO (-66%)	NO
L12 Central	NO (-83.3%)	NO
L12 P3	NO (-78.8%)	NO
L12 P4	NO (-65.3%)	NO
L13 Core	N/A	N/A
L13 P1	NO (-69.8%)	NO
L13 P2	NO (-69.2%)	NO
L13 Central	NO (-86.3%)	NO
L13 P3	NO (-79.5%)	NO
L13 P4	NO (-66.7%)	NO
G Office Lobby Central	NO (-96.1%)	NO
G Office Lobby P1	NO (-49.5%)	NO

### Criterion 4: The performance of the building, as built, should be consistent with the 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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

### Technical Data Sheet (Actual vs. Notional Building)

### **Building Global Parameters**

	Actual	Notional
Area [m²]	14730.5	14730.5
External area [m²]	8624.8	8624.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	4730.57	5927.76
Average U-value [W/m²K]	0.55	0.69
Alpha value* [%]	10	10

<sup>\*</sup> 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	4.2	5.69
Cooling	6.84	6.46
Auxiliary	13.03	15.05
Lighting	17.69	21.46
Hot water	3.34	3.17
Equipment*	42.18	42.18
TOTAL**	45.1	51.83

<sup>\*</sup> 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/m<sup>2</sup>]

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

### Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	106.36	105.78
Primary energy* [kWh/m²]	121.64	139.43
Total emissions [kg/m²]	20.6	23.7

<sup>\*</sup> Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

H	HVAC Systems Performance									
Sys	stem Type	Heat dem MJ/m2	Cool dem MJ/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] Electricity										
	Actual	13	93.4	4.2	6.8	13	0.86	3.79	0.91	5.01
	Notional	17.7	88.1	5.7	6.5	15.1	0.86	3.79		

### 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

### **Key Features**

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

### **Building fabric**

Element	<b>U</b> i-Тур	U <sub>i-Min</sub>	Surface where the minimum value occurs*		
Wall	0.23	0.2	LV000000:Surf[1]		
Floor	0.2	0.2	LV000000:Surf[0]		
Roof	0.15	0.18	LV000001:Surf[0]		
Windows, roof windows, and rooflights	1.5	1.1	L100002A:Surf[0]		
Personnel doors	1.5	-	No Personnel doors in building		
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building		
High usage entrance doors	1.5	-	No High usage entrance doors in building		
U <sub>i-Typ</sub> = Typical individual element U-values [W/(m²K)]			U <sub>i-Min</sub> = 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	3	

## 



Compliance with England Building Regulations Part L 2013

#### Project name

### **Templar House**

As designed

Date: Mon Jul 13 16:02:11 2015

#### Administrative information

**Building Details** 

Address: High Holborn, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2 BRUKL compliance check version: v5.2.b.1

**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 CO₂ emission rate for the building should not exceed the target

1.1	CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum	23.7
1.2	Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	23.7
1.3	Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	19.9
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	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 which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

#### 2.a Building fabric

Element	U <sub>a-Limit</sub>	U <sub>a-Calc</sub>	U <sub>i-Calc</sub>	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	LV000000:Surf[1]
Floor	0.25	0.2	0.2	LV000000:Surf[0]
Roof	0.25	0.18	0.18	LV000001:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.36	1.49	LV00000C:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
Ua-Limit = Limiting area-weighted average U-values [W Ua-Calc = Calculated area-weighted average U-values	. ,,		Ui-Calc = C	alculated maximum individual element U-values [W/(m²K)]

<sup>\*</sup> There might be more than one surface where the maximum U-value occurs.

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 <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa	10	3	

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

<sup>\*\*\*</sup> Display windows and similar glazing are excluded from the U-value check.

#### 2.b 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			
Whole building electric power factor achieved by power factor correction	>0.95		

### 1- Main system

	Heating efficiency	Cooling efficiency	cooling efficiency Radiant efficiency		HR efficiency			
This system	0.95	3.11	0	1.6	0.8			
Standard value	0.91*	2.7	N/A	1.6	0.65			
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.								

<sup>&</sup>quot;No HWS in project, or hot water is provided by HVAC system"

### Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide						
Α	Local supply or extract ventilation units serving a single area						
В	Zonal supply system where the fan is remote from the zone						
С	Zonal extract system where the fan is remote from the zone						
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery						
Е	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						
Н	Fan coil units						
ı	Zonal extract system where the fan is remote from the zone with grease filter						

Zone name		SFP [W/(I/s)]									UD -#G-i	
ID of system type	Α	В	С	D	E	F	G	Н	ı	1 HH 6	fficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
G Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L1 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L2 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L2 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L2 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L2 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L2 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L2 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A	
L2 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A	

Zone name	SFP [W/(I/s)]									HR efficiency	
ID of system type	Α	В	С	D	E	F	G	Н	I	пке	eniciency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L2 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P1	-	† <u> </u>	ļ_	0.4	-	-	-	1.6	† <u> </u>	-	N/A
L5 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P5	-	-	-	0.4	-	-	-	1.6	ļ_	-	N/A
L5 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P8	-	-	-	0.4	-	-	-	1.6	١_	-	N/A
L5 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P6	-	-	-	0.4	-	-	_	1.6	-	-	N/A
L6 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 Core		_	_	0.4	-		-	1.6	-	-	N/A N/A
L4 Core	-	-	-	0.4	-	-		1.6	-	-	N/A N/A
	-	<del> </del>				-	-	_	+	+	
L3 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A

Zone name	SFP [W/(I/s)]									HR efficiency	
ID of system type	Α	В	С	D	E	F	G	Н	I	ппе	eniciency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L7 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P2	-	ļ_	ļ_	0.4	-	-	-	1.6	-	-	N/A
L9 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
podium level 1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P4	-	_	-	0.4	-	_	_	1.6	_	-	N/A
L12 Core	_	_	_	0.4	_	_	_	1.6	_	_	N/A
L12 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
LILIZ				0.4				1.0			13/74

Zone name		SFP [W/(I/s)]								HR efficiency	
ID of system type	Α	В	С	D	E	F	G	Н	I	пке	miciency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L12 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
G Office Lobby Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
G Office Lobby P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A

General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
G Core	70	-	-	2211
L1 Core	70	-	-	2185
L1 P1	70	-	-	902
L1 P2	70	-	-	773
L1 P3	70	-	-	378
L1 P4	70	-	-	437
L1 P5	70	-	-	410
L1 P6	70	-	-	1477
L1 P7	70	-	-	242
L1 P8	70	-	-	423
L1 Central	70	-	-	3210
L2 P1	70	-	-	902
L2 P2	70	-	-	773
L2 P3	70	-	-	378
L2 P4	70	-	-	437
L2 P5	70	-	-	410
L2 P6	70	-	-	1477
L2 P7	70	-	-	242
L2 P8	70	-	-	423
L2 Central	70	-	-	3210
L3 P1	70	-	-	902
L3 P2	70	-	-	773
L3 P3	70	-	-	378
L3 P4	70	-	-	437
L3 P5	70	-	-	410
L3 P6	70	-	-	1477
L3 P7	70	-	-	242
L3 P8	70	-	-	423

General lighting and display lighting						
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]		
Standard value	60	60	22			
L3 Central	70	-	-	3210		
L4 P1	70	-	-	902		
L4 P2	70	-	-	773		
L4 P3	70	-	-	378		
L4 P4	70	-	-	437		
L4 P5	70	-	-	410		
L4 P6	70	-	-	1477		
L4 P7	70	-	-	242		
L4 P8	70	-	-	423		
L4 Central	70	-	-	3210		
L5 P1	70	-	-	902		
L5 P2	70	-	-	773		
L5 P3	70	-	-	378		
L5 P4	70	-	-	437		
L5 P5	70	-	-	410		
L5 P6	70	-	-	1477		
L5 P7	70	-	-	242		
L5 P8	70	-	-	423		
L5 Central	70	-	-	3210		
L6 P1	70	-	-	902		
L6 P2	70	-	-	773		
L6 P3	70	-	-	378		
L6 P4	70	-	-	437		
L6 P5	70	-	-	410		
L6 P6	70	-	-	1477		
L6 P7	70	-	-	242		
L6 P8	70	-	-	423		
L6 Central	70	-	-	3210		
L6 Core	70	-	-	2161		
L5 Core	70	-	-	2161		
L4 Core	70	-	-	2161		
L3 Core	70	-	-	2161		
L2 Core	70	-	-	2161		
L7 Core	70	-	-	2161		
L7 P1	70	-	-	902		
L7 P2	70	-	-	771		
L7 P3	70	-	-	195		
L7 P4	70	-	-	731		
L7 P5	70	-	-	423		
L7 P6	70	-	-	231		
L7 Central	70	-	-	2789		
L7 P7	70	-	-	1412		
L8 Core	70	-	-	2161		
<u></u>	1		I	I - · - ·		

eneral lighting [W]
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General lighting and display lighting	Lumino	us effic	acy [lm/W]	
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
G Office Lobby P1	70	-	-	476

# 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?
G Core	N/A	N/A
L1 Core	N/A	N/A
L1 P1	NO (-89.6%)	NO
L1 P2	NO (-88.5%)	NO
L1 P3	NO (-98.3%)	NO
L1 P4	NO (-99.1%)	NO
L1 P5	NO (-97.2%)	NO
L1 P6	NO (-81.2%)	NO
L1 P7	NO (-96.1%)	NO
L1 P8	NO (-97.5%)	NO
L1 Central	NO (-97.3%)	NO
L2 P1	NO (-89.4%)	NO
L2 P2	NO (-87.9%)	NO
L2 P3	NO (-98.3%)	NO
L2 P4	NO (-99.1%)	NO
L2 P5	NO (-97.7%)	NO
L2 P6	NO (-81.5%)	NO
L2 P7	NO (-96.7%)	NO
L2 P8	NO (-97.6%)	NO
L2 Central	NO (-97.4%)	NO
L3 P1	NO (-89.2%)	NO
L3 P2	NO (-86%)	NO
L3 P3	NO (-98.1%)	NO
L3 P4	NO (-99%)	NO
L3 P5	NO (-97.3%)	NO
L3 P6	NO (-77.9%)	NO
L3 P7	NO (-96.2%)	NO
L3 P8	NO (-97.4%)	NO
L3 Central	NO (-97.1%)	NO
L4 P1	NO (-88.4%)	NO
L4 P2	NO (-82.1%)	NO
L4 P3	NO (-97.7%)	NO
L4 P4	NO (-98.8%)	NO
L4 P5	NO (-96.9%)	NO
L4 P6	NO (-73.6%)	NO
L4 P7	NO (-95.3%)	NO
L4 P8	NO (-97.1%)	NO
L4 Central	NO (-96.6%)	NO
L5 P1	NO (-87.5%)	NO

L5 P2	Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L5 P4 NO (+98.7%) NO ( L5 P5 NO (+96.6%) NO ( L5 P6 NO (+71.5%) NO ( L5 P7 NO (+94.9%) NO ( L5 P8 NO (+96.8%) NO ( L6 P1 NO (+95.9%) NO ( L6 P1 NO (+95.9%) NO ( L6 P2 NO (+95.9%) NO ( L6 P2 NO (+96.8%) NO ( L6 P3 NO (+96.8%) NO ( L6 P5 NO (+96.8%) NO ( L6 P6 NO (+96.9%) NO ( L6 P6 NO (+96.9%) NO ( L6 P7 NO (+96.9%) NO ( L6 P7 NO (+94.1%) NO ( L6 P8 NO (+96.9%) NO ( L6 P8 NO (+96.9%) NO ( L6 Core NA NA NA NA ( L5 Core NA NA NA ( L5 Core NA NA NA ( L7 Core NA (NA NA ( L2 Core NA (NA ( L2 Core NA (NA ( L7 P1 ( L7 Core NA (NA ( L7 P1 ( L7 P2 ( L7 P2 ( L7 P3 ( L7 P3 ( L7 P4 ( L7 P4 ( L7 P5 (	L5 P2	NO (-75.6%)	NO
L5 P5 NO (-96.8%) NO (-71.5%) NO L5 P6 NO (-71.5%) NO NO L5 P6 NO (-71.5%) NO NO L5 P7 NO (-94.9%) NO NO L5 P8 NO (-96.8%) NO (-96.8%) NO L5 Central NO (-96.8%) NO (-96.8%) NO L6 Central NO (-96.8%) NO NO L6 P1 NO (-96.8%) NO NO L6 P2 NO (-96.8%) NO (-96.8%) NO NO L6 P2 NO (-96.8%) NO (-96.8%) NO NO L6 P3 NO (-96.9%) NO NO L6 P5 NO (-96.9%) NO NO L6 P6 NO (-96.9%) NO NO L6 Central NO (-95.1%) NO NO L6 Central NO (-95.9%) NO	L5 P3	NO (-97.2%)	NO
L5 P6	L5 P4	NO (-98.7%)	NO
L5 P7 NO (-94.9%) NO (-96.8%) NO (-58.6%) NO (-68.6%) NO (-69.6%) NO (-68.6%) NO (-69.9%) NO (-68.6%)	L5 P5		NO
L5 P7	L5 P6	, ,	NO
L5 Central  NO (-95.1%) L6 P1  NO (-85.8%) NO L6 P2  NO (-85.8%) NO L6 P3  NO (-96.4%) NO L6 P3  NO (-96.4%) NO L6 P4  NO (-96.4%) NO L6 P5  NO (-96.2%) NO L6 P6  NO (-96.3%) NO L6 P7  NO (-96.3%) NO L6 P8  NO (-96.4%) NO L6 P7  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P7  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P8  NO (-95.1%) NO L6 Core  NA NA NA NA L5 Core  NA NA NA NA L5 Core  NA NA NA NA L2 Core NA NA NA NA NA L2 Core NA NA NA NA NA NA L7 Core NA NA NA NA NA NA NA L7 Core NA	L5 P7		NO
L5 Central  L6 P1  NO (+96.1%) NO  L6 P2  NO (+85.8%) NO  L6 P3  NO (+96.4%) NO  L6 P4  NO (+96.4%) NO  L6 P5  NO (+96.2%) NO  L6 P6  NO (+96.3%) NO  L6 P7  NO (+96.3%) NO  L6 P8  NO (+96.4%) NO  L6 P8  NO (+96.4%) NO  L6 P8  NO (+96.4%) NO  L6 Core  NA  NA  NA  L5 Core  NA  NA  NA  L3 Core  NA  NA  NA  L2 Core  NA  NA  NA  NA  L7 Core  NA  NO (+91.2%) NO  L7 P2  NO (+90.7%) NO  L7 P5  NO (+91.7%) NO  L7 P6  NO (+91.5%) NO  NO  L8 P1  NO (+91.5%) NO  NO  L7 P6  NO (+91.5%) NO  NO  L8 P1  NO (+91.5%) NO  NO  L7 P7  NO (-91.5%) NO  NO  L7 P7  NO (-91.5%) NO  NO  L7 P8  NO (-91.5%) NO  NO  L8 P9  NO (-91.5%) NO  NO  L8 P1  NO (-91.5%) NO  NO  L8 P2  NO (-93.5%) NO  NO  L8 P4  NO (-93.5%) NO  NO  L8 P6  NO (-91.2%) NO	L5 P8	NO (-96.8%)	NO
L6 P2 NO (-95.3%) NO L6 P3 NO (-95.4%) NO L6 P4 NO (-96.4%) NO L6 P5 NO (-96.2%) NO L6 P6 NO (-96.2%) NO L6 P6 NO (-96.3%) NO L6 P7 NO (-96.4%) NO L6 P8 NO (-96.4%) NO L6 P8 NO (-96.4%) NO L6 Central NO (-95.4%) NO L6 Core N/A NA L6 Core N/A NA L7 Core N/A NA L7 P1 NO (-81.2%) NO L7 P2 NO (-58.7%) NO L7 P5 NO (-94.7%) NO L7 P5 NO (-94.7%) NO L7 P7 NO (-95.3%) NO L8 P1 NO (-96.5%) NO L7 P7 NO (-96.5%) NO L7 P7 NO (-96.5%) NO L8 P1 NO L8 P1 NO (-96.5%) NO L8 P1 NO L9 P5 NO L8 P1 NO (-96.5%) NO L9 P5 NO L8 P1 NO (-96.5%) NO L9 P2 NO (-96.5%) NO L9 P3 NO (-97.7%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-96.5%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6	L5 Central		NO
L6 P3	L6 P1	NO (-85.8%)	NO
L6 P4         NO (-98.4%)         NO           L6 P5         NO (-96.2%)         NO           L6 P6         NO (-96.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-96.4%)         NO           L6 Cental         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-75.9%)         NO           L8 P2         NO (-59.9%)         NO           L8 P3         NO (-90.9%) <td< td=""><td>L6 P2</td><td>NO (-65.3%)</td><td>NO</td></td<>	L6 P2	NO (-65.3%)	NO
L6 P5         NO (-96.2%)         NO           L6 P6         NO (-98.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-95.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-80.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L8 Core         N/A         N/A           L8 Core         N/A         N/A           L8 P1         NO (-91.9%)         NO           L8 P2         NO (-95.8%)         NO           L8 P3         NO (-95.8%) <t< td=""><td>L6 P3</td><td>NO (-96.4%)</td><td>NO</td></t<>	L6 P3	NO (-96.4%)	NO
L6 P6         NO (-69.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 P1         NO (-91.9%)         NO           L8 P2         NO (-95.9%)         NO           L8 P3         NO (-90.2%)         NO           L8 P4         NO (-90.2%)         NO           L8 P6         NO (-90.9%)	L6 P4	NO (-98.4%)	NO
L6 P7         NO (-94.1%)         NO           L6 P8         NO (-95.4%)         NO           L6 Central         NO (-95.4%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 P7         NO (-73.5%)         NO           L8 P2         NO (-73.5%)         NO           L8 P3         NO (-59.%)         NO           L8 P3         NO (-50.8%)         NO           L8 P6         NO (-91.2%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)	L6 P5		NO
L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-94.7%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L7 P7         NO (-65.3%)         NO           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59.9%)         NO           L8 P4         NO (-50.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-50.8%)	L6 P6	NO (-69.3%)	NO
L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-94.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-94.7%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-75.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-68.2%)         NO           L8 P4         NO (-59.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-68.7%)	L6 P7		NO
L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-60.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Contral         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-66.8%)         NO <td>L6 P8</td> <td></td> <td>NO</td>	L6 P8		NO
L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-59.7%)         NO           L7 P4         NO (-60.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Contral         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-66.8%)         NO	L6 Central		NO
L4 Core         N/A         N/A           L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59.9%)         NO           L8 P4         NO (-50.2%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P3         NO (-60.3%)         NO           L9 P4         NO (-50.8%)         NO           L9 P5         NO (-50.8%)	L6 Core		N/A
L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-93.9%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-65.8%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-56.9%)         NO           L9 P6         NO (-90.6%)	L5 Core	N/A	N/A
L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-58%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-56.8%)         NO           L9 P5         NO (-90.6%)	L4 Core	N/A	N/A
L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-96.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-66.8%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-65.9%)         NO           L9 P4         NO (-	L3 Core	N/A	N/A
L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-63.7%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-79.7%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-96.5%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6	L2 Core	N/A	N/A
L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-63.7%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-79.7%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-96.5%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6	L7 Core	N/A	N/A
L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-60.8%)         NO           L9 P1         NO (-66.8%)         NO           L9 P2         NO (-66.8%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-65.9%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6         NO (-90.6%)         NO           L9 P6         NO (-90.6%)         NO		NO (-81.2%)	NO
L7 P3       NO (-80.7%)       NO         L7 P4       NO (-66.2%)       NO         L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-93.9%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-60.8%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-64.4%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P2		NO
L7 P4       NO (-66.2%)       NO         L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-93.9%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P3		NO
L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.6%)       NO	L7 P4		NO
L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 P7       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 P0       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P5		NO
L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P6	NO (-91.9%)	NO
L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 Central         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 Core         NO (-100%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-65.9%)         NO           L9 P5         NO (-93.1%)         NO           L9 P6         NO (-90.6%)         NO           L9 Central         NO (-90.1%)         NO	L7 Central	NO (-91.5%)	NO
L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P7	NO (-65.3%)	NO
L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 Core	N/A	N/A
L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P1	NO (-73.5%)	NO
L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P2		NO
L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P3	NO (-80.2%)	NO
L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P4		NO
L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P5	NO (-93.9%)	NO
L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P6		NO
L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 Central		NO
L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		, ,	NO
L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L9 Core		NO
L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			NO
L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		1	
L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			
L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		, ,	
L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			
L9 Central NO (-90.1%) NO			
		1 1	
	L9 P7	NO (-62.1%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L10 Core	N/A	N/A
L10 P1	NO (-58.4%)	NO
L10 P2	NO (-57.1%)	NO
L10 Central	NO (-83.3%)	NO
L10 P3	NO (-80.8%)	NO
L10 P4	NO (-70%)	NO
podium level 1	NO (-94.8%)	NO
L11 Core	N/A	N/A
L11 P1	NO (-69.1%)	NO
L11 P2	NO (-56.8%)	NO
L11 Central	NO (-84.6%)	NO
L11 P3	NO (-79.7%)	NO
L11 P4	NO (-67.6%)	NO
L12 Core	N/A	N/A
L12 P1	NO (-56.4%)	NO
L12 P2	NO (-66%)	NO
L12 Central	NO (-83.3%)	NO
L12 P3	NO (-78.8%)	NO
L12 P4	NO (-65.3%)	NO
L13 Core	N/A	N/A
L13 P1	NO (-69.8%)	NO
L13 P2	NO (-69.2%)	NO
L13 Central	NO (-86.3%)	NO
L13 P3	NO (-79.5%)	NO
L13 P4	NO (-66.7%)	NO
G Office Lobby Central	NO (-96.1%)	NO
G Office Lobby P1	NO (-49.5%)	NO

### Criterion 4: The performance of the building, as built, should be consistent with the 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?				
Is evidence of such assessment available as a separate submission?				
Are any such measures included in the proposed design?	YES			

### Technical Data Sheet (Actual vs. Notional Building)

### **Building Global Parameters**

	Actual	Notional
Area [m²]	14730.5	14730.5
External area [m²]	8624.8	8624.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	4730.57	5927.76
Average U-value [W/m²K]	0.55	0.69
Alpha value* [%]	10	10

<sup>\*</sup> 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	3.75	5.69
Cooling	6.72	6.46
Auxiliary	13.03	15.05
Lighting	17.69	21.46
Hot water	3.2	3.17
Equipment*	42.18	42.18
TOTAL**	44.39	51.83

<sup>\*</sup> 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	1.12	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

### Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	105.47	105.78
Primary energy* [kWh/m²]	120.56	139.43
Total emissions [kg/m²]	19.9	23.7

<sup>\*</sup> Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

H	HVAC Systems Performance									
Sys	stem Type	Heat dem MJ/m2	Cool dem MJ/m2		ı	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[S]	[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
	Actual	12.1	93.4	3.7	6.7	13	0.9	3.86	0.95	5.1
	Notional	17.7	88.1	5.7	6.5	15.1	0.86	3.79		

### 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

### **Key Features**

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

### **Building fabric**

Element	<b>U</b> i-Тур	U <sub>i-Min</sub>	Surface where the minimum value occurs*	
Wall	0.23	0.2	LV000000:Surf[1]	
Floor	0.2	0.2	LV000000:Surf[0]	
Roof	0.15	0.18	LV000001:Surf[0]	
Windows, roof windows, and rooflights	1.5	1.1	L100002A:Surf[0]	
Personnel doors	1.5	-	No Personnel doors in building	
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building	
High usage entrance doors	1.5	-	No High usage entrance doors in building	
U <sub>i-Typ</sub> = Typical individual element U-values [W/(m²K)	)		U <sub>i-Min</sub> = 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	3

## 



Compliance with England Building Regulations Part L 2013

#### Project name

### **Templar House**

As designed

Date: Tue Jul 14 17:02:43 2015

#### Administrative information

**Building Details** 

Address: High Holborn, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2 BRUKL compliance check version: v5.2.b.1

#### **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 CO₂ emission rate for the building should not exceed the target

1.1	CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum	23.7
1.2	Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	23.7
1.3	Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	20.4
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	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 which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

#### 2.a Building fabric

Element	<b>U</b> a-Limit	U <sub>a-Calc</sub>	U <sub>i-Calc</sub>	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	LV000000:Surf[1]
Floor	0.25	0.2	0.2	LV000000:Surf[0]
Roof	0.25	0.18	0.18	LV000001:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.36	1.49	LV00000C:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
Ua-Limit = Limiting area-weighted average U-values [W				alouloted as a significant side of aloue at the same of the same o
Ua-calc = Calculated area-weighted average U-values [W/(m²K)]   Ui-calc = Calculated maximum individual element U-values [W/(m²K)]				

<sup>\*</sup> There might be more than one surface where the maximum U-value occurs.

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 <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa	10	3

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

<sup>\*\*\*</sup> Display windows and similar glazing are excluded from the U-value check.

#### 2.b 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- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency			
This system	0.95	3.11	0	1.6	0.8			
Standard value	0.91*	2.7	N/A	1.6	0.65			
Automatic moni	toring & targeting w	ith alarms for out-of	-range values for th	is HVAC syster	n 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.								

<sup>&</sup>quot;No HWS in project, or hot water is provided by HVAC system"

### Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide						
Α	Local supply or extract ventilation units serving a single area						
В	Zonal supply system where the fan is remote from the zone						
С	Zonal extract system where the fan is remote from the zone						
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery						
Е	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						
Н	Fan coil units						
ı	Zonal extract system where the fan is remote from the zone with grease filter						

Zone name	SFP [W/(I/s)]									LID officion on	
ID of system type	Α	В	С	D	E	F	G	Н	ı	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
G Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L1 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A

Zone name	SFP [W/(I/s)]									UD 4	fficiency
ID of system type	Α	В	С	D	E	F	G	Н	I	пке	eniciency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L2 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L3 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L4 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P1	-	† <u> </u>	ļ_	0.4	-	-	-	1.6	† <u> </u>	-	N/A
L5 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P5	-	-	-	0.4	-	-	-	1.6	ļ_	-	N/A
L5 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 P8	-	-	-	0.4	-	-	-	1.6	١_	-	N/A
L5 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 P8	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L6 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L5 Core		_	_	0.4	-		-	1.6	-	-	N/A N/A
L4 Core	-	-	-	0.4	-	-		1.6	-	-	N/A N/A
	-	<del> </del>				-	-	_	+	+	
L3 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L2 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A

Zone name	SFP [W/(I/s)]									up.	History
ID of system type	Α	В	С	D	E	F	G	Н	I	ппе	efficiency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L7 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L7 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L8 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P2	-	ļ_	ļ_	0.4	-	-	-	1.6	-	-	N/A
L9 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P5	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P6	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L9 P7	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L10 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
podium level 1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L11 P4	-	_	-	0.4	-	_	_	1.6	_	-	N/A
L12 Core	_	_	_	0.4	_	_	_	1.6	_	_	N/A
L12 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
LILIZ				0.4				1.0			13/74

Zone name		SFP [W/(I/s)]								HR efficiency	
ID of system type	Α	В	С	D	E	F	G	Н	I	пке	miciency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L12 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L12 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 Core	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P2	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P3	-	-	-	0.4	-	-	-	1.6	-	-	N/A
L13 P4	-	-	-	0.4	-	-	-	1.6	-	-	N/A
G Office Lobby Central	-	-	-	0.4	-	-	-	1.6	-	-	N/A
G Office Lobby P1	-	-	-	0.4	-	-	-	1.6	-	-	N/A

General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
G Core	70	-	-	2211
L1 Core	70	-	-	2185
L1 P1	70	-	-	902
L1 P2	70	-	-	773
L1 P3	70	-	-	378
L1 P4	70	-	-	437
L1 P5	70	-	-	410
L1 P6	70	-	-	1477
L1 P7	70	-	-	242
L1 P8	70	-	-	423
L1 Central	70	-	-	3210
L2 P1	70	-	-	902
L2 P2	70	-	-	773
L2 P3	70	-	-	378
L2 P4	70	-	-	437
L2 P5	70	-	-	410
L2 P6	70	-	-	1477
L2 P7	70	-	-	242
L2 P8	70	-	-	423
L2 Central	70	-	-	3210
L3 P1	70	-	-	902
L3 P2	70	-	-	773
L3 P3	70	-	-	378
L3 P4	70	-	-	437
L3 P5	70	-	-	410
L3 P6	70	-	-	1477
L3 P7	70	-	-	242
L3 P8	70	-	-	423

General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
L3 Central	70	-	-	3210
L4 P1	70	-	-	902
L4 P2	70	-	-	773
L4 P3	70	-	-	378
L4 P4	70	-	-	437
L4 P5	70	-	-	410
L4 P6	70	-	-	1477
L4 P7	70	-	-	242
L4 P8	70	-	-	423
L4 Central	70	-	-	3210
L5 P1	70	-	-	902
L5 P2	70	-	-	773
L5 P3	70	-	-	378
L5 P4	70	-	-	437
L5 P5	70	-	-	410
L5 P6	70	-	-	1477
L5 P7	70	-	-	242
L5 P8	70	-	-	423
L5 Central	70	-	-	3210
L6 P1	70	-	-	902
L6 P2	70	-	-	773
L6 P3	70	-	-	378
L6 P4	70	-	-	437
L6 P5	70	-	-	410
L6 P6	70	-	-	1477
L6 P7	70	-	-	242
L6 P8	70	-	-	423
L6 Central	70	-	-	3210
L6 Core	70	-	-	2161
L5 Core	70	-	-	2161
L4 Core	70	-	-	2161
L3 Core	70	-	-	2161
L2 Core	70	-	-	2161
L7 Core	70	-	-	2161
L7 P1	70	-	-	902
L7 P2	70	-	-	771
L7 P3	70	-	-	195
L7 P4	70	-	-	731
L7 P5	70	-	-	423
L7 P6	70	-	-	231
L7 Central	70	-	-	2789
L7 P7	70	-	-	1412
L8 Core	70	-	-	2161
<u></u>	1		I	I - · - ·

eneral lighting [W]
2
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3
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'89
12
61
2
5
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789
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30
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02
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77
'4
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02
30
'9
577
'4
38

General lighting and display lighting	Lumino	us effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
G Office Lobby P1	70	-	-	476

# 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?
G Core	N/A	N/A
L1 Core	N/A	N/A
L1 P1	NO (-89.6%)	NO
L1 P2	NO (-88.5%)	NO
L1 P3	NO (-98.3%)	NO
L1 P4	NO (-99.1%)	NO
L1 P5	NO (-97.2%)	NO
L1 P6	NO (-81.2%)	NO
L1 P7	NO (-96.1%)	NO
L1 P8	NO (-97.5%)	NO
L1 Central	NO (-97.3%)	NO
L2 P1	NO (-89.4%)	NO
L2 P2	NO (-87.9%)	NO
L2 P3	NO (-98.3%)	NO
L2 P4	NO (-99.1%)	NO
L2 P5	NO (-97.7%)	NO
L2 P6	NO (-81.5%)	NO
L2 P7	NO (-96.7%)	NO
L2 P8	NO (-97.6%)	NO
L2 Central	NO (-97.4%)	NO
L3 P1	NO (-89.2%)	NO
L3 P2	NO (-86%)	NO
L3 P3	NO (-98.1%)	NO
L3 P4	NO (-99%)	NO
L3 P5	NO (-97.3%)	NO
L3 P6	NO (-77.9%)	NO
L3 P7	NO (-96.2%)	NO
L3 P8	NO (-97.4%)	NO
L3 Central	NO (-97.1%)	NO
L4 P1	NO (-88.4%)	NO
L4 P2	NO (-82.1%)	NO
L4 P3	NO (-97.7%)	NO
L4 P4	NO (-98.8%)	NO
L4 P5	NO (-96.9%)	NO
L4 P6	NO (-73.6%)	NO
L4 P7	NO (-95.3%)	NO
L4 P8	NO (-97.1%)	NO
L4 Central	NO (-96.6%)	NO
L5 P1	NO (-87.5%)	NO

L5 P2	Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L5 P4 NO (+98.7%) NO ( L5 P5 NO (+96.6%) NO ( L5 P6 NO (+71.5%) NO ( L5 P7 NO (+94.9%) NO ( L5 P8 NO (+96.8%) NO ( L6 P1 NO (+95.9%) NO ( L6 P1 NO (+95.9%) NO ( L6 P2 NO (+95.9%) NO ( L6 P2 NO (+96.8%) NO ( L6 P3 NO (+96.8%) NO ( L6 P5 NO (+96.8%) NO ( L6 P6 NO (+96.9%) NO ( L6 P6 NO (+96.9%) NO ( L6 P7 NO (+96.9%) NO ( L6 P7 NO (+94.1%) NO ( L6 P8 NO (+96.9%) NO ( L6 P8 NO (+96.9%) NO ( L6 Core NA NA NA NA ( L5 Core NA NA NA ( L5 Core NA NA NA ( L7 Core NA (NA NA ( L2 Core NA (NA ( L2 Core NA (NA ( L7 P1 ( L7 Core NA (NA ( L7 P1 ( L7 P2 ( L7 P2 ( L7 P3 ( L7 P3 ( L7 P4 ( L7 P4 ( L7 P5 (	L5 P2	NO (-75.6%)	NO
L5 P5 NO (-96.8%) NO (-71.5%) NO L5 P6 NO (-71.5%) NO NO L5 P6 NO (-71.5%) NO NO L5 P7 NO (-94.9%) NO NO L5 P8 NO (-96.8%) NO (-96.8%) NO L5 Central NO (-96.8%) NO (-96.8%) NO L6 Central NO (-96.8%) NO NO L6 P1 NO (-96.8%) NO NO L6 P2 NO (-96.8%) NO (-96.8%) NO NO L6 P2 NO (-96.8%) NO (-96.8%) NO NO L6 P3 NO (-96.9%) NO NO L6 P5 NO (-96.9%) NO NO L6 P6 NO (-96.9%) NO NO L6 Central NO (-95.1%) NO NO L6 Central NO (-95.9%) NO	L5 P3	NO (-97.2%)	NO
L5 P6	L5 P4	NO (-98.7%)	NO
L5 P7 NO (-94.9%) NO (-96.8%) NO (-58.6%) NO (-68.6%) NO (-69.6%) NO (-68.6%) NO (-69.9%) NO (-68.6%)	L5 P5	NO (-96.6%)	NO
L5 P7	L5 P6	NO (-71.5%)	NO
L5 Central  NO (-95.1%) L6 P1  NO (-85.8%) NO L6 P2  NO (-85.8%) NO L6 P3  NO (-96.4%) NO L6 P3  NO (-96.4%) NO L6 P4  NO (-96.4%) NO L6 P5  NO (-96.2%) NO L6 P6  NO (-96.3%) NO L6 P7  NO (-96.3%) NO L6 P8  NO (-96.4%) NO L6 P7  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P7  NO (-96.4%) NO L6 P8  NO (-96.4%) NO L6 P8  NO (-95.1%) NO L6 Core  NA NA NA NA L5 Core  NA NA NA NA L5 Core  NA NA NA NA L2 Core NA NA NA NA NA L2 Core NA NA NA NA NA NA L7 Core NA NA NA NA NA NA NA L7 Core NA	L5 P7		NO
L5 Central  L6 P1  NO (+96.1%) NO  L6 P2  NO (+85.8%) NO  L6 P3  NO (+96.4%) NO  L6 P4  NO (+96.4%) NO  L6 P5  NO (+96.2%) NO  L6 P6  NO (+96.3%) NO  L6 P7  NO (+96.3%) NO  L6 P8  NO (+96.4%) NO  L6 P8  NO (+96.4%) NO  L6 P8  NO (+96.4%) NO  L6 Core  NA  NA  NA  L5 Core  NA  NA  NA  L3 Core  NA  NA  NA  L2 Core  NA  NA  NA  NA  L7 Core  NA  NO (+91.2%) NO  L7 P2  NO (+90.7%) NO  L7 P5  NO (+91.7%) NO  L7 P6  NO (+91.5%) NO  NO  L8 P1  NO (+91.5%) NO  NO  L7 P6  NO (+91.5%) NO  NO  L8 P1  NO (+91.5%) NO  NO  L7 P7  NO (-91.5%) NO  NO  L7 P7  NO (-91.5%) NO  NO  L7 P8  NO (-91.5%) NO  NO  L8 P9  NO (-91.5%) NO  NO  L8 P1  NO (-91.5%) NO  NO  L8 P2  NO (-93.5%) NO  NO  L8 P4  NO (-93.5%) NO  NO  L8 P6  NO (-91.2%) NO	L5 P8	NO (-96.8%)	NO
L6 P2 NO (-95.3%) NO L6 P3 NO (-95.4%) NO L6 P4 NO (-96.4%) NO L6 P5 NO (-96.2%) NO L6 P6 NO (-96.2%) NO L6 P6 NO (-96.3%) NO L6 P7 NO (-96.4%) NO L6 P8 NO (-96.4%) NO L6 P8 NO (-96.4%) NO L6 Central NO (-95.4%) NO L6 Core N/A NA L6 Core N/A NA L7 Core N/A NA L7 P1 NO (-81.2%) NO L7 P2 NO (-58.7%) NO L7 P5 NO (-94.7%) NO L7 P5 NO (-94.7%) NO L7 P7 NO (-95.3%) NO L8 P1 NO (-96.5%) NO L7 P7 NO (-96.5%) NO L7 P7 NO (-96.5%) NO L8 P1 NO L8 P1 NO (-96.5%) NO L8 P1 NO L9 P5 NO L8 P1 NO (-96.5%) NO L9 P5 NO L8 P1 NO (-96.5%) NO L9 P2 NO (-96.5%) NO L9 P3 NO (-97.7%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-96.5%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6 NO (-90.6%) NO L9 P7 NO (-90.6%) NO L9 P6	L5 Central		NO
L6 P3	L6 P1	NO (-85.8%)	NO
L6 P4         NO (-98.4%)         NO           L6 P5         NO (-96.2%)         NO           L6 P6         NO (-96.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-96.4%)         NO           L6 Cental         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-75.9%)         NO           L8 P2         NO (-59.9%)         NO           L8 P3         NO (-90.9%) <td< td=""><td>L6 P2</td><td>NO (-65.3%)</td><td>NO</td></td<>	L6 P2	NO (-65.3%)	NO
L6 P5         NO (-96.2%)         NO           L6 P6         NO (-98.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-95.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-80.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L7 P7         NO (-91.9%)         NO           L8 Core         N/A         N/A           L8 Core         N/A         N/A           L8 P1         NO (-91.9%)         NO           L8 P2         NO (-95.8%)         NO           L8 P3         NO (-95.8%) <t< td=""><td>L6 P3</td><td>NO (-96.4%)</td><td>NO</td></t<>	L6 P3	NO (-96.4%)	NO
L6 P6         NO (-69.3%)         NO           L6 P7         NO (-94.1%)         NO           L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 P1         NO (-91.9%)         NO           L8 P2         NO (-95.9%)         NO           L8 P3         NO (-90.2%)         NO           L8 P4         NO (-90.2%)         NO           L8 P6         NO (-90.9%)	L6 P4	NO (-98.4%)	NO
L6 P7         NO (-94.1%)         NO           L6 P8         NO (-95.4%)         NO           L6 Central         NO (-95.4%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 P7         NO (-73.5%)         NO           L8 P2         NO (-73.5%)         NO           L8 P3         NO (-59.%)         NO           L8 P3         NO (-50.8%)         NO           L8 P6         NO (-91.2%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)	L6 P5		NO
L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-94.7%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L7 P7         NO (-65.3%)         NO           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59.9%)         NO           L8 P4         NO (-50.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-50.8%)	L6 P6	NO (-69.3%)	NO
L6 P8         NO (-96.4%)         NO           L6 Central         NO (-95.1%)         NO           L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-94.7%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-94.7%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-75.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-68.2%)         NO           L8 P4         NO (-59.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-68.7%)	L6 P7		NO
L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-60.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Contral         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-66.8%)         NO <td>L6 P8</td> <td></td> <td>NO</td>	L6 P8		NO
L6 Core         N/A         N/A           L5 Core         N/A         N/A           L4 Core         N/A         N/A           L3 Core         N/A         N/A           L3 Core         N/A         N/A           L7 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-59.7%)         NO           L7 P4         NO (-60.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Contral         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-90.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-66.8%)         NO	L6 Central		NO
L4 Core         N/A         N/A           L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-59.9%)         NO           L8 P4         NO (-50.2%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P3         NO (-60.3%)         NO           L9 P4         NO (-50.8%)         NO           L9 P5         NO (-50.8%)	L6 Core		N/A
L3 Core         N/A         N/A           L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-93.9%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-65.8%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-56.9%)         NO           L9 P6         NO (-90.6%)	L5 Core	N/A	N/A
L2 Core         N/A         N/A           L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 P7         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-58%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-93.9%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-56.8%)         NO           L9 P5         NO (-90.6%)	L4 Core	N/A	N/A
L7 Core         N/A         N/A           L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-96.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P6         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 P0         NO (-64.4%)         NO           L9 P1         NO (-66.8%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-65.9%)         NO           L9 P4         NO (-	L3 Core	N/A	N/A
L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-63.7%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-79.7%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-96.5%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6	L2 Core	N/A	N/A
L7 P1         NO (-81.2%)         NO           L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-94.7%)         NO           L7 P6         NO (-91.9%)         NO           L7 Central         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-63.7%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-79.7%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-96.5%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6	L7 Core	N/A	N/A
L7 P2         NO (-59.7%)         NO           L7 P3         NO (-80.7%)         NO           L7 P4         NO (-66.2%)         NO           L7 P5         NO (-91.9%)         NO           L7 P6         NO (-91.5%)         NO           L7 P7         NO (-65.3%)         NO           L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 P7         NO (-63.7%)         NO           L8 P7         NO (-60.8%)         NO           L9 P1         NO (-66.8%)         NO           L9 P2         NO (-66.8%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-65.9%)         NO           L9 P5         NO (-90.6%)         NO           L9 P6         NO (-90.6%)         NO           L9 P6         NO (-90.6%)         NO		NO (-81.2%)	NO
L7 P3       NO (-80.7%)       NO         L7 P4       NO (-66.2%)       NO         L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-93.9%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-60.8%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-64.4%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P2		NO
L7 P4       NO (-66.2%)       NO         L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-93.9%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P3		NO
L7 P5       NO (-94.7%)       NO         L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.6%)       NO	L7 P4		NO
L7 P6       NO (-91.9%)       NO         L7 Central       NO (-91.5%)       NO         L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 P7       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 P0       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-95.9%)       NO         L9 P5       NO (-90.6%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P5		NO
L7 P7       NO (-65.3%)       NO         L8 Core       N/A       N/A         L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P6	NO (-91.9%)	NO
L8 Core         N/A         N/A           L8 P1         NO (-73.5%)         NO           L8 P2         NO (-59%)         NO           L8 P3         NO (-80.2%)         NO           L8 P4         NO (-65.8%)         NO           L8 P5         NO (-93.9%)         NO           L8 P6         NO (-91.2%)         NO           L8 Central         NO (-90.9%)         NO           L8 P7         NO (-63.7%)         NO           L9 Core         NO (-100%)         NO           L9 P1         NO (-64.4%)         NO           L9 P2         NO (-56.8%)         NO           L9 P3         NO (-79.7%)         NO           L9 P4         NO (-65.9%)         NO           L9 P5         NO (-93.1%)         NO           L9 P6         NO (-90.6%)         NO           L9 Central         NO (-90.1%)         NO	L7 Central	NO (-91.5%)	NO
L8 P1       NO (-73.5%)       NO         L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L7 P7	NO (-65.3%)	NO
L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 Core	N/A	N/A
L8 P2       NO (-59%)       NO         L8 P3       NO (-80.2%)       NO         L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P1	NO (-73.5%)	NO
L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P2		NO
L8 P4       NO (-65.8%)       NO         L8 P5       NO (-93.9%)       NO         L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P3	NO (-80.2%)	NO
L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P4		NO
L8 P6       NO (-91.2%)       NO         L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P5	NO (-93.9%)	NO
L8 Central       NO (-90.9%)       NO         L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 P6		NO
L8 P7       NO (-63.7%)       NO         L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L8 Central		NO
L9 Core       NO (-100%)       NO         L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		, ,	NO
L9 P1       NO (-64.4%)       NO         L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO	L9 Core		NO
L9 P2       NO (-56.8%)       NO         L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			NO
L9 P3       NO (-79.7%)       NO         L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		1	
L9 P4       NO (-65.9%)       NO         L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			
L9 P5       NO (-93.1%)       NO         L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO		, ,	
L9 P6       NO (-90.6%)       NO         L9 Central       NO (-90.1%)       NO			
L9 Central NO (-90.1%) NO			
		1 1	
	L9 P7	NO (-62.1%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?	
L10 Core	N/A	N/A	
L10 P1	NO (-58.4%)	NO	
L10 P2	NO (-57.1%)	NO	
L10 Central	NO (-83.3%)	NO	
L10 P3	NO (-80.8%)	NO	
L10 P4	NO (-70%)	NO	
podium level 1	NO (-94.8%)	NO	
L11 Core	N/A	N/A	
L11 P1	NO (-69.1%)	NO	
L11 P2	NO (-56.8%)	NO	
L11 Central	NO (-84.6%)	NO	
L11 P3	NO (-79.7%)	NO	
L11 P4	NO (-67.6%)	NO	
L12 Core	N/A	N/A	
L12 P1	NO (-56.4%)	NO	
L12 P2	NO (-66%)	NO	
L12 Central	NO (-83.3%)	NO	
L12 P3	NO (-78.8%)	NO	
L12 P4	NO (-65.3%)	NO	
L13 Core	N/A	N/A	
L13 P1	NO (-69.8%)	NO	
L13 P2	NO (-69.2%)	NO	
L13 Central	NO (-86.3%)	NO	
L13 P3	NO (-79.5%)	NO	
L13 P4	NO (-66.7%)	NO	
G Office Lobby Central	NO (-96.1%)	NO	
G Office Lobby P1	NO (-49.5%)	NO	

### Criterion 4: The performance of the building, as built, should be consistent with the 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?			
Is evidence of such assessment available as a separate submission?			
Are any such measures included in the proposed design?	YES		

### **Technical Data Sheet (Actual vs. Notional Building)**

### **Building Global Parameters**

	Actual	Notional
Area [m²]	14730.5	14730.5
External area [m²]	8624.8	8624.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	4730.57	5927.76
Average U-value [W/m²K]	0.55	0.69
Alpha value* [%]	10	10

<sup>\*</sup> 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	3.75	5.69
Cooling	6.72	6.46
Auxiliary	13.03	15.05
Lighting	17.69	21.46
Hot water	3.2	3.17
Equipment*	42.18	42.18
TOTAL**	44.39	51.83

<sup>\*</sup> 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/m<sup>2</sup>]

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

### Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	105.47	105.78
Primary energy* [kWh/m²]	120.56	139.43
Total emissions [kg/m²]	20.4	23.7

<sup>\*</sup> Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

H	HVAC Systems Performance									
Sys	stem Type	Heat dem MJ/m2	Cool dem MJ/m2			Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST	[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
	Actual	12.1	93.4	3.7	6.7	13	0.9	3.86	0.95	5.1
	Notional	17.7	88.1	5.7	6.5	15.1	0.86	3.79		

### 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

# **Key Features**

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

### **Building fabric**

Element	<b>U</b> i-Тур	U <sub>i-Min</sub>	Surface where the minimum value occurs*
Wall	0.23	0.2	LV000000:Surf[1]
Floor	0.2	0.2	LV000000:Surf[0]
Roof	0.15	0.18	LV000001:Surf[0]
Windows, roof windows, and rooflights	1.5	1.1	L100002A:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U <sub>i-Typ</sub> = Typical individual element U-values [W/(m²K)	)		U <sub>i-Min</sub> = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the n	ninimum U	l-value oc	curs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

### Design - 'Lean' Energy Strategy



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	David Mason	Assessor number	12345
Client	Northwood Investors	Last modified	30/06/2015
Address	High Holborn, London		

Client	Northwoo	d Investors					La	ast modified	d	30/06	5/2015	
Address	High Holb	orn, London										
4.0												
1. Overall dwelling dimen	sions			Δ.			A			V.	-l	
				A	rea (m²)			rage storey eight (m)		VC	olume (m³)	
Lowest occupied					55.70	(1a) x		2.90	(2a) =		161.53	(3a)
Total floor area	(1a)	+ (1b) + (1	c) + (1d)(1	n) =	55.70	(4)						
Dwelling volume							(3a	) + (3b) + (3	c) + (3d)(3	3n) =	161.53	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								0	x 40 =	:	0	(6a)
Number of open flues								0	x 20 =	:	0	(6b)
Number of intermittent fan	S							0	x 10 =	:	0	(7a)
Number of passive vents								0	x 10 =	:	0	(7b)
Number of flueless gas fires	5							0	x 40 =	:	0	(7c)
										Air	changes pe hour	r
Infiltration due to chimneys	s, flues, fans	s, PSVs		(6a)	+ (6b) + (7	a) + (7b) + (	7c) =	0	÷ (5) =	=	0.00	(8)
If a pressurisation test has	been carried	d out or is i	ntended, pro	oceed to (1	17), otherw	vise continu	e from (9)	to (16)				
Air permeability value, q50	, expressed	in cubic m	etres per ho	ur per squ	are metre	of envelope	e area				2.50	(17)
If based on air permeability	value, ther	n (18) = [(1	7) ÷ 20] + (8)	, otherwis	se (18) = (1	6)					0.13	(18)
Number of sides on which t	he dwelling	; is sheltere	ed								3	(19)
Shelter factor								1 -	- [0.075 x (1	9)] =	0.78	(20)
Infiltration rate incorporati	ng shelter fa	actor							(18) x (2	20) =	0.10	(21)
Infiltration rate modified fo	r monthly v	vind speed	:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee	ed from Tab	le U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	llowing for	shelter and	d wind factor	r) (21) x (2	2a)m							
0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.09	0.10	0.10	0.11	0.11	(22b)
Calculate effective air chan	ge rate for t	he applica	ble case:									

	0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.09	0.10	0.10	0.11	0.11	(22b)
Calculate effective	ve air chang	ge rate for t	he applical	ole case:									
If mechanical	ventilation	: air change	e rate throu	ıgh system								0.50	(23a)
If balanced w	ith heat red	covery: effic	ciency in %	allowing fo	r in-use fac	tor from Ta	able 4h					73.10	(23c)
a) If balanced	mechanica	al ventilatio	n with hea	t recovery (	MVHR) (22	b)m + (23b	) x [1 - (23c	:) ÷ 100]					
	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.23	0.24	0.24	0.25	(24a)
Effective air char	nge rate - e	nter (24a) c	or (24b) or (	(24c) or (24	d) in (25)								
	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.23	0.24	0.24	0.25	(25)



3. Heat losses a	and heat lo	33 paramete	CI.									
Element			;	Gross area, m²	Openings m <sup>2</sup>	Net a A, n		U-value W/m²K	A x U W/	К к-value, kJ/m².K	Αxκ, kJ/K	
Window						13.9	2 x	1.33	= 18.45			(27)
Party wall						70.4	7 x	0.00	= 0.00			(32)
External wall						12.7	'6 x	0.18	= 2.30			(29a)
Total area of ext	ternal elem	ents ∑A, m²				26.6	8					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26)	(30) + (32) =	20.75	(33)
Heat capacity Cr	m = ∑(A x κ)							(28)	.(30) + (32) +	(32a)(32e) =	N/A	(34)
Thermal mass pa	arameter (T	TMP) in kJ/m	1²K								250.00	(35)
Thermal bridges	s: ∑(L x Ѱ) ca	alculated us	ing Apper	ndix K							4.00	(36)
Total fabric heat	t loss									(33) + (36) =	24.75	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	, Dec	
Ventilation heat	loss calcula	ated monthl	ly 0.33 x (	25)m x (5)								
	13.75	13.62	13.50	12.85	12.72	12.08	12.08	11.95	12.33	12.72 12.9	8 13.24	(38)
Heat transfer co	efficient, W	//K (37)m +	(38)m									
	38.51	38.38	38.25	37.60	37.47	36.83	36.83	36.70	37.09	37.47 37.7	3 37.99	
									Average = ∑(	39)112/12 =	37.57	(39)
Heat loss param	eter (HLP),	W/m²K (39	)m ÷ (4)									
	0.69	0.69	0.69	0.68	0.67	0.66	0.66	0.66	0.67	0.67 0.68	0.68	
									Average = ∑(	40)112/12 =	0.67	(40)
Number of days	in month (	Table 1a)										
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.0	0 31.00	(40)
4. Water heating	ng energy r	aquiramant										
		equirement	•									7 ()
Assumed occupa	ancy, N				(2)						1.86	(42)
	ancy, N hot water ι	usage in litre	es per day								78.32	(42)
Assumed occupa	ancy, N hot water u Jan	usage in litre <b>Feb</b>	es per day <b>Mar</b>	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	78.32	= -
Assumed occupa	ancy, N hot water u Jan e in litres pe	usage in litre <b>Feb</b> er day for ea	es per day <b>Mar</b> ch month	Apr Vd,m = fac	<b>May</b> tor from Tab	<b>Jun</b> le 1c x (43)					78.32 / Dec	7
Assumed occupa	ancy, N hot water u Jan	usage in litre <b>Feb</b>	es per day <b>Mar</b>	Apr	May	Jun	Jul 70.49	Aug 73.62	<b>Sep</b>	79.89 83.0	78.32 Dec 2 86.16	(43)
Assumed occupa Annual average Hot water usage	ancy, N hot water u <b>Jan</b> e in litres pe 86.16	usage in litre Feb er day for ea	es per day <b>Mar</b> ch month 79.89	<b>Apr</b> Vd,m = fac 76.76	May tor from Tab 73.62	Jun le 1c x (43) 70.49	70.49	73.62			78.32 / Dec	7
Assumed occupa	hot water u Jan e in litres pe 86.16	usage in litre Feb er day for ea 83.02	es per day  Mar  ch month  79.89	Apr Vd,m = fac 76.76  x nm x Tm/3	May tor from Tab 73.62 3600 kWh/m	Jun le 1c x (43) 70.49 onth (see T	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83.0 Σ(44)112 =	78.32 Dec 2 86.16 939.88	(43)
Assumed occupa Annual average Hot water usage	ancy, N hot water u <b>Jan</b> e in litres pe 86.16	usage in litre Feb er day for ea	es per day <b>Mar</b> ch month 79.89	<b>Apr</b> Vd,m = fac 76.76	May tor from Tab 73.62	Jun le 1c x (43) 70.49	70.49	73.62		79.89 83.0 Σ(44)112 = 104.38 113.9	78.32  Dec  2 86.16  939.88	(43)
Assumed occupa Annual average Hot water usage Energy content o	hot water u Jan in litres pe 86.16 of hot wate	r used = 4.1	es per day  Mar  ch month  79.89	Apr Vd,m = fac 76.76  x nm x Tm/3	May tor from Tab 73.62 3600 kWh/m	Jun le 1c x (43) 70.49 onth (see T	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83.0 Σ(44)112 =	78.32 Dec 2 86.16 939.88	(43)
Assumed occupa Annual average Hot water usage	hot water u Jan e in litres pe 86.16 of hot wate 127.77	r used = 4.1 111.75	Mar ch month 79.89 8 x Vd,m 115.31	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see T	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  Dec  2 86.16  939.88  4 123.74  1232.34	(43)
Assumed occupated Annual average  Hot water usage  Energy content of Distribution loss	hot water u  Jan e in litres pe  86.16  of hot wate  127.77  6 0.15 x (45)	r used = 4.1 111.75 )m	es per day  Mar  ch month  79.89  8 x Vd,m  115.31	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83.0 Σ(44)112 = 104.38 113.9	78.32  Dec  86.16  939.88  123.74  1232.34	(43)
Assumed occupation occupation and average.  Hot water usage occupation occupa	hot water u Jan e in litres pe 86.16  of hot wate 127.77  c 0.15 x (45 19.17  (litres) includes	r used = 4.1 111.75 )m	es per day  Mar  ch month  79.89  8 x Vd,m  115.31	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  Dec  2 86.16  939.88  4 123.74  1232.34	(43)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water use in litres per 86.16  of hot water 127.77  s 0.15 x (45  19.17  (litres) includes:	r used = 4.1  111.75  m  16.76  usage in litre  red  183.02	es per day Mar ch month 79.89 8 x Vd,m 115.31 17.30 olar or WV	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08  VHRS storage	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  Dec  86.16  939.88  123.74  1232.34	(43)
Assumed occupation occupation and average.  Hot water usage occupation occupa	hot water u  Jan e in litres pe  86.16  of hot wate  127.77  6 0.15 x (45  19.17  (litres) incluses: r's declared	r used = 4.1  111.75  )m  16.76  uding any so	es per day Mar ch month 79.89 8 x Vd,m 115.31  17.30 blar or WV	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00	(43) (44) (45) (46) (47)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water under the second sec	r used = 4.1  111.75  m  16.76  uding any so	es per day Mar ch month 79.89 8 x Vd,m 115.31  17.30 blar or WV	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  34 123.74  1232.34  9 18.56  110.00	(43) (44) (44) (45) (46) (47)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water u  Jan e in litres pe  86.16  of hot wate  127.77  c 0.15 x (45  19.17  (litres) incluses: e's declared orage loss from Tab	r used = 4.1  111.75  In the series of the s	es per day Mar ch month 79.89 8 x Vd,m 115.31  17.30 blar or WV	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00  0.02  1.03	(43) (44) (44) (45) (46) (47) (51) (52)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water use in litres per second orage loss for from Table and second or s	reber day for ea 83.02 er used = 4.1 111.75 )m 16.76 uding any so factor from Table 2b	Mar ch month 79.89  8 x Vd,m 115.31  17.30  olar or WV  is not kno	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00  0.02  1.03  0.60	(43) (44) (44) (45) (46) (47) (51) (52) (53)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water u  Jan e in litres pe  86.16  of hot wate  127.77  6 0.15 x (45  19.17  (litres) inclusors: r's declared orage loss from Table a factor from water services.	reber day for ea 83.02 er used = 4.1 111.75 )m 16.76 uding any so factor from Table 2b	Mar ch month 79.89  8 x Vd,m 115.31  17.30  olar or WV  is not kno	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00  0.02  1.03  0.60  1.03	(43) (44) (44) (45) (46) (47) (51) (52) (53) (54)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water to Jan e in litres per 86.16  of hot water 127.77  6 0.15 x (45 19.17  (litres) inclusors: r's declared orage loss from Table e factor from water states in (55)	reber day for ea 83.02 er used = 4.1 111.75 )m 16.76 uding any so actor from Table 2a m Table 2b storage (kW	es per day Mar ch month 79.89  8 x Vd,m 115.31  17.30  olar or WV  is not kno  Fable 2 (kv	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da 7) x (51) x (	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00  0.02  1.03  0.60	(43) (44) (44) (45) (46) (47) (51) (52) (53)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water to Jan e in litres per 86.16  of hot water 127.77  6 0.15 x (45 19.17  (litres) inclusors: r's declared orage loss from Tab e factor from water series 1) in (55) poss calculate	r used = 4.1  111.75  In the standard of the s	es per day Mar ch month 79.89 8 x Vd,m 115.31  17.30  olar or WV is not kno Γable 2 (k) h/day) (4	Apr Vd,m = fac 76.76  x nm x Tm/: 100.53  15.08  VHRS storag wn Wh/litre/da 7) x (51) x ( 5) x (41)m	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san y)	Jun le 1c x (43) 70.49 onth (see T 83.24  12.49 ne vessel	70.49 ables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (44) (45) (46) (47) (51) (52) (53) (54) (55)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water to Jan e in litres per 86.16  of hot water 127.77  6 0.15 x (45 19.17  (litres) inclusors: r's declared orage loss from Table e factor from water states and in (55) poss calculate 32.01	reber day for ea 83.02  rused = 4.1 111.75  m 16.76  uding any so actor from Tactor from Table 2b storage (kW) ed for each 28.92	es per day  Mar  ch month  79.89  8 x Vd,m  115.31  17.30  blar or WV  is not kno  Fable 2 (k)  h/day) (4  month (5)  32.01	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08 VHRS storag wn Wh/litre/da 7) x (51) x ( 5) x (41)m 30.98	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san y)  52) x (53)	Jun le 1c x (43) 70.49 onth (see T 83.24  12.49 ne vessel	70.49 ables 1b 77.13  11.57	73.62 , 1c 1d) 88.51 13.28	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (44) (45) (46) (47) (51) (52) (53) (54)
Assumed occupated Annual average  Hot water usage  Energy content of the content	hot water to Jan e in litres per 86.16  of hot water 127.77  6 0.15 x (45 19.17  (litres) inclusors: r's declared orage loss from Table e factor from water states and in (55) poss calculate 32.01	reber day for ea 83.02  rused = 4.1 111.75  m 16.76  uding any so actor from Tactor from Table 2b storage (kW) ed for each 28.92	es per day  Mar  ch month  79.89  8 x Vd,m  115.31  17.30  blar or WV  is not kno  Fable 2 (k)  h/day) (4  month (5)  32.01	Apr Vd,m = fac 76.76  x nm x Tm/3 100.53  15.08 VHRS storag wn Wh/litre/da 7) x (51) x ( 5) x (41)m 30.98	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san y)  52) x (53)	Jun le 1c x (43) 70.49 onth (see T 83.24  12.49 ne vessel	70.49 ables 1b 77.13  11.57	73.62 , 1c 1d) 88.51 13.28	76.76 89.57	79.89 83.0 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	78.32  7 Dec  2 86.16  939.88  04 123.74  1232.34  9 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (44) (45) (46) (47) (51) (52) (53) (54) (55)

Primary circuit	t loss for each	month fro	m Table 3										
	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)
Combi loss for	r each month	from Table	3a, 3b or 3	С		•					•	•	'
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requ	uired for wat	er heating c	alculated f	or each mo	onth 0.85 >	κ (45)m + (4	6)m + (57)ı	m + (59)m +	· (61)m				,
	183.04	161.67	170.59	154.03	151.74	136.73	132.41	143.79	143.06	159.66	167.44	179.01	(62)
Solar DHW inp	out calculated	using Appe	endix G or A	Appendix H	I	•		•					
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from w	water heater f	or each mo	nth (kWh/ı	month) (6	2)m + (63)r	n	1	•		•			
	183.04	161.67	170.59	154.03	151.74	136.73	132.41	143.79	143.06	159.66	167.44	179.01	
					•	•	•			Σ(64)1	.12 = 1	883.18	(64)
Heat gains fror	m water heat	ing (kWh/m	nonth) 0.25	5 × [0.85 ×	(45)m + (6	1)m] + 0.8 >	〈 [(46)m + (	57)m + (59)	m]				
	86.70	77.10	82.56	76.22	76.30	70.47	69.87	73.65	72.58	78.93	80.68	85.36	(65)
											1		
5. Internal ga	ains												
Metabolic gain	<b>Jan</b> ns (Table 5)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	(66)
Lighting gains (	(calculated in	Appendix I		L9 or L9a)	, also see T	able 5				•	•	•	
	36.91	32.79	26.66	20.19	15.09	12.74	13.77	17.89	24.02	30.49	35.59	37.94	(67)
Appliance gain	ns (calculated	in Appendi	x L, equation	on L13 or L	13a), also s	see Table 5	•						
	241.77	244.28	237.96	224.50	207.51	191.54	180.87	178.37	184.69	198.15	215.14	231.10	(68)
Cooking gains	(calculated in	Appendix I	L, equation	L15 or L15	sa), also see	e Table 5				•			
	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	(69)
Pump and fan	gains (Table !	5a)								Į.			
	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. eva	aporation (Tal	ble 5)											, ,
· ·	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	(71)
Water heating						•				ı	1	1	
J	116.54	114.73	110.97	105.86	102.55	97.88	93.91	98.99	100.80	106.09	112.06	114.74	(72)
Total internal ខ្												1	, , ,
	480.39	476.96	460.76	435.71	410.31	387.32	373.71	380.41	394.67	419.89	447.95	468.94	(73)
6. Solar gains	c												
o. Solai gallis			Access f Table		Area m²		lar flux V/m²	-	g ific data able 6b	FF specific o		Gains W	
North			0.30	) x C	11.52	x 1	10.63 x	0.9 x	).63 x	0.95		19.79	(74)
East			0.30		2.40				0.63 x			7.62	(74)
	watts Σ(74)m	ı(82)m	5.5	· ^ L			^		^	3.33			, (. 0)
Solar gains in v	,		00.02	139.04	182.95	193.80	181.76	147.01	105.83	62.71	33.92	22.77	(83)
Solar gains in v	27.41	52.73	88.82	133.0-									, , , , , ,
-	27.41	52.73 plar (73)m +		133.04		•							
-				574.75	593.26	581.12	555.47	527.42	500.49	482.60	481.86	491.71	(84)
-	507.80	olar (73)m + 529.69	(83)m 549.58			581.12	555.47	527.42	500.49	482.60	481.86	491.71	(84)
Total gains - in	507.80	529.69 ture (heatin	(83)m 549.58 ng season)	574.75	593.26		555.47	527.42	500.49	482.60	481.86		1
Solar gains in v Total gains - in  7. Mean inter Temperature o	507.80	529.69 ture (heatin	(83)m 549.58 ng season)	574.75	593.26 Table 9, Th	1(°C)						21.00	] (84) ] (85)
Total gains - in  7. Mean inter Temperature o	507.80  rnal tempera during heating	blar (73)m + 529.69 ture (heating periods in Feb	(83)m 549.58  ng season) the living a	574.75  area from Apr	593.26  Table 9, Thi		555.47 Jul	527.42 Aug	500.49 Sep	482.60 Oct	481.86 Nov		1
Total gains - in	507.80  rnal tempera during heating	blar (73)m + 529.69 ture (heating periods in Feb	(83)m 549.58  ng season) the living a	574.75  area from Apr	593.26  Table 9, Thi	1(°C)						21.00	1

	temp of livin	g area T1 (s	steps 3 to 7	' in Table 9	c)								
	20.71	20.78	20.88	20.97	21.00	21.00	21.00	21.00	21.00	20.97	20.85	20.70	(87)
Temperature du	uring heatin	g periods ir	the rest o	f dwelling f	from Table 9	9, Th2(°C)		•			•		_
	20.35	20.35	20.35	20.36	20.36	20.38	20.38	20.38	20.37	20.36	20.36	20.36	(88)
Utilisation facto	or for gains f	1											. ,
	0.95	0.93	0.87	0.73	0.55	0.37	0.25	0.28	0.46	0.74	0.90	0.96	(89)
Mean internal t		ļ	ļ	ı	ļ			0.20	0.40	0.74	0.50	0.50	] (03)
Wican internal t			,		· ·	1		20.20	20.27	20.24	20.10	10.07	7 (00)
	19.99	20.08	20.21	20.33	20.36	20.38	20.38	20.38	20.37	20.34	20.18	19.97	(90)
Living area fract									Liv	ving area ÷	(4) =	0.46	(91)
Mean internal t			1	_	+(1 - fLA) x <sup>-</sup>	Г2	,			,	,		7
	20.32	20.40	20.52	20.63	20.66	20.67	20.67	20.67	20.66	20.63	20.49	20.31	(92)
Apply adjustme	ent to the m	ean interna	l temperati	ure from Ta	able 4e whe	re appropr	iate						_
	20.32	20.40	20.52	20.63	20.66	20.67	20.67	20.67	20.66	20.63	20.49	20.31	(93)
8. Space heati	ng requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains,	ηm											
	0.95	0.93	0.87	0.74	0.56	0.38	0.27	0.30	0.49	0.75	0.91	0.96	(94)
Useful gains, ηn	mGm, W (94	4)m x (84)m	ı										
	483.22	492.51	480.60	426.81	333.99	223.32	149.73	156.58	242.98	362.87	436.94	471.13	(95)
Monthly averag	ge external t	emperature	e from Tabl	le U1									
	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		ernal tempe	erature. Lm		n x [(93)m -					l		1	. ,
	617.06	595.03	536.31	440.96	335.64	223.39	149.74	156.59	243.39	375.88	505.39	612.05	(97)
Space heating r			l.	1	-		143.74	130.33	243.33	373.00	303.33	012.03	] (37)
Space nearing i	_	68.90	41.45		1.23		0.00	0.00	0.00	0.60	10.20	T	7
	99.58	1 hX 90											1
		00.50	41.43	10.19	1.23	0.00	0.00	0.00	0.00	9.68	49.29	104.84	] (00)
		1		10.19	1.25	0.00	0.00	0.00		3)15, 10	.12 =	385.14	(98)
Space heating r	equirement	1		10.13	1.25	0.00	0.00	0.00		3)15, 10		1	(98) (99)
		kWh/m²/y		10.19	1.23	0.00	0.00	0.00		3)15, 10	.12 =	385.14	_
Space heating r	ling requirer	kWh/m²/y	ear						∑(98	(98)	.12 = ÷ (4)	385.14 6.91	_
8c. Space cool	ling requirer Jan	kWh/m²/y		Apr	May	Jun	Jul	Aug		3)15, 10	.12 =	385.14	_
8c. Space cool	ling requirer Jan	kWh/m²/yı nent Feb	ear Mar	Apr	May	Jun	Jul	Aug	∑(98 <b>Sep</b>	(98) Oct	.12 = ÷ (4)	385.14 6.91 Dec	(99)
8c. Space cool Heat loss rate L	Jan m 0.00	kWh/m²/yı ment Feb  0.00	ear						∑(98	(98)	.12 = ÷ (4)	385.14 6.91	
8c. Space cool	Jan .m 0.00 or for loss ηr	kWh/m²/yo	Mar 0.00	<b>Apr</b>	<b>May</b>	Jun 346.19	Jul 272.53	Aug 278.92	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	385.14 6.91 Dec	(100)
8c. Space cool Heat loss rate L Utilisation factor	Jan .m 0.00 or for loss nr	kWh/m²/yı ment Feb  0.00 m	Mar 0.00	Apr	May	Jun	Jul	Aug	∑(98 <b>Sep</b>	(98) Oct	.12 = ÷ (4)	385.14 6.91 Dec	(100)
8c. Space cool Heat loss rate L Utilisation factor	Jan .m 0.00 or for loss nr	kWh/m²/yı ment Feb  0.00 m	Mar 0.00	<b>Apr</b>	<b>May</b>	Jun 346.19	Jul 272.53	Aug 278.92	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	385.14 6.91 Dec	] (99) ] (100) ] (101)
8c. Space cool Heat loss rate L	Jan .m 0.00 or for loss nr	kWh/m²/yı ment Feb  0.00 m	Mar 0.00	<b>Apr</b>	<b>May</b>	Jun 346.19	Jul 272.53	Aug 278.92	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	385.14 6.91 Dec	] (99) ] (100 ] (101)
8c. Space cool Heat loss rate L Utilisation factor	Jan .m  0.00 or for loss nr  0.00 Lm (watts) (	kWh/m²/yı ment Feb  0.00 m  0.00 100)m x (10	Mar 0.00 0.00 0.1)m	<b>Apr</b> 0.00 0.00	<b>May</b> 0.00	Jun 346.19	Jul 272.53	Aug 278.92	∑(98 Sep  0.00  0.00	(98) Oct 0.00	.12 = ÷ (4)	385.14 6.91 Dec 0.00	] (99) ] (100 ] (101)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL	Jan .m  0.00 or for loss nr  0.00 Lm (watts) (	kWh/m²/yı ment Feb  0.00 m  0.00 100)m x (10	Mar 0.00 0.00 0.1)m	<b>Apr</b> 0.00 0.00	<b>May</b> 0.00	Jun 346.19	Jul 272.53	Aug 278.92	∑(98 Sep  0.00  0.00	(98) Oct 0.00	.12 = ÷ (4)	385.14 6.91 Dec 0.00	(100) (101) (102)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains	Jan .m  0.00 or for loss nr  0.00 .m (watts) (  0.00	kWh/m²/yı ment Feb  0.00 m  0.00 100)m x (10 0.00	Mar  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00	0.00 0.00 0.00	Jun  346.19  1.00  345.62	Jul 272.53 1.00 272.42 676.65	Aug 278.92 1.00 278.68	Sep  0.00  0.00  0.00	Oct  0.00  0.00	.12 =	385.14 6.91  Dec  0.00  0.00	(100) (101) (102)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains	Jan .m  0.00 or for loss nr  0.00 .m (watts) (  0.00	kWh/m²/yı ment Feb  0.00 m  0.00 100)m x (10 0.00	Mar  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00	0.00 0.00 0.00	Jun  346.19  1.00  345.62  710.32 (103)m - (1	Jul 272.53 1.00 272.42 676.65 02)m] x (41	Aug 278.92 1.00 278.68 625.43 L)m	Sep  0.00  0.00  0.00	Oct  0.00  0.00	.12 =	385.14 6.91  Dec  0.00  0.00	(99)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL	Jan .m  0.00 or for loss nr  0.00 Lm (watts) (  0.00  0.00 equirement	kWh/m²/yı ment Feb  0.00 m  0.00 100)m x (10 0.00  0.00 , whole dwa	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00 0.00 inuous (kw	0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun  346.19  1.00  345.62	Jul 272.53 1.00 272.42 676.65	Aug 278.92 1.00 278.68	Sep  0.00  0.00  0.00	Oct  0.00  0.00  0.00	.12 =	385.14 6.91  Dec  0.00  0.00  0.00  0.00	(100) (101) (102) (103)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re	Jan .m  0.00 or for loss nr  0.00 .m (watts) (  0.00  0.00 equirement,	kWh/m²/yı ment Feb  0.00 m  0.00 100)m x (10 0.00  0.00 , whole dwa	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00 0.00 inuous (kw	0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun  346.19  1.00  345.62  710.32 (103)m - (1	Jul 272.53 1.00 272.42 676.65 02)m] x (41	Aug 278.92 1.00 278.68 625.43 L)m	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00	.12 =	385.14 6.91 Dec 0.00 0.00 0.00 0.00 0.00 821.31	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	Jan  .m  0.00  or for loss nr  0.00  .m (watts) (  0.00  0.00  equirement,  0.00	New	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00 0.00 inuous (kw	0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun  346.19  1.00  345.62  710.32 (103)m - (1	Jul 272.53 1.00 272.42 676.65 02)m] x (41	Aug 278.92 1.00 278.68 625.43 L)m	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00	.12 =	385.14 6.91  Dec  0.00  0.00  0.00  0.00	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	Jan  .m  0.00  or for loss nr  0.00  m (watts) (  0.00  equirement,  0.00	kWh/m²/yı ment Feb  0.00 m 0.00 100)m x (10 0.00 0.00 0.00 0.00	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00 inuous (kW 0.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Jun  346.19  1.00  345.62  710.32 (103)m - (1 262.58	Jul 272.53  1.00  272.42  676.65  02)m] x (41 300.75	Aug  278.92  1.00  278.68  625.43  1)m  257.98	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  2(104)6.  oled area ÷	.12 =	385.14 6.91  Dec  0.00  0.00  0.00  0.00  821.31 0.72	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re	Jan  .m  0.00  or for loss nr  0.00  .m (watts) (  0.00  0.00  equirement,  0.00	New	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00 0.00 inuous (kw	0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun  346.19  1.00  345.62  710.32 (103)m - (1	Jul 272.53 1.00 272.42 676.65 02)m] x (41	Aug 278.92 1.00 278.68 625.43 L)m	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  Σ(104)6. oled area ÷	.12 =	385.14 6.91 Dec  0.00  0.00  0.00  0.00  0.72  0.00	(100) (100) (101) (102) (103) (104) (105)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	Jan  .m  0.00  or for loss nr  0.00  m (watts) (  0.00  equirement,  0.00	kWh/m²/yı ment Feb  0.00 m 0.00 100)m x (10 0.00 0.00 0.00 0.00	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00 0.00 inuous (kW 0.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Jun  346.19  1.00  345.62  710.32 (103)m - (1 262.58	Jul 272.53  1.00  272.42  676.65  02)m] x (41 300.75	Aug  278.92  1.00  278.68  625.43  1)m  257.98	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  2(104)6.  oled area ÷	.12 =	385.14 6.91  Dec  0.00  0.00  0.00  0.00  821.31 0.72	(100) (101) (102) (103) (104) (105)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	Jan  .m  0.00  or for loss nr  0.00  .m (watts) (  0.00  equirement,  0.00  actor (Table	kWh/m²/yı ment Feb  0.00 m 0.00 100)m x (10 0.00 0.00 0.00 10) 0.00	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  nuous (kW  0.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Jun  346.19  1.00  345.62  710.32 (103)m - (1 262.58	Jul 272.53  1.00  272.42  676.65  02)m] x (41 300.75	Aug  278.92  1.00  278.68  625.43  1)m  257.98	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  Σ(104)6. oled area ÷	.12 =	385.14 6.91  Dec  0.00  0.00  0.00  0.00  821.31  0.72	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction  Intermittency factor	Jan  .m  0.00  or for loss nr  0.00  .m (watts) (  0.00  equirement,  0.00  actor (Table	kWh/m²/yı ment Feb  0.00 m 0.00 100)m x (10 0.00 0.00 0.00 10) 0.00	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  nuous (kW  0.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Jun  346.19  1.00  345.62  710.32 (103)m - (1 262.58	Jul 272.53  1.00  272.42  676.65  02)m] x (41 300.75	Aug  278.92  1.00  278.68  625.43  1)m  257.98	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  Σ(104)6. oled area ÷	.12 =	385.14 6.91  Dec  0.00  0.00  0.00  0.00  821.31  0.72	(100) (101) (102) (103) (104) (105)

Fraction of total space heat from community boilers   Factor for control and charging method (Table 46(3)) for community space heating   Tactor for control and charging method (Table 46(3)) for community water heating   Tactor for charging method (Table 46(3)) for community water heating   Tactor for charging method (Table 46(3)) for community water heating   Tactor for charging method (Table 46(3)) for community water heating   Tactor for charging method (Table 46(3)) for community heating system   Tactor for charging method (Table 46(3)) for community heating system   Tactor for charging requirement   385.14   385.	Space cooling requirement kWh/m²/year			(107) ÷ (4) =	2.66	(108)
Fraction of space heat from community eastern   1-(301)   1.000   (302)	9b. Energy requirements - community heating scheme					
Fraction of community heat from boilers  Fraction of tord ispace heat from community boilers  Fractior for orthor and charging method (Table 4(3)) for community space heating Factor for orthor and charging method (Table 4(3)) for community water heating.  Distribution loss factor (Table 12x) for community heating system  Space heating  Fraction of charging method (Table 4(3)) for community water heating.  Space heating  Fraction of charging method (Table 4(3)) for community water heating.  Space heating  Fraction of charging method (Table 4(3)) for community heating system  Space heating  Fraction of charging method (Table 4(3)) for community heating system  Space heating  Fraction of charging method (Table 4(3)) for community heating system  Space heating  Fraction of charging method (Table 4(3)) for community heating system  Space heating  Fraction of charging method (Table 4(3)) for community heating system  Space heating  Fraction of charging method (Table 4(3)) for community heating system  Space heating  Fraction of charging method (Table 4(1)) for community heating system  Space heating from boilers  Space cooling  Space heating from boilers  Space heat	Fraction of space heat from secondary/supplementary syste	m (table 11)		'0' if none	0.00	(301)
Fraction of total space heat from community boilers Factor for control and charging method (Table 4(3)) for community space heating Factor for control and charging method (Table 4(3)) for community water heating Distribution loss factor (Table 12c) for community water heating Distribution loss factor (Table 12c) for community heating system  Space heating Annual space heating requirement Space heating requirement Space heating requirement Space heating Space heating requirement Space heating requirement Space heating for heat distribution Space heating for heat heating for heat distribution Space heating for heating for heating heating scheme  Fuel between the space heating for heating scheme  Fuel space heating from boilers Space cooling 120 260.77 x 131.90 x001 233.00 340.0	Fraction of space heat from community system			1 - (301) =	1.00	(302)
Factor for control and charging method (Table 4c(3)) for community water heating   1.00   1	Fraction of community heat from boilers				1.00	(303a)
Section for charging method (Table 4(31)) for community water heating system   1.00   1.05	Fraction of total space heat from community boilers			(302) x (303a) =	1.00	(304a)
Space heating   Space heating requirement   Space heating heatin	Factor for control and charging method (Table 4c(3)) for con	nmunity space heating			1.00	(305)
Space heating   Space heating requirement   Space   Space heating requirement   Space   Space heating requirement   Space   Space heating requirement   Space   Spac	Factor for charging method (Table 4c(3)) for community wat	er heating			1.00	(305a)
Annual space heating requirement  Space heat from boilers  Water heating  Annual water heating requirement  Mater heat from boilers  Annual water heating from boilers  Annual water heat	Distribution loss factor (Table 12c) for community heating sy	ystem			1.05	(306)
Space heat from boilers   Space heat from	Space heating					
Water heating           Annual water heating requirement         1883.18         (64)           Water heat from boilers         (64) x (303a) x (305a) x (306) = 1977.33         (310a)           Electricity used for heat distribution         0.01 x ([307a)(307e) + (310a)(310e) = 23.81         (331)           Cooling System Energy Efficiency Ratio         0         (314)           Electricity for pumps, fans and electric keep-hot (Table 4f)         mechanical ventilation fans - balanced, extract or positive input from outside         177.36         (331)           Total electricity for flaghting (Appendix L)         260.77         (332)           Total electricity for lighting (Appendix L)         260.77         (332)           Total delivered energy for all uses         (307) + (309) + (310) + (312) + (315) + (331) + (332)(337b) = 2850.36         (338)           Displace leasting from boilers         Fuel by Fuel Wkh/year         Fuel price         <	Annual space heating requirement			385.14		(98)
Manual water heating requirement   1883.18   (64)   (64)   (777.35   (15)   (	Space heat from boilers			(98) x (304a) x (305) x (306) =	404.40	(307a)
Water heat from boiliers   (64) x (303a) x (305a) x (305a)   (310a)   (31	Water heating					
Electricity used for heat distribution 0.01 × [(307a)(307e) + (310a)(310e) [313] (313] (301g) (314g) (314	Annual water heating requirement			1883.18		(64)
Cooling System Energy Efficiency Ratio   0   144     Electricity for pumps, fans and electric keep-hot (Table 4f)     mechanical ventilation fans - balanced, extract or positive input from outside   177.36   137.39   137.39	Water heat from boilers			(64) x (303a) x (305a) x (306) =	1977.33	(310a)
Electricity for pumps, fans and electric keep-hot (Table 4f) mechanical ventilation fans - balanced, extract or positive input from outside  Total electricity for the above, kWh/year  Electricity for lighting (Appendix L)  Total delivered energy for all uses  (307) + (309) + (310) + (312) + (315) + (331) + (332)(337b) = 2850.36	Electricity used for heat distribution		$0.01 \times [(3$	07a)(307e) + (310a)(310e)] =	23.81	(313)
Trace   Process   177.36   177.36   177.36   130.00   1	Cooling System Energy Efficiency Ratio				0	(314)
Total electricity for the above, kWh/year   260.77   3321	Electricity for pumps, fans and electric keep-hot (Table 4f)					
Electricity for lighting (Appendix L)  Total delivered energy for all uses  (307) + (309) + (310) + (312) + (315) + (331) + (332)(337b) = 2850.36 (338)    10b. Fuel costs - community heating scheme	mechanical ventilation fans - balanced, extract or positive	e input from outside		177.36		(330a)
Total delivered energy for all uses   (307) + (309) + (310) + (312) + (315) + (331) + (332)(337b) = 2850.36   (338)	Total electricity for the above, kWh/year				177.36	(331)
Tuel costs - community heating scheme   Fuel kWh/year   Fuel price kWh/year   Fuel price cost £/year	Electricity for lighting (Appendix L)				260.77	(332)
Fuel   Fuel   KWh/year   Fuel   Fuel   Cost E/year	Total delivered energy for all uses	(307) + (309) + (	(310) + (312)	+ (315) + (331) + (332)(337b) =	2850.36	(338)
kWh/year         cost £/year           Space heating from boilers         404.40         x         4.24         x 0.01 =         17.15         (340a)           Water heating from boilers         1977.33         x         4.24         x 0.01 =         83.84         (342a)           Space cooling         -1.00         x         13.19         x 0.01 =         4.02         (348)           Pumps and fans         177.36         x         13.19         x 0.01 =         23.39         (349)           Electricity for lighting         260.77         x         13.19         x 0.01 =         23.39         (349)           Additional standing charges         120.00         (351)         (350)         (351)         (350)         (351)           Total energy cost         (340a)(342e) + (345)(354) =         282.80         (355)         (355)           ***********************************	10b. Fuel costs - community heating scheme					
Water heating from boilers         1977.33         x         4.24         x 0.01 =         83.84         (342a)           Space cooling         -1.00         x         13.19         x 0.01 =         4.02         (348)           Pumps and fans         177.36         x         13.19         x 0.01 =         23.39         (349)           Electricity for lighting         260.77         x         13.19         x 0.01 =         34.40         (350)           Additional standing charges         120.00         (351)         (351)         (351)         (351)         (351)         (351)         (351)         (351)         (351)         (351)         (351)         (352)         (355)         (355)         (356)         (358)				Fuel price		
Space cooling		KVVII/ year			cost £/year	
Pumps and fans   177.36	Space heating from boilers		x	4.24 x 0.01 =	-	(340a)
Electricity for lighting		404.40			17.15	(340a) (342a)
Additional standing charges  Total energy cost  120.00 (351)  Total energy cost  (340a)(342e) + (345)(354) = 282.80 (355)  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12) 0.42 (356)  Energy cost factor (ECF) 1.18 (357)  SAP value 83.55  SAP value 83.55  SAP tating (section 13) 84 (358)  SAP band B  12b. Carbon dioxide emissions - Community heating scheme  Energy kWh/year Emission factor Emissions (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers 89.50 (367a)	Water heating from boilers	404.40 1977.33	x	4.24 x 0.01 =	17.15 83.84	(342a)
Total energy cost (340a)(342e) + (345)(354) = 282.80 (355)  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12) 0.42 (356) Energy cost factor (ECF) 1.18 (357) SAP value 83.55 SAP rating (section 13) 84 (358) SAP band B  12b. Carbon dioxide emissions - Community heating scheme  Energy kWh/year Emission factor Emissions (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers 89.50 (367a)	Water heating from boilers Space cooling	404.40 1977.33 -1.00	x x	4.24	17.15 83.84 4.02	(342a) (348)
11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)  SAP band  Energy  Energy  kWh/year	Water heating from boilers  Space cooling  Pumps and fans	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15 83.84 4.02 23.39	(342a) (348) (349)
Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)  SAP band  12b. Carbon dioxide emissions - Community heating scheme  Energy kWh/year  Energy Emission factor Emissions (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers  89.50  (356)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15 83.84 4.02 23.39 34.40	(342a) (348) (349) (350)
Energy cost factor (ECF)  SAP value  SAP rating (section 13)  SAP band  12b. Carbon dioxide emissions - Community heating scheme  Energy kWh/year  Emission factor (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers  89.50  (367a)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15 83.84 4.02 23.39 34.40 120.00	(342a) (348) (349) (350) (351)
SAP value  SAP rating (section 13)  SAP band  12b. Carbon dioxide emissions - Community heating scheme  Energy kWh/year  Emission factor (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers  83.55  B  (358)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15 83.84 4.02 23.39 34.40 120.00 282.80	(342a) (348) (349) (350) (351) (355)
SAP rating (section 13)  SAP band  12b. Carbon dioxide emissions - Community heating scheme  Energy Emission factor Emissions (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers  89.50  (358)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15 83.84 4.02 23.39 34.40 120.00 282.80	(342a) (348) (349) (350) (351) (355) (356)
SAP band  12b. Carbon dioxide emissions - Community heating scheme  Energy Emission factor (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers  89.50  (367a)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15 83.84 4.02 23.39 34.40 120.00 282.80 0.42 1.18	(342a) (348) (349) (350) (351) (355) (356)
12b. Carbon dioxide emissions - Community heating scheme  Energy Emission factor Emissions (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers 89.50 (367a)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15  83.84  4.02  23.39  34.40  120.00  282.80  0.42  1.18  83.55	(342a) (348) (349) (350) (351) (355) (356) (357)
Energy kWh/year Emission factor kWh/year (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers 89.50 (367a)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15  83.84  4.02  23.39  34.40  120.00  282.80  0.42  1.18  83.55  84	(342a) (348) (349) (350) (351) (355) (356) (357)
kWh/year (kg/year)  Emissions from other sources (space heating)  Efficiency of boilers 89.50 (367a)	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)	404.40 1977.33 -1.00 177.36	x x x	4.24	17.15  83.84  4.02  23.39  34.40  120.00  282.80  0.42  1.18  83.55  84	(342a) (348) (349) (350) (351) (355) (356) (357)
Efficiency of boilers 89.50	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)  SAP band	404.40 1977.33 -1.00 177.36 260.77	x x x	4.24	17.15  83.84  4.02  23.39  34.40  120.00  282.80  0.42  1.18  83.55  84	(342a) (348) (349) (350) (351) (355) (356) (357)
	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)  SAP band	404.40  1977.33  -1.00  177.36  260.77	x x x	4.24	17.15  83.84  4.02  23.39  34.40  120.00  282.80  0.42  1.18  83.55  84  B	(342a) (348) (349) (350) (351) (355) (356) (357)
[(307a)+(310a)] x 100 ÷ (367a) =	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)  SAP band  12b. Carbon dioxide emissions - Community heating scheme	404.40  1977.33  -1.00  177.36  260.77	x x x	4.24	17.15  83.84  4.02  23.39  34.40  120.00  282.80  0.42  1.18  83.55  84  B	(342a) (348) (349) (350) (351) (355) (356) (357)
URN: 2L3 version	Water heating from boilers  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges  Total energy cost  11b. SAP rating - community heating scheme  Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP value  SAP rating (section 13)  SAP band  12b. Carbon dioxide emissions - Community heating scheme	404.40  1977.33  -1.00  177.36  260.77  Energy kWh/year	x x x	4.24	17.15  83.84  4.02  23.39  34.40  120.00  282.80  0.42  1.18  83.55  84  B	(342a) (348) (349) (350) (351) (355) (356) (357)

∑(107)6...8 = [

148.19

(107)

CO2 emissions from boilers		451.84	x	0.216	= [	97.60	(367)
Emissions from other sources (wa	ter heating)						
Efficiency of boilers		89.50					(367a)
CO2 emissions from boilers [	(307a)+(310a)] x 100 ÷ (367a) =	2208.20	x	0.216	= [	477.21	(367)
Electrical energy for community h	eat distribution	23.81	x	0.52	= [	12.36	(372)
Total CO2 associated with commu	unity systems					587.17	(373)
Total CO2 associated with space a	and water heating					587.17	(376)
Space cooling		-1.00	x	0.52	= [	15.83	(377)
Pumps and fans		177.36	x	0.52	= [	92.05	(378)
Electricity for lighting		260.77	x	0.52	= [	135.34	(379)
Total CO₂, kg/year					(376)(382) = [	830.38	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [	14.91	(384)
El value					[	88.95	
El rating (section 14)						89	(385)
EI band						В	

13b. Primary energy - Comm	unity heating scheme						
		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sou	rces (space heating)						
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	451.84	x	1.22	=	551.25	(367)
Primary energy from other sou	ırces (water heating)						
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2208.20	x	1.22	=	2695.36	(367)
Electrical energy for communit	ty heat distribution	23.81	x	3.07	=	73.09	(372)
Total primary energy associate	ed with community systems					3319.70	(373)
Total primary energy associate	ed with space and water heating					3319.70	(376)
Space cooling		-1.00	x	3.07	=	3.07	(377)
Pumps and fans		177.36	x	3.07	=	544.50	(378)
Electricity for lighting		260.77	x	3.07	=	800.57	(379)
Primary energy kWh/year						4758.37	(383)
Dwelling primary energy rate k	xWh/m2/year					85.43	(384)

## Design - 'Clean' Energy Strategy



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	David Mason	Assessor number	12345
Client	Northwood Investors	Last modified	30/06/2015
Address	High Holborn, London		

Client	Northwood						La	st modified		30/00	5/2015	
Address	High Holbo	orn, London										
1. Overall dwelling dime	ensions											
				Ar	rea (m²)			age storey eight (m)		Vo	olume (m³)	
owest occupied					55.70	(1a) x		2.90	(2a) =		161.53	] (3
otal floor area	(1a) +	- (1b) + (1c	c) + (1d)(1	1n) =	55.70	(4)						
welling volume							(3a)	+ (3b) + (3	c) + (3d)(3	3n) =	161.53	(5
2. Ventilation rate												
										m	<sup>3</sup> per hour	
lumber of chimneys								0	x 40 =	:	0	(
lumber of open flues								0	x 20 =	:	0	(6
umber of intermittent f	ans							0	x 10 =	:	0	(
umber of passive vents								0	x 10 =	:	0	(
									7			_
umber of flueless gas fir	es							0	x 40 =	:	0	(
lumber of flueless gas fir	res							0	x 40 =		changes pe	
_		PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7	7c) =	0	-	Air	changes pe	r
lumber of flueless gas find the filtration due to chimner a pressurisation test ha	eys, flues, fans,		ntended, pr			a) + (7b) + (7 ise continue		0	x 40 =	Air	changes pe hour	r
nfiltration due to chimne a pressurisation test ha	eys, flues, fans, s been carried	out or is in		roceed to (1	7), otherw	ise continue	from (9) t	0	-	Air	changes pe hour	r ] (:
nfiltration due to chimne fa pressurisation test ha ir permeability value, q5	eys, flues, fans, s been carried of 60, expressed in	out or is in	etres per ho	roceed to (1 our per squ	7), otherware metre	ise continue of envelope	from (9) t	0	-	Air	changes pe hour 0.00	r ] (:
nfiltration due to chimne fa pressurisation test ha ir permeability value, qs based on air permeabil	eys, flues, fans, s been carried of 50, expressed in ity value, then of	<i>out or is in</i> n cubic me (18) = [(17	etres per ho ') ÷ 20] + (8	roceed to (1 our per squ	7), otherware metre	ise continue of envelope	from (9) t	0	-	Air	changes pe hour 0.00	r (2
nfiltration due to chimne fa pressurisation test ha ir permeability value, q5	eys, flues, fans, s been carried of 50, expressed in ity value, then of	<i>out or is in</i> n cubic me (18) = [(17	etres per ho ') ÷ 20] + (8	roceed to (1 our per squ	7), otherware metre	ise continue of envelope	from (9) t	0 o (16)	÷ (5) =	Air	0.00 2.50 0.13	r (8
ofiltration due to chimner of a pressurisation test ha ir permeability value, qs based on air permeabili lumber of sides on which	eys, flues, fans, s been carried of 60, expressed in ty value, then on the dwelling i	out or is in n cubic me (18) = [(17 is sheltere	etres per ho ') ÷ 20] + (8	roceed to (1 our per squ	7), otherware metre	ise continue of envelope	from (9) t	0 o (16)	÷ (5) =	Air	0.00 2.50 0.13	(£
nfiltration due to chimne f a pressurisation test ha ir permeability value, q5 based on air permeabili lumber of sides on whicl	eys, flues, fans, is been carried of 60, expressed in ity value, then on the dwelling in the dwelling in the shelter fac	out or is in n cubic me (18) = [(17 is sheltered	etres per ho ') ÷ 20] + (8 d	roceed to (1 our per squ	7), otherware metre	ise continue of envelope	from (9) t	0 o (16)	÷ (5) =	Air	0.00 2.50 0.13 3 0.78	(£
nfiltration due to chimner of a pressurisation test has ir permeability value, questions to be a seed on air permeability with the control of sides on which the control of the corporation of the corporat	eys, flues, fans, is been carried of 60, expressed in ity value, then on the dwelling in the dwelling in the shelter fac	out or is in n cubic me (18) = [(17 is sheltered	etres per ho ') ÷ 20] + (8 d	roceed to (1 our per squ	7), otherware metre	ise continue of envelope	from (9) t	0 o (16)	÷ (5) =	Air	0.00 2.50 0.13 3 0.78	(5) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7
ofiltration due to chimner a pressurisation test has ir permeability value, questions based on air permeability umber of sides on which helter factor of illtration rate modified Jan	eys, flues, fans, s been carried of 60, expressed in the dwelling in the dwelling in the dwelling in the for monthly wi	out or is in n cubic me (18) = [(17 is sheltered ctor ind speed:	etres per ho () ÷ 20] + (8 d	roceed to (1 our per squ 3), otherwis	7), otherw are metre ( e (18) = (16	ise continue of envelope 5)	e from (9) t	0 o (16)	÷ (5) =  • (0.075 x (19) (18) x (2	Air	0.00 2.50 0.13 3 0.78 0.10	(; (; (; (; (; (;
ofiltration due to chimner of a pressurisation test has ir permeability value, questions as a same of sides on which helter factor of sides on which the same of sides on which helter factor of sides on which the same of sides on which helter factor of sides of s	eys, flues, fans, s been carried of 60, expressed in the dwelling in the dwelling in the dwelling in the for monthly wi	out or is in n cubic me (18) = [(17 is sheltered ctor ind speed:	etres per ho () ÷ 20] + (8 d	roceed to (1 our per squ 3), otherwis	7), otherw are metre ( e (18) = (16	ise continue of envelope 5)	e from (9) t	0 o (16)	÷ (5) =  • (0.075 x (19) (18) x (2	Air	0.00 2.50 0.13 3 0.78 0.10	r ((() (() () () () () () () () () () ()
ofiltration due to chimner a pressurisation test has ir permeability value, questions to based on air permeability with the start of sides on which the start of sides on which the start of the start o	eys, flues, fans, s been carried of the carried of	out or is in number of the cubic me (18) = [(17) is sheltered ctor ind speed:  Mar e U2	etres per ho ') ÷ 20] + (8 d Apr	roceed to (1 pur per squ s), otherwis	7), otherw are metre e (18) = (16	ise continue of envelope 5) Jul	e from (9) t area Aug	0 o (16)	÷ (5) =  • (0.075 x (19) (18) x (2)	Air  9)] = 20) =	0.00  2.50  0.13  3  0.78  0.10	r ((() (() () () () () () () () () () ()
ofiltration due to chimner a pressurisation test has ir permeability value, question test on air permeability value, question of sides on which the ter factor of the fact	eys, flues, fans, s been carried of the carried of	out or is in number of the cubic me (18) = [(17) is sheltered ctor ind speed:  Mar e U2	etres per ho ') ÷ 20] + (8 d Apr	roceed to (1 pur per squ s), otherwis	7), otherw are metre e (18) = (16	ise continue of envelope 5) Jul	e from (9) t area Aug	0 o (16)	÷ (5) =  • (0.075 x (19) (18) x (2)	Air  9)] = 20) =	0.00  2.50  0.13  3  0.78  0.10	(£
ofiltration due to chimner a pressurisation test has ir permeability value, questions to be a pressurisation test has ir permeability value, questions on air permeability with the second state of the second state of the second	eys, flues, fans, s been carried in the dwelling in the dwelling in the dwelling in the for monthly wing the form Table in the dwelling in the	out or is in n cubic me (18) = [(17 is sheltered ctor ind speed:  Mar e U2 4.90	etres per ho d') ÷ 20] + (8 d Apr 4.40	May  4.30	7), otherw are metre e (18) = (16 Jun 3.80	ise continue of envelope 5)  Jul  3.80	Aug 3.70	0 o (16)	: (5) =  : (0.075 x (19) (18) x (2)  Oct	Air  9)] =  20) =  Nov  4.50	0.00  2.50  0.13  3  0.78  0.10  Dec	(3) (3) (4) (4) (4) (4) (4) (5) (5) (5) (5) (6) (6) (6) (6) (6) (6) (6) (6) (6) (6

	0.12	0.12	0.12	0.11	0.10	0.05	0.05	0.05	0.10	0.10	0.11	0.11	(220)
Calculate effective	ve air chang	ge rate for t	he applica	ble case:									
If mechanical	ventilation	: air change	e rate thro	ugh system								0.50	(23a)
If balanced w	ith heat rec	covery: effic	ciency in %	allowing fo	r in-use fac	ctor from Ta	able 4h					73.10	(23c)
a) If balanced	mechanica	ıl ventilatio	n with hea	t recovery (	MVHR) (22	b)m + (23b	) x [1 - (23c	c) ÷ 100]					
	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.23	0.24	0.24	0.25	(24a)
Effective air char	nge rate - ei	nter (24a) c	or (24b) or	(24c) or (24	d) in (25)								
	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.23	0.24	0.24	0.25	(25)



3. Heat losses a				_	- ·					· ·	<u>-</u>	
Element			á	Gross area, m²	Openings m <sup>2</sup>	Net a A, n		U-value W/m²K	A x U W/	′K κ-value, kJ/m².K	Ахк, kJ/K	
Window						13.9	92 x	1.05	= 14.67			(27)
Party wall						70.4	17 x	0.00	= 0.00			(32)
External wall						12.7	76 x	0.18	= 2.30			(29a)
Total area of exte	ernal eleme	ents ∑A, m²				26.6	88					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26)	)(30) + (32) = [	16.96	(33)
Heat capacity Cm	n = ∑(A x κ)							(28)	(30) + (32) +	(32a)(32e) = [	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/m	1 <sup>2</sup> K								250.00	(35)
Thermal bridges:	: ∑(L x Ψ) ca	alculated us	ing Apper	ndix K							4.00	(36)
Total fabric heat	loss									(33) + (36) =	20.97	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct No	ov Dec	_
Ventilation heat	loss calcula	ated monthl	y 0.33 x (	25)m x (5)								
!	13.75	13.62	13.50	12.85	12.72	12.08	12.08	11.95	12.33	12.72 12.	98 13.24	(38)
Heat transfer coe	efficient, W	//K (37)m+	(38)m	1		· ·			<u>'</u>		 	_ ` `
!	34.72	34.59	34.46	33.82	33.69	33.04	33.04	32.91	33.30	33.69 33.	94 34.20	٦
					1					(39)112/12 = [	33.78	]     (39)
Heat loss parame	eter (HLP).	W/m²K (39	)m ÷ (4)						2.000	[		(,
	0.62	0.62	0.62	0.61	0.60	0.59	0.59	0.59	0.60	0.60 0.6	0.61	٦
l		1 0.02		1 0.02	1 0.00			7.22		(40)112/12 =	0.61	_   (40)
Number of days	in month (1	Table 1a)							71101480 2	(10)==, == [	0.02	(,
. rumber er daye	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.	00 31.00	(40)
l	31.00	20.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00   30.	31.00	(40)
4. Water heatin	ng energy r	equirement	t									
Assumed occupa	ancy, N										1.86	(42)
Assumed occupa Annual average h	-	ısage in litre	es per day	Vd,average	e = (25 x N) +	36				]	1.86 78.32	(42) (43)
	-	ısage in litre <b>Feb</b>	es per day <b>Mar</b>	Vd,average <b>Apr</b>	e = (25 x N) + <b>May</b>	36 Jun	Jul	Aug	Sep	[ Coct No	78.32	7
Annual average h	hot water u	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	[ Oct No	78.32	7
Annual average h	hot water u	Feb	Mar	Apr	May	Jun	<b>Jul</b> 70.49	Aug 73.62	<b>Sep</b>	79.89 83.	78.32 ov Dec	7
Annual average h	Jan in litres pe	Feb er day for ea	<b>Mar</b> ch month	Apr Vd,m = fact	May tor from Tab	<b>Jun</b> le 1c x (43)					78.32 ov Dec	(43)
Annual average h	Jan in litres pe	Feb er day for ea 83.02	Mar ch month 79.89	<b>Apr</b> Vd,m = fact 76.76	May tor from Tab 73.62	Jun le 1c x (43) 70.49	70.49	73.62		79.89 83.	78.32 <b>Dec</b> 02 86.16	7
Annual average h	Jan in litres pe	Feb er day for ea 83.02	Mar ch month 79.89	<b>Apr</b> Vd,m = fact 76.76	May tor from Tab 73.62	Jun le 1c x (43) 70.49	70.49	73.62		79.89 83.	78.32 <b>Dec</b> 02 86.16 939.88	(43)
Annual average h	Jan in litres pe 86.16	Feb er day for ea 83.02 r used = 4.1	Mar ch month 79.89 8 x Vd,m	Apr Vd,m = fact 76.76  x nm x Tm/3	May tor from Tab 73.62 8600 kWh/m	Jun le 1c x (43) 70.49 onth (see 1	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83. Σ(44)112 = [	78.32 <b>Dec</b> 02 86.16 939.88	(43)
Annual average h Hot water usage	Jan in litres pe 86.16 of hot wate	Feb er day for ea 83.02 r used = 4.1 111.75	Mar ch month 79.89 8 x Vd,m	Apr Vd,m = fact 76.76  x nm x Tm/3	May tor from Tab 73.62 8600 kWh/m	Jun le 1c x (43) 70.49 onth (see 1	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83. Σ(44)112 = [ 104.38 113	78.32 <b>Dec</b> 02 86.16  939.88  .94 123.74	(43)
Annual average h Hot water usage	Jan in litres pe 86.16 of hot wate	Feb er day for ea 83.02 r used = 4.1 111.75	Mar ch month 79.89 8 x Vd,m	Apr Vd,m = fact 76.76  x nm x Tm/3	May tor from Tab 73.62 8600 kWh/m	Jun le 1c x (43) 70.49 onth (see 1	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83. Σ(44)112 = [ 104.38 113	78.32 <b>Dec</b> 02 86.16  939.88  .94 123.74  1232.34	(43)
Annual average h  Hot water usage  Energy content of	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17	Feb er day for ea 83.02 r used = 4.1 111.75 m	Mar ch month 79.89 8 x Vd,m : 115.31	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32 <b>Dec</b> 02 86.16  939.88  .94 123.74  1232.34	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume (	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) includes	Feb er day for ea 83.02 r used = 4.1 111.75 m	Mar ch month 79.89 8 x Vd,m : 115.31	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses:	Feb er day for ea  83.02  r used = 4.1  111.75  )m  16.76  uding any so	Mar ch month 79.89 8 x Vd,m : 115.31 17.30 olar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses:	Feb er day for ea  83.02  r used = 4.1  111.75  )m  16.76  uding any so  loss factor i	Mar ch month 79.89 8 x Vd,m: 115.31  17.30 blar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  8600 kWh/m 96.46  14.47 ge within sam	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56	(43) (44) (45) (46) (47)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses:	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from T	Mar ch month 79.89 8 x Vd,m: 115.31  17.30 blar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  8600 kWh/m 96.46  14.47 ge within sam	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses: 's declared orage loss for from Table	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so  loss factor if actor from Tole 2a	Mar ch month 79.89 8 x Vd,m: 115.31  17.30 blar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  8600 kWh/m 96.46  14.47 ge within sam	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00	(43) (44) (45) (46) (47) (51) (52)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses: or see loss far from Table factor from	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from Tile 2a  n Table 2b	Mar ch month 79.89 8 x Vd,m s 115.31  17.30 blar or WV is not kno	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within sam	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03	(43) (44) (45) (46) (47) (51) (52) (53)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost free	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses: or seel area loss for from Table factor from water seen and the seed area water seed are	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from Tile 2a  n Table 2b	Mar ch month 79.89 8 x Vd,m s 115.31  17.30 blar or WV is not kno	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within sam	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03	(43) (44) (45) (46) (47) (51) (52) (53) (54)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost from  Enter (50) or (54)	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses: or see loss far from Table factor from water see) in (55)	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from The 2a m Table 2b storage (kW)	Mar ch month 79.89  8 x Vd,m s 115.31  17.30  olar or WV  is not kno Fable 2 (k)	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da 7) x (51) x (51)	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within sam	Jun le 1c x (43) 70.49 onth (see 1 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60	(43) (44) (45) (46) (47) (51) (52) (53)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost free	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses: or seclared orage loss for from Table factor from water second or water second or sec	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from The 2a m Table 2b storage (kW)  ed for each if actor each if actor from the 2a m Table 2b storage (kW)	Mar ch month 79.89 8 x Vd,m x 115.31  17.30 blar or WV dis not kno Fable 2 (k) h/day) (4	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da 7) x (51)	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within sam y)	Jun le 1c x (43) 70.49 onth (see 1 83.24  12.49 ne vessel	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (45) (46) (47) (51) (52) (53) (54) (55)
Annual average h Hot water usage Energy content of Distribution loss Storage volume ( Water storage lo b) Manufacturer Hot water sto Volume facto Temperature Energy lost fri Enter (50) or (54) Water storage lo	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17  (litres) incluses: or second and a second area of the company o	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from The 2a m Table 2b storage (kW)  ed for each if 28.92	Mar ch month 79.89  8 x Vd,m : 115.31  17.30 blar or WV  is not kno Fable 2 (k)  h/day) (4  month (5 32.01	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da  7) x (51) x (51) x (55) x (41)m 30.98	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within sam y)  52) x (53)	Jun le 1c x (43) 70.49 onth (see 1 83.24  12.49 ne vessel	70.49 Tables 1b 77.13  11.57	73.62 , 1c 1d) 88.51 13.28	76.76 89.57	79.89 83. $\Sigma(44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (45) (46) (47) (51) (52) (53) (54)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost from  Enter (50) or (54)	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17  (litres) incluses: or second and a second area of the company o	r day for ear 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from The 2a m Table 2b storage (kW)  ed for each if 28.92	Mar ch month 79.89  8 x Vd,m : 115.31  17.30 blar or WV  is not kno Fable 2 (k)  h/day) (4  month (5 32.01	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da  7) x (51) x (51) x (55) x (41)m 30.98	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within sam y)  52) x (53)	Jun le 1c x (43) 70.49 onth (see 1 83.24  12.49 ne vessel	70.49 Tables 1b 77.13  11.57	73.62 , 1c 1d) 88.51 13.28	76.76 89.57	79.89 83.	78.32  0v Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03  1.03  98 32.01	(43) (44) (45) (46) (47) (51) (52) (53) (54)

Primary circuit	loss for each	n month fro	m Table 3										
	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)
Combi loss for	each month	from Table	3a, 3b or 3	С									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requ	uired for wat	er heating (	calculated f	or each mo	onth 0.85 x	(45)m + (4	l6)m + (57)ı	m + (59)m +	· (61)m				
	183.04	161.67	170.59	154.03	151.74	136.73	132.41	143.79	143.06	159.66	167.44	179.01	(62)
Solar DHW inpu	ut calculated	using Appe	endix G or A	Appendix H	l	•	•	•			•		_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from w	ater heater f	or each mc	onth (kWh/	month) (6	2)m + (63)n	n	•	•			•	-	_
	183.04	161.67	170.59	154.03	151.74	136.73	132.41	143.79	143.06	159.66	167.44	179.01	]
			•		•					Σ(64)1	.12 = 1	1883.18	(64)
Heat gains fron	n water heat	ing (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (62	1)m] + 0.8 >	< [(46)m + (	57)m + (59)	m]				_
	86.70	77.10	82.56	76.22	76.30	70.47	69.87	73.65	72.58	78.93	80.68	85.36	(65)
			1	•	<u>'</u>	1					1		
5. Internal gai	ins												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gain	s (Table 5)												
	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	(66)
Lighting gains (	calculated in	Appendix !	L, equation	L9 or L9a)	, also see Ta	able 5							
	36.91	32.79	26.66	20.19	15.09	12.74	13.77	17.89	24.02	30.49	35.59	37.94	(67)
Appliance gains	s (calculated	in Appendi	ix L, equatio	on L13 or L	13a), also s	ee Table 5							
	241.77	244.28	237.96	224.50	207.51	191.54	180.87	178.37	184.69	198.15	215.14	231.10	(68)
Cooking gains (	(calculated in	Appendix	L, equation	L15 or L15	āa), also see	e Table 5							
	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	(69)
Pump and fan g	gains (Table	5a)											
	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. eva	poration (Ta	ble 5)											
	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	(71)
Water heating	gains (Table	5)											_
	116.54	114.73	110.97	105.86	102.55	97.88	93.91	98.99	100.80	106.09	112.06	114.74	(72)
Total internal g	gains (66)m -	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (	72)m		•			•	-	_
	480.39	476.96	460.76	435.71	410.31	387.32	373.71	380.41	394.67	419.89	447.95	468.94	(73)
						•	•	•	•	•	•	_	
6. Solar gains													
			Access f		Area m²		lar flux V/m²	snos	g ific data	FF specific o	data	Gains W	
			Table	ou	""	·	W/111	•	able 6b	or Table		VV	
North			0.3	0 x	11.52	x 1	10.63 x	0.9 x	).40 x	0.95		12.57	(74)
East			0.3		2.40				0.40 x			4.84	(76)
Solar gains in w	vatts Σ(74)m	ı (82)m	0.5	^ _	2.40	^	15.04 X	0.5 X	7.40 X	0.55			] (70)
		33.48	56.39	88.28	116.16	123.05	115.40	93.34	67.19	39.82	21.53	14.45	(83)
Ü	1 / ///	1 33.40	30.33	00.20	110.10	123.03	113.40	1 23.34	07.13	J9.02		14.47	(ده)
-	17.40	1	- (83)m										
Total gains - int	ternal and so	olar (73)m +		E22.00	E26.47	E10.27	400.43	472.75	161.00	450.74	460.40	102.40	7 (0.4)
-		1	- (83)m 517.15	523.99	526.47	510.37	489.12	473.75	461.86	459.71	469.48	483.40	(84)
-	ternal and so	blar (73)m + 510.44	517.15	523.99	526.47	510.37	489.12	473.75	461.86	459.71	469.48	483.40	(84)
Total gains - int	497.79	510.44 ture (heati	517.15				489.12	473.75	461.86	459.71	469.48	483.40	
Total gains - int	497.79	510.44 ture (heati	517.15				489.12 Jul	473.75	461.86 Sep	459.71 Oct	469.48 Nov		(84)
7. Mean inter Temperature d	497.79  rnal tempera luring heating	olar (73)m + 510.44  ture (heating periods in	517.15  ng season)  the living a	area from <sup>-</sup> <b>Apr</b>	Table 9, Th:	1(°C)						21.00	
Total gains - int	497.79  rnal tempera luring heating	olar (73)m + 510.44  ture (heating periods in	517.15  ng season)  the living a	area from <sup>-</sup> <b>Apr</b>	Table 9, Th:	1(°C)						21.00	

	emp of livin	ig area T1 (s	steps 3 to 7	' in Table 9	c)								
	20.80	20.85	20.92	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.91	20.79	(87)
Temperature du	uring heatin	g periods ir	the rest o	f dwelling 1	from Table !	9, Th2(°C)	•	•		•	•	•	_
	20.41	20.41	20.41	20.42	20.43	20.44	20.44	20.44	20.43	20.43	20.42	20.42	(88)
Utilisation facto	or for gains f	for rest of d	welling n2.										_ ` ′
	0.94	0.92	0.86	0.73	0.56	0.38	0.26	0.28	0.46	0.71	0.88	0.95	(89)
Mean internal to				ı	!			0.20	0.40	0.71	0.00	0.55	_ (03)
ivicali iliterilai t		1			· ·	1		20.44	20.42	20.44	20.21	20.15	7 (00)
	20.16	20.22	20.32	20.40	20.42	20.44	20.44	20.44	20.43	20.41	20.31	20.15	(90)
Living area fract									Liv	ving area ÷	(4) =	0.46	(91)
Mean internal to		1	1	ig tLA x T1	+(1 - fLA) x	Г2					,		7
	20.46	20.51	20.59	20.67	20.69	20.70	20.70	20.70	20.70	20.68	20.59	20.45	(92)
Apply adjustme	nt to the m	ean interna	l temperati	ure from T	able 4e whe	ere appropr	riate						
	20.46	20.51	20.59	20.67	20.69	20.70	20.70	20.70	20.70	20.68	20.59	20.45	(93)
8. Space heati													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains,	ηm											
	0.94	0.92	0.86	0.74	0.57	0.39	0.28	0.30	0.48	0.72	0.88	0.95	(94)
Useful gains, ηn	mGm, W (94	4)m x (84)m	1										
	467.47	468.38	447.01	388.38	301.77	201.46	135.41	141.50	219.46	332.66	415.12	457.39	(95)
Monthly averag	ge external t	emperature	e from Tabl	le U1									
	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 fo		ernal tempe	erature. Lm		n x [(93)m -							1	_ ` ′
	560.91	540.00	485.70	397.98	302.85	201.49	135.41	141.50	219.63	339.46	457.85	555.70	(97)
Space heating re				1	-		133.41	141.50	213.03	333.40	437.03	333.70	_ (37)
Space neating n	,	., κννιη ΙΙΙΟΙΙ	UI 0.024 X	[(37)111 - (3	) / [III] X (41)								
		40.43	20.70	C 01	0.00	0.00	0.00	0.00	0.00	F 00	20.77	72.14	٦
	69.52	48.13	28.78	6.91	0.80	0.00	0.00	0.00	0.00	5.06	30.77	73.14	] (00)
		1	•	6.91	0.80	0.00	0.00	0.00		3)15, 10	.12 =	263.12	(98)
Space heating re		1	•	6.91	0.80	0.00	0.00	0.00		3)15, 10			(98)
	equirement	kWh/m²/y	•	6.91	0.80	0.00	0.00	0.00		3)15, 10	.12 =	263.12	
Space heating ro	equirement	kWh/m²/yo	ear						∑(98	(98)	.12 = ÷ (4)	263.12 4.72	_
8c. Space cooli	equirement ing requirer Jan	kWh/m²/y	•	6.91 Apr	0.80 May	0.00 Jun	0.00	0.00		3)15, 10	.12 =	263.12	_
8c. Space cooli	equirement ing requirer Jan m	kWh/m²/yı ment Feb	ear Mar	Apr	May	Jun	Jul	Aug	∑(98 <b>Sep</b>	(98) Oct	.12 = ÷ (4)	263.12 4.72 Dec	(99)
8c. Space cooli	equirement ing requirer Jan m 0.00	kWh/m²/yı ment Feb  0.00	ear						∑(98	(98)	.12 = ÷ (4)	263.12 4.72	(99)
8c. Space cooli	equirement  ing requirer  Jan  m  0.00  or for loss nr	ment Feb  0.00	Mar 0.00	<b>Apr</b>	<b>May</b>	Jun 310.58	<b>Jul</b> 244.50	Aug 250.13	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	263.12 4.72 Dec	(100)
8c. Space cooling the space of	equirement  ing requirer  Jan  m  0.00  or for loss nr  0.00	kWh/m²/yı ment Feb  0.00 m	Mar 0.00	Apr	May	Jun	Jul	Aug	∑(98 <b>Sep</b>	(98) Oct	.12 = ÷ (4)	263.12 4.72 Dec	(100)
8c. Space cooling the street loss rate Linux Utilisation factors	equirement  ing requirer  Jan  m  0.00  or for loss nr  0.00	kWh/m²/yı ment Feb  0.00 m	Mar 0.00	<b>Apr</b>	<b>May</b>	Jun 310.58	<b>Jul</b> 244.50	Aug 250.13	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	263.12 4.72 Dec	(100)
8c. Space cooling the street loss rate Linux Utilisation factors	equirement  ing requirer  Jan  m  0.00  or for loss nr  0.00	kWh/m²/yı ment Feb  0.00 m	Mar 0.00	<b>Apr</b>	<b>May</b>	Jun 310.58	<b>Jul</b> 244.50	Aug 250.13	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	263.12 4.72 Dec	(100)
8c. Space cooling the street loss rate Linux Utilisation factors	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (	ment Feb  0.00 m  0.00 100)m x (10	Mar 0.00 0.00 0.1)m	<b>Apr</b> 0.00 0.00	May 0.00	Jun 310.58	Jul 244.50	Aug 250.13	∑(98 Sep  0.00  0.00	(98)  Oct  0.00	.12 = ÷ (4)	263.12 4.72 Dec 0.00	_
8c. Space cooli Heat loss rate Li Utilisation facto Useful loss ηmL	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (	ment Feb  0.00 m  0.00 100)m x (10	Mar 0.00 0.00 0.1)m	<b>Apr</b> 0.00 0.00	May 0.00	Jun 310.58	Jul 244.50	Aug 250.13	∑(98 Sep  0.00  0.00	(98)  Oct  0.00	.12 = ÷ (4)	263.12 4.72 Dec 0.00	(100)
8c. Space coolid Heat loss rate Li Utilisation facto Useful loss ηmL	equirement  ing requirer  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00	kWh/m²/yıment   0.00   0.00   0.00   0.00	Mar  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00	0.00 0.00 0.00	Jun 310.58 1.00 310.08	Jul 244.50 1.00 244.42 566.05	Aug 250.13 1.00 249.97	Sep  0.00  0.00  0.00	Oct  0.00  0.00	.12 =	263.12 4.72 Dec 0.00	(100) (101) (102)
8c. Space coolid Heat loss rate Li Utilisation facto Useful loss ηmL	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00  0.00  equirement	kWh/m²/yi ment	Mar  0.00  0.00  0.00  0.00  0.00  elling, conti	Apr 0.00 0.00 0.00 0.00 inuous (kW	0.00 0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun 310.58 1.00 310.08 592.40 (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (4:	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00	Oct  0.00  0.00  0.00	.12 =	263.12 4.72  Dec  0.00  0.00  0.00	(100) (101) (102)
8c. Space coolid Heat loss rate Li Utilisation facto Useful loss ηmL	equirement  ing requirer  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00	kWh/m²/yıment   0.00   0.00   0.00   0.00	Mar  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00	0.00 0.00 0.00	Jun 310.58 1.00 310.08	Jul 244.50 1.00 244.42 566.05	Aug 250.13 1.00 249.97	Sep  0.00  0.00  0.00	Oct  0.00  0.00  0.00	.12 =	263.12 4.72  Dec  0.00  0.00  0.00	(100) (101) (102) (103)
8c. Space cooling Reactions  8c. Space cooling reactions	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00  equirement,  0.00	kWh/m²/yi ment	Mar  0.00  0.00  0.00  0.00  0.00  elling, conti	Apr 0.00 0.00 0.00 0.00 inuous (kW	0.00 0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun 310.58 1.00 310.08 592.40 (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (4:	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  655.36	(100) (101) (102) (103) (104)
8c. Space cooling  Heat loss rate Li  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00  0.00  equirement,	ment Feb  0.00 m  0.00 100)m x (10 0.00  0.00 , whole dwe	Mar  0.00  0.00  0.00  0.00  0.00  elling, conti	Apr 0.00 0.00 0.00 0.00 inuous (kW	0.00 0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun 310.58 1.00 310.08 592.40 (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (4:	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00	.12 =	263.12 4.72  Dec  0.00  0.00  0.00	(100) (100) (101) (102) (103)
8c. Space cooling  Heat loss rate Li  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00  equirement,  0.00  actor (Table	kWh/m²/yi ment   Feb	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  inuous (kW	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (4: 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	.12 =	263.12  4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.72	(100) (100) (101) (102) (103)
8c. Space cooling  Heat loss rate Li  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00  0.00  equirement,	ment Feb  0.00 m  0.00 100)m x (10 0.00  0.00 , whole dwe	Mar  0.00  0.00  0.00  0.00  0.00  elling, conti	Apr 0.00 0.00 0.00 0.00 inuous (kW	0.00 0.00 0.00 0.00 0.00 0.00 /h) 0.024 x [	Jun 310.58 1.00 310.08 592.40 (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (4:	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  0.00  Σ(104)6  bled area ÷	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  655.36	(100) (101) (102)
8c. Space cooling  Heat loss rate Li  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	equirement  Jan  m  0.00  or for loss nr  0.00  .m (watts) (  0.00  equirement,  0.00  actor (Table	kWh/m²/yi ment   Feb	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  inuous (kW	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (4: 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	.12 =	263.12  4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.72	(100) (101) (102) (103) (104) (105)
8c. Space cooling Heat loss rate Li Utilisation factor Useful loss ηmL Gains Space cooling re Cooled fraction Intermittency fa	equirement  Jan  m  0.00  or for loss nr  0.00  m (watts) (  0.00  equirement,  0.00  actor (Table  0.00	kWh/m²/yi ment	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  nuous (kW  0.00  0.00	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (4: 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  0.00  Σ(104)6  bled area ÷	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	(100) (101) (102) (103) (104) (105)
8c. Space cooling  Heat loss rate Li  Utilisation factor  Useful loss ηmL  Gains  Space cooling re	equirement  Jan  m  0.00  or for loss nr  0.00  m (watts) (  0.00  equirement,  0.00  actor (Table  0.00	kWh/m²/yi ment	Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  nuous (kW  0.00  0.00	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (4: 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  0.00  Σ(104)6  bled area ÷	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	(100) (101) (102) (103) (104)

				Σ(107)68 = [	118.25	(107)
Space cooling requirement kWh/m²/year				$(107) \div (4) = $	2.12	(108)
9b. Energy requirements - community heating scheme						
Fraction of space heat from secondary/supplementary system (ta	ble 11)			'0' if none	0.00	(301)
Fraction of space heat from community system				1 - (301) =	1.00	(302)
Fraction of community heat from heat pump				[	1.00	(303a)
Fraction of total space heat from community heat pump			(3	02) x (303a) = [	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for commun	nity snace heating		(3	02, x (3030) [	1.00	(305)
Factor for charging method (Table 4c(3)) for community water he				L	1.00	(305a)
Distribution loss factor (Table 12c) for community heating system	_			L	1.05	(306)
Distribution loss factor (Table 126) for community fleating system	!			L	1.03	_ (300)
Space heating						
Annual space heating requirement			263.12			(98)
Space heat from heat pump			(98) x (304a) x (	305) x (306) = [	276.27	(307a)
Water heating			1002.40			(6.4)
Annual water heating requirement			1883.18	o= ) (oos) [		(64)
Water heat from boilers			(64) x (303a) x (3		790.93	(310a)
Water heat from heat pump			(64) x (303b) x (3		751.39	(310b)
Water heat from heat pump			(64) x (303c) x (3		435.01	(310c)
Electricity used for heat distribution		0.01 × [(	(307a)(307e) + (31	] = [(310e)] آ	22.51	(313)
Cooling System Energy Efficiency Ratio					0	(314)
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive inpu	ut from outside		177.36	Г		(330a)
Total electricity for the above, kWh/year					177.36	(331)
Electricity for lighting (Appendix L)					260.77	(332)
Energy saving/generation technologies				г		7
electricity generated by PV (Appendix M)					-204.09	(333)
Total delivered energy for all uses	(307) + (309) + (	310) + (312)	) + (315) + (331) + (3	32)(337b) = [	2511.98	(338)
10b. Fuel costs - community heating scheme						
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	276.27	x	4.24	x 0.01 =	11.71	(340a)
Water heating from boilers	790.93	x	4.24	x 0.01 =	33.54	(342a)
Water heating from heat pump	751.39	x	4.24	x 0.01 =	31.86	(342b)
Water heating from heat pump	435.01	x	4.24	x 0.01 =	18.44	(342c)
Space cooling	-1.00	x	13.19	x 0.01 =	3.21	(348)
Pumps and fans	177.36	x	13.19	x 0.01 =	23.39	(349)
Electricity for lighting	260.77	x	13.19	x 0.01 =	34.40	(350)
Additional standing charges				[	120.00	(351)
Energy saving/generation technologies				L		_ (301)
pv savings	-204.09	X	13.19	x 0.01 =	0.00	(352)
Total energy cost		^	(340a)(342e) + (		276.55	(355)
			(5.53/(5720) 1	,5,(554) <sup>-</sup> [	_, 0.55	_ (555)
11b. SAP rating - community heating scheme				-		7.
Energy cost deflator (Table 12)					0.42	(356)
Energy cost factor (ECF)					1.15	(357)

SAP rating (section 13)

SAP band

83.91

В

84 (358)

12b. Carbon dioxide emissions - Community heating scheme						
	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of heat pump	300.00					(367a)
CO2 emissions from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	92.09	x	0.519	=	47.80	(367)
Emissions from other sources (water heating)						
Efficiency of boilers	93.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 $\div$ (367a) =	849.39	x	0.216	=	183.70	(367)
Efficiency of heat pump	300.00					(367b)
CO2 emissions from heat pump $[(307b)+(310b)] \times 100 \div (367b) =$	250.13	x	0.519	= [	129.99	(368)
Efficiency of heat pump	400.00					(367c)
CO2 emissions from heat pump $[(307c)+(310c)] \times 100 \div (367c) =$	108.50	x	0.519	=	56.44	(369)
Electrical energy for community heat distribution	22.51	x	0.52	=	11.68	(372)
Total CO2 associated with community systems					429.61	(373)
Total CO2 associated with space and water heating					429.61	(376)
Space cooling	-1.00	х	0.52	=	12.63	(377)
Pumps and fans	177.36	х	0.52	=	92.05	(378)
Electricity for lighting	260.77	X	0.52	=	135.34	(379)
Energy saving/generation technologies						_
pv savings	-204.09	x	0.52	=	-105.92	(380)
Total CO₂, kg/year				(376)(382) =	563.71	(383)
Dwelling CO₂ emission rate				(383) ÷ (4) =	10.12	(384)
El value					92.50	_
El rating (section 14)					92	(385)
El band					А	

13b. Primary energy - Community heating scheme						
	Energy kWh/year		Primary factor		Primary energ (kWh/year)	у
Primary energy from other sources (space heating)						
Efficiency of heat pump	300.00					(367a)
Primary energy from heat pump [(307a)+(310a)] x 100 $\div$ (367a) = [	92.09	x	3.07	=	282.72	(367)
Primary energy from other sources (water heating)						
Efficiency of boilers	93.00					(367a)
Primary energy from boilers $[(307a)+(310a)] \times 100 \div (367a) = [$	849.39	х	1.22	=	1037.57	(367)
Efficiency of heat pump	300.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 $\div$ (367b) = [	250.13	х	3.07	=	768.92	(368)
Efficiency of heat pump	400.00					(367c)
Primary energy from heat pump [(307c)+(310c)] x 100 $\div$ (367c) = [	108.50	х	3.07	=	333.87	(369)
Electrical energy for community heat distribution	22.51	х	3.07	=	69.09	(372)
Total primary energy associated with community systems					2492.17	(373)
Total primary energy associated with space and water heating					2492.17	(376)
Space cooling [	-1.00	х	3.07	=	3.07	(377)
Pumps and fans	177.36	х	3.07	=	544.50	(378)

Electricity for lighting 260.77 x 3.07 = 800.57 (379)

Energy saving/generation technologies

Energy saving/generation technologies

Electricity generated - PVs

-204.09

x

3.07

=

-626.54

(380)

Primary energy kWh/year

3285.39

(383)

Dwelling primary energy rate kWh/m2/year

### Design - 'Green' Energy Strategy



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	David Mason	Assessor number	12345
Client	Northwood Investors	Last modified	30/06/2015
Address	High Holborn, London		

Client	Northwood	d Investors					La	ast modified	l	30/06	5/2015	
Address	High Holbo	orn, London										
1. Overall dwelling dimens	ions											
				A	rea (m²)			rage storey eight (m)	,	Vo	olume (m³)	
Lowest occupied					55.70	(1a) x		2.90	(2a) =		161.53	(3a)
Total floor area	(1a)	+ (1b) + (1c	c) + (1d)(1	Ln) =	55.70	(4)						
Dwelling volume							(3a	) + (3b) + (3	c) + (3d)(3	3n) =	161.53	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								0	x 40 =	:	0	(6a)
Number of open flues								0	x 20 =		0	(6b
Number of intermittent fans	;							0	x 10 =	:	0	(7a)
Number of passive vents								0	x 10 =	:	0	(7b
Number of flueless gas fires								0	x 40 =	: [	0	(7c)
										Air	changes pe	r
Infiltration due to chimneys,	flues, fans	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (	7c) =	0	÷ (5) =	=	0.00	(8)
If a pressurisation test has b	een carried	d out or is i	ntended, pr	roceed to (1	17), otherw	ise continue	e from (9)	to (16)	_			
Air permeability value, q50,	expressed	in cubic me	etres per ho	our per squ	are metre	of envelope	area				2.50	(17
If based on air permeability	value, ther	n (18) = [(17	7) ÷ 20] + (8	s), otherwis	se (18) = (1	6)					0.13	(18
Number of sides on which th	ne dwelling	is sheltere	ed								3	(19)
Shelter factor								1 -	· [0.075 x (1	9)] =	0.78	(20)
Infiltration rate incorporatin	g shelter fa	actor							(18) x (	20) =	0.10	(21
Infiltration rate modified for	monthly v	vind speed	:									_
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee	d from Tab	le U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22
Adjusted infiltration rate (al	lowing for	shelter and	wind facto	or) (21) x (2	2a)m							
0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.09	0.10	0.10	0.11	0.11	(22
Calculate effective air chang	e rate for t	he applical	ble case:									-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	e wind spee	ed from Tab	ole U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	tion rate (al	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.09	0.10	0.10	0.11	0.11	(22b)
Calculate effective	ve air chang	ge rate for	the applical	ole case:									
If mechanical	ventilation	n: air chang	e rate throu	ıgh system								0.50	(23a)

If mechanical	ventilation	n: air chang	e rate throu	ugh system								0.50	(23a)
If balanced w	If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h											73.10	(23c)
a) If balanced	mechanica	al ventilatio	n with hea	t recovery (	(MVHR) (22	b)m + (23b	) x [1 - (23c	:) ÷ 100]					
	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.23	0.24	0.24	0.25	(24a)
Effective air chan	nge rate - e	nter (24a) d	or (24b) or	(24c) or (24	d) in (25)								
	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.23	0.24	0.24	0.25	(25)



3. Heat losses a				_	- ·				<b>a a</b> .	· ·	<u>-</u>	
Element			á	Gross area, m²	Openings m <sup>2</sup>	Net a A, n		U-value W/m²K	A x U W/	′K κ-value, kJ/m².K	Ахк, kJ/K	
Window						13.9	92 x	1.05	= 14.67			(27)
Party wall						70.4	17 x	0.00	= 0.00			(32)
External wall						12.7	76 x	0.18	= 2.30			(29a)
Total area of exte	ernal eleme	ents ∑A, m²				26.6	88					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26)	)(30) + (32) = [	16.96	(33)
Heat capacity Cm	n = ∑(A x κ)							(28)	(30) + (32) +	(32a)(32e) = [	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/m	1 <sup>2</sup> K								250.00	(35)
Thermal bridges:	: ∑(L x Ψ) ca	alculated us	ing Apper	ndix K							4.00	(36)
Total fabric heat	loss									(33) + (36) =	20.97	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct No	ov Dec	_
Ventilation heat	loss calcula	ated monthl	y 0.33 x (	25)m x (5)								
!	13.75	13.62	13.50	12.85	12.72	12.08	12.08	11.95	12.33	12.72 12.	98 13.24	(38)
Heat transfer coe	efficient, W	//K (37)m+	(38)m	1		-			<u>'</u>		<b>'</b>	_ ` `
!	34.72	34.59	34.46	33.82	33.69	33.04	33.04	32.91	33.30	33.69 33.	94 34.20	٦
		I I			1	1				(39)112/12 = [	33.78	]     (39)
Heat loss parame	eter (HLP).	W/m²K (39	)m ÷ (4)						2.000	[		(,
	0.62	0.62	0.62	0.61	0.60	0.59	0.59	0.59	0.60	0.60 0.6	0.61	٦
									-1	(40)112/12 =	0.61	(40)
Number of days	in month (1	Table 1a)							7110.000	[	0.02	(,
. rumber er daye	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.	00 31.00	(40)
l	31.00	20.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00   30.	00   31.00	(40)
4. Water heatin	ng energy r	equirement	t									
Assumed occupa	ancy, N									[	1.86	(42)
Assumed occupa Annual average h	-	ısage in litre	es per day	Vd,average	e = (25 x N) +	36				]	1.86 78.32	(42) (43)
	-	ısage in litre <b>Feb</b>	es per day <b>Mar</b>	Vd,average <b>Apr</b>	e = (25 x N) + <b>May</b>	36 Jun	Jul	Aug	Sep	[ Coct No	78.32	7
Annual average h	hot water u	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	[ Oct No	78.32	7
Annual average h	hot water u	Feb	Mar	Apr	May	Jun	<b>Jul</b> 70.49	Aug 73.62	<b>Sep</b>	79.89 83.	78.32 ov Dec	7
Annual average h	Jan in litres pe	Feb er day for ea	<b>Mar</b> ch month	Apr Vd,m = fact	May tor from Tab	<b>Jun</b> le 1c x (43)					78.32 ov Dec	(43)
Annual average h	Jan in litres pe	Feb er day for ea 83.02	Mar ch month 79.89	<b>Apr</b> Vd,m = fact 76.76	May tor from Tab 73.62	Jun le 1c x (43) 70.49	70.49	73.62		79.89 83.	78.32 <b>Dec</b> 02 86.16	7
Annual average h	Jan in litres pe	Feb er day for ea 83.02	Mar ch month 79.89	<b>Apr</b> Vd,m = fact 76.76	May tor from Tab 73.62	Jun le 1c x (43) 70.49	70.49	73.62		79.89 83.	78.32 <b>Dec</b> 02 86.16  939.88	(43)
Annual average h	Jan in litres pe 86.16	Feb er day for ea 83.02 r used = 4.1	Mar ch month 79.89 8 x Vd,m	Apr Vd,m = fact 76.76  x nm x Tm/3	May tor from Tab 73.62 3600 kWh/m	Jun le 1c x (43) 70.49 onth (see T	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83. ∑(44)112 = [	78.32 <b>Dec</b> 02 86.16  939.88	(43)
Annual average h Hot water usage	Jan in litres pe 86.16 of hot wate	Feb er day for ea 83.02 r used = 4.1 111.75	Mar ch month 79.89 8 x Vd,m	Apr Vd,m = fact 76.76  x nm x Tm/3	May tor from Tab 73.62 3600 kWh/m	Jun le 1c x (43) 70.49 onth (see T	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83. ∑(44)112 = [ 104.38 113	78.32  Dec  02 86.16  939.88	(43)
Annual average h Hot water usage	Jan in litres pe 86.16 of hot wate	Feb er day for ea 83.02 r used = 4.1 111.75	Mar ch month 79.89 8 x Vd,m	Apr Vd,m = fact 76.76  x nm x Tm/3	May tor from Tab 73.62 3600 kWh/m	Jun le 1c x (43) 70.49 onth (see T	70.49 ables 1b	73.62 , 1c 1d)	76.76	79.89 83. ∑(44)112 = [ 104.38 113	78.32  02	(43)
Annual average h  Hot water usage  Energy content of	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17	Feb er day for ea 83.02 r used = 4.1 111.75 m	Mar ch month 79.89 8 x Vd,m : 115.31	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  02	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume (	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) includes	Feb er day for ea 83.02 r used = 4.1 111.75 m	Mar ch month 79.89 8 x Vd,m : 115.31	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses:	Feb er day for ea 83.02  r used = 4.1 111.75  )m 16.76  uding any so	Mar ch month 79.89 8 x Vd,m : 115.31 17.30 olar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage	May tor from Tab 73.62 3600 kWh/m 96.46	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses:	Feb er day for ea  83.02  r used = 4.1  111.75  )m  16.76  uding any so	Mar ch month 79.89 8 x Vd,m: 115.31  17.30 blar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  8600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56	(43) (44) (45) (46) (47)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses:	r day for ea  83.02  r used = 4.1  111.75  )m  16.76  uding any so  loss factor if	Mar ch month 79.89 8 x Vd,m: 115.31  17.30 blar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  8600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  NV Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00	(43) (44) (45) (46)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses: 's declared orage loss for from Table	r day for ea  83.02  r used = 4.1  111.75  )m  16.76  uding any so  loss factor if actor from The 2a	Mar ch month 79.89 8 x Vd,m: 115.31  17.30 blar or WV	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storage wn	May tor from Tab 73.62  8600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00	(43) (44) (45) (46) (47) (51) (52)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses: or see loss far from Table factor from	r day for ea  83.02  r used = 4.1  111.75  m  16.76  uding any so  loss factor if actor from Table 2b	Mar ch month 79.89 8 x Vd,m s 115.31  17.30 blar or WV is not kno	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  NV Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03	(43) (44) (45) (46) (47) (51) (52) (53)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost free	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses: or seel area loss for from Table factor from water seen and the seed area water seed are	r day for ea  83.02  r used = 4.1  111.75  m  16.76  uding any so  loss factor if actor from Table 2b	Mar ch month 79.89 8 x Vd,m s 115.31  17.30 blar or WV is not kno	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  NV Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03	(43) (44) (45) (46) (47) (51) (52) (53) (54)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost from  Enter (50) or (54)	Jan in litres pe 86.16 of hot wate 127.77 0.15 x (45) 19.17 (litres) incluses: or see loss far from Table factor from water see) in (55)	r day for ea  83.02  r used = 4.1  111.75  m  16.76  uding any so  loss factor if actor from Table 2b  storage (kW	Mar ch month 79.89  8 x Vd,m s 115.31  17.30  olar or WV  is not kno Fable 2 (k)	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da 7) x (51) x (51)	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60	(43) (44) (45) (46) (47) (51) (52) (53)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost free	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17 (litres) incluses: or seclared orage loss for from Table factor from water second or water second or sec	r day for ea 83.02  r used = 4.1  111.75  m  16.76  loss factor if actor from Table 2b storage (kW)	Mar ch month 79.89 8 x Vd,m x 115.31  17.30 blar or WV dis not kno Fable 2 (k) h/day) (4	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da 7) x (51)	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san	Jun le 1c x (43) 70.49 onth (see T 83.24  12.49 ne vessel	70.49 Tables 1b 77.13	73.62 , 1c 1d) 88.51	76.76 89.57	79.89 83.	78.32  NV Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (45) (46) (47) (51) (52) (53) (54)
Annual average h Hot water usage Energy content of Distribution loss Storage volume ( Water storage lo b) Manufacturer Hot water sto Volume facto Temperature Energy lost fri Enter (50) or (54) Water storage lo	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17  (litres) incluses: or second and a second area of the company o	r day for ea 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from Table 2b storage (kW)  ed for each 28.92	Mar ch month 79.89  8 x Vd,m : 115.31  17.30  blar or WV  is not kno  Table 2 (k)  h/day) (4  month (5  32.01	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da  7) x (51) x (51) x (55) x (41)m 30.98	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san (y)  32.01	Jun le 1c x (43) 70.49 onth (see T 83.24  12.49 ne vessel	70.49 Tables 1b 77.13  11.57	73.62 , 1c 1d) 88.51 13.28	76.76 89.57	79.89 83. $\sum (44)112 = \begin{bmatrix} \\ 104.38 \\ \\ 104.31 \end{bmatrix}$ 113 $\sum (45)112 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$	78.32  NV Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (45) (46) (47) (51) (52) (53) (54)
Annual average h  Hot water usage  Energy content of  Distribution loss  Storage volume ( Water storage lo b) Manufacturer  Hot water sto  Volume facto  Temperature  Energy lost free  Enter (50) or (54)	Jan in litres pe 86.16  of hot wate 127.77  0.15 x (45) 19.17  (litres) incluses: or second and a second area of the company o	r day for ea 83.02  r used = 4.1  111.75  m  16.76  uding any so loss factor if actor from Table 2b storage (kW)  ed for each 28.92	Mar ch month 79.89  8 x Vd,m : 115.31  17.30  blar or WV  is not kno  Table 2 (k)  h/day) (4  month (5  32.01	Apr Vd,m = fact 76.76  x nm x Tm/3 100.53  15.08  VHRS storag wn Wh/litre/da  7) x (51) x (51) x (55) x (41)m 30.98	May tor from Tab 73.62  3600 kWh/m 96.46  14.47 ge within san (y)  32.01	Jun le 1c x (43) 70.49 onth (see T 83.24  12.49 ne vessel	70.49 Tables 1b 77.13  11.57	73.62 , 1c 1d) 88.51 13.28	76.76 89.57	79.89 83.	78.32  NV Dec  02 86.16  939.88  .94 123.74  1232.34  09 18.56  110.00  0.02  1.03  0.60  1.03  1.03	(43) (44) (45) (46) (47) (51) (52) (53) (54)

Primary circuit	loss for each	n month fro	m Table 3										
	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)
Combi loss for	each month	from Table	3a, 3b or 3	С									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requ	uired for wat	er heating (	calculated f	or each mo	onth 0.85 x	(45)m + (4	l6)m + (57)ı	m + (59)m +	· (61)m				
	183.04	161.67	170.59	154.03	151.74	136.73	132.41	143.79	143.06	159.66	167.44	179.01	(62)
Solar DHW inpu	ut calculated	using Appe	endix G or A	Appendix H	1	•	•				•		_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from w	ater heater f	or each mc	onth (kWh/	month) (6	2)m + (63)n	n	•				•	-	-
	183.04	161.67	170.59	154.03	151.74	136.73	132.41	143.79	143.06	159.66	167.44	179.01	]
			•		•					Σ(64)1	.12 = 1	1883.18	(64)
Heat gains fron	n water heat	ing (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (62	1)m] + 0.8 >	< [(46)m + (	57)m + (59)	m]				_
	86.70	77.10	82.56	76.22	76.30	70.47	69.87	73.65	72.58	78.93	80.68	85.36	(65)
			1	•	<u>'</u>	1					1		
5. Internal gai	ins												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gain	s (Table 5)												
	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	111.47	(66)
Lighting gains (	calculated in	Appendix !	L, equation	L9 or L9a)	, also see Ta	able 5							
	36.91	32.79	26.66	20.19	15.09	12.74	13.77	17.89	24.02	30.49	35.59	37.94	(67)
Appliance gains	s (calculated	in Appendi	ix L, equatio	on L13 or L	13a), also s	ee Table 5							
	241.77	244.28	237.96	224.50	207.51	191.54	180.87	178.37	184.69	198.15	215.14	231.10	(68)
Cooking gains (	(calculated in	Appendix	L, equation	L15 or L15	āa), also see	e Table 5							
	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	(69)
Pump and fan g	gains (Table	5a)											
	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. eva	poration (Ta	ble 5)											
	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	-74.31	(71)
Water heating	gains (Table	5)											_
	116.54	114.73	110.97	105.86	102.55	97.88	93.91	98.99	100.80	106.09	112.06	114.74	(72)
Total internal g	gains (66)m -	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (	72)m					•	-	-
	480.39	476.96	460.76	435.71	410.31	387.32	373.71	380.41	394.67	419.89	447.95	468.94	(73)
						•	•	•	•	•	•	_	
6. Solar gains													
			Access f		Area m²		lar flux V/m²	cnoc	g ific data	FF specific o	data	Gains W	
			Table	ou	""	·	W/111	•	able 6b	or Table		VV	
North			0.3	0 x	11.52	x 1	10.63 x	0.9 x	).40 x	0.95		12.57	(74)
East			0.3		2.40				0.40 x			4.84	(76)
Solar gains in w	vatts Σ(74)m	ı (82)m	0.5	^ _	2.40	^	15.04 X	0.5 X	7.40 X	0.55			] (70)
		33.48	56.39	88.28	116.16	123.05	115.40	93.34	67.19	39.82	21.53	14.45	(83)
Ü	1 / ///	1 22.40	30.33	00.20	110.10	123.03	113.40	1 22.34	07.13	J9.02		14.47	(دی)
-	17.40	1	(83)m										
Total gains - int	ternal and so	olar (73)m +		E22.00	E26.47	E10.27	400.43	472.75	161.00	AEO 74	460.40	102.40	] (OA)
-		1	(83)m 517.15	523.99	526.47	510.37	489.12	473.75	461.86	459.71	469.48	483.40	(84)
-	ternal and so	blar (73)m + 510.44	517.15	523.99	526.47	510.37	489.12	473.75	461.86	459.71	469.48	483.40	(84)
Total gains - int	497.79	510.44 ture (heati	517.15				489.12	473.75	461.86	459.71	469.48	483.40	
Total gains - int	497.79	510.44 ture (heati	517.15				489.12 Jul	473.75	461.86 Sep	459.71 Oct	469.48 Nov		(84)
7. Mean inter Temperature d	497.79  rnal tempera luring heating	olar (73)m + 510.44  ture (heating periods in	517.15  ng season)  the living a	area from <sup>-</sup> <b>Apr</b>	Table 9, Th:	1(°C)						21.00	
Total gains - int	497.79  rnal tempera luring heating	olar (73)m + 510.44  ture (heating periods in	517.15  ng season)  the living a	area from <sup>-</sup> <b>Apr</b>	Table 9, Th:	1(°C)						21.00	

	temp of livin	g area T1 (s	steps 3 to 7	in Table 9	c)								
	20.80	20.85	20.92	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.91	20.79	(87)
Temperature du	uring heatin	g periods ir	the rest o	f dwelling f	from Table 9	9, Th2(°C)	•	•	•	•	•	•	_
	20.41	20.41	20.41	20.42	20.43	20.44	20.44	20.44	20.43	20.43	20.42	20.42	(88)
Utilisation facto		1	I.					-					
	0.94	0.92	0.86	0.73	0.56	0.38	0.26	0.28	0.46	0.71	0.88	0.95	(89)
Mean internal t			ļ		!			0.20	0.40	0.71	0.00	0.55	_ (03)
Wican internal t	20.16		,			1		20.44	20.42	20.44	20.21	20.15	7 (00)
		20.22	20.32	20.40	20.42	20.44	20.44	20.44	20.43	20.41	20.31	20.15	(90)
Living area fract				<b>.</b>					Liv	ving area ÷	(4) =	0.46	(91)
Mean internal t			1	g tLA x T1	+(1 - †LA) x <sup>-</sup>	Г2					,		7
	20.46	20.51	20.59	20.67	20.69	20.70	20.70	20.70	20.70	20.68	20.59	20.45	(92)
Apply adjustme	ent to the m	ean interna	l temperati	ure from Ta	able 4e whe	ere appropr	riate						_
	20.46	20.51	20.59	20.67	20.69	20.70	20.70	20.70	20.70	20.68	20.59	20.45	(93)
O Constant													
8. Space heati							7.		-				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains,	ηm										_	_
	0.94	0.92	0.86	0.74	0.57	0.39	0.28	0.30	0.48	0.72	0.88	0.95	(94)
Useful gains, ηn	mGm, W (94	4)m x (84)m	l										
	467.47	468.38	447.01	388.38	301.77	201.46	135.41	141.50	219.46	332.66	415.12	457.39	(95)
Monthly averag	ge external t	emperature	e from Tabl	e U1									
	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	or mean inte	ernal tempe	erature, Lm	, W [(39)n	n x [(93)m -	(96)m]				•	•	•	_
	560.91	540.00	485.70	397.98	302.85	201.49	135.41	141.50	219.63	339.46	457.85	555.70	(97)
Space heating r			l.										
opace meaning.					151ml x (41)	m							
	60 52		1		1		0.00	0.00	0.00	5.06	30.77	72 1/1	7
	69.52	48.13	28.78	6.91	0.80	0.00	0.00	0.00	0.00	5.06	30.77	73.14	(08)
Coope heating r		48.13	28.78		1		0.00	0.00		3)15, 10	.12 =	263.12	(98)
Space heating r		48.13	28.78		1		0.00	0.00		3)15, 10			(98)
Space heating r	equirement	48.13 kWh/m²/y	28.78		1		0.00	0.00		3)15, 10	.12 =	263.12	_
	equirement	48.13 kWh/m²/y	28.78	6.91	0.80	0.00	0.00		∑(98	3)15, 10	.12 =	263.12	_
8c. Space cool	requirement ling requirer Jan	48.13 kWh/m²/y	28.78 ear		1			0.00 Aug		(98)	.12 = ÷ (4)	263.12 4.72	_
8c. Space cool	requirement ling requirer Jan	48.13 kWh/m²/y ment Feb	28.78 ear Mar	6.91	0.80 May	0.00	Jul	Aug	∑(98 <b>Sep</b>	(98) Oct	.12 = ÷ (4)	263.12 4.72 Dec	(99)
8c. Space cool Heat loss rate L	requirement ling requirer Jan .m 0.00	48.13 kWh/m²/y nent Feb 0.00	28.78 ear	6.91	0.80	0.00			∑(98	(98)	.12 = ÷ (4)	263.12 4.72	
8c. Space cool	Jan  0.00  or for loss nr	48.13 kWh/m²/yı ment Feb  0.00	28.78 ear  Mar  0.00	Apr 0.00	May 0.00	Jun 310.58	<b>Jul</b> 244.50	Aug 250.13	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	263.12 4.72 Dec	(99)
8c. Space cool Heat loss rate L Utilisation factor	Jan  0.00  or for loss nr	48.13 kWh/m²/y ment Feb  0.00 m  0.00	28.78 ear  Mar  0.00	6.91	0.80 May	0.00	Jul	Aug	∑(98 <b>Sep</b>	(98) Oct	.12 = ÷ (4)	263.12 4.72 Dec	(99)
8c. Space cool Heat loss rate L Utilisation factor	Jan  0.00  or for loss nr  0.00  m (watts) (	48.13  kWh/m²/yment Feb  0.00  0.00  100)m x (10	28.78  ear  Mar  0.00  0.00  01)m	Apr 0.00	May 0.00	Jun 310.58	Jul 244.50	Aug 250.13	∑(98 Sep  0.00  0.00	(98)  Oct  0.00	.12 = ÷ (4)	263.12 4.72 Dec 0.00	(100)
8c. Space cool Heat loss rate L	Jan  0.00  or for loss nr	48.13 kWh/m²/y ment Feb  0.00 m  0.00	28.78 ear  Mar  0.00	Apr 0.00	May 0.00	Jun 310.58	<b>Jul</b> 244.50	Aug 250.13	∑(98 Sep 0.00	(98) Oct 0.00	.12 = ÷ (4)	263.12 4.72 Dec	(100)
8c. Space cool Heat loss rate L Utilisation factor	Jan  0.00  or for loss nr  0.00  m (watts) (	48.13  kWh/m²/yment Feb  0.00  0.00  100)m x (10	28.78  ear  Mar  0.00  0.00  01)m	Apr 0.00	May 0.00	Jun 310.58	Jul 244.50	Aug 250.13	∑(98 Sep  0.00  0.00	(98)  Oct  0.00	.12 = ÷ (4)	263.12 4.72 Dec 0.00	(100)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL	Jan  0.00  or for loss nr  0.00  m (watts) (	48.13  kWh/m²/yment Feb  0.00  0.00  100)m x (10	28.78  ear  Mar  0.00  0.00  01)m	Apr 0.00	May 0.00	Jun 310.58	Jul 244.50	Aug 250.13	∑(98 Sep  0.00  0.00	(98)  Oct  0.00	.12 = ÷ (4)	263.12 4.72 Dec 0.00	(100)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains	Jan .m  0.00 or for loss nr  0.00 .m (watts) (  0.00	48.13   kWh/m²/yement   Feb   0.00   m   0.00   100)m x (10   0.00   0.00	28.78  Mar  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00	May  0.00  0.00  0.00	Jun 310.58 1.00 310.08	Jul 244.50 1.00 244.42 566.05	Aug 250.13 1.00 249.97	Sep  0.00  0.00  0.00	Oct  0.00  0.00	.12 =	263.12 4.72 Dec 0.00	(100) (101) (102)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL	Jan .m  0.00 or for loss nr  0.00 .m (watts) (  0.00	48.13   kWh/m²/yement   Feb   0.00   m   0.00   100)m x (10   0.00   0.00	28.78  Mar  0.00  0.00  0.00  0.00  0.00	Apr 0.00 0.00 0.00	May  0.00  0.00  0.00	Jun 310.58 1.00 310.08	Jul 244.50 1.00 244.42 566.05	Aug 250.13 1.00 249.97	Sep  0.00  0.00  0.00	Oct  0.00  0.00	.12 =	263.12 4.72 Dec 0.00	(99)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains	on the sequirement of the sequir	48.13  kWh/m²/y  ment  Feb  0.00  0.00  0.00  0.00  vwhole dwa	28.78  Mar  0.00  0.00  0.00  0.00  elling, conti	Apr  0.00  0.00  0.00  nuous (kW	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun  310.58  1.00  310.08  592.40  (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (41	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00	Oct  0.00  0.00  0.00	.12 =	263.12 4.72  Dec  0.00  0.00  0.00	(100)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re	Jan  .m  0.00  or for loss nr  0.00  Lm (watts) (  0.00  0.00  equirement,  0.00	48.13  kWh/m²/y  ment  Feb  0.00  0.00  0.00  0.00  vwhole dwa	28.78  Mar  0.00  0.00  0.00  0.00  elling, conti	Apr  0.00  0.00  0.00  nuous (kW	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun  310.58  1.00  310.08  592.40  (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (41	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  655.36	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	requirement  Jan  .m  0.00  or for loss nr  0.00  .m (watts) (  0.00  0.00  equirement,  0.00	48.13   kWh/m²/y/ment   Feb   0.00     0.00	28.78  Mar  0.00  0.00  0.00  0.00  elling, conti	Apr  0.00  0.00  0.00  nuous (kW	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun  310.58  1.00  310.08  592.40  (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (41	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00	.12 =	263.12 4.72  Dec  0.00  0.00  0.00	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	requirement  Jan   0.00  or for loss nr  0.00   (watts) (  0.00  equirement,  0.00  actor (Table	48.13  kWh/m²/y  ment  Feb  0.00  0.00  0.00  0.00  whole dwe  0.00	28.78  ear  Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  nuous (kW	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (41 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	.12 =	263.12  4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.72	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re	requirement  Jan  .m  0.00  or for loss nr  0.00  .m (watts) (  0.00  0.00  equirement,  0.00	48.13   kWh/m²/y/ment   Feb   0.00     0.00	28.78  Mar  0.00  0.00  0.00  0.00  elling, conti	Apr  0.00  0.00  0.00  nuous (kW	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun  310.58  1.00  310.08  592.40  (103)m - (1	Jul 244.50 1.00 244.42 566.05 02)m] x (41	Aug 250.13 1.00 249.97 535.98	Sep  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  0.00  Σ(104)6  bled area ÷	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	(100) (101) (102) (103) (104) (105)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction  Intermittency factor	requirement  Jan  .m  0.00  or for loss nr  0.00  m (watts) (  0.00  equirement,  0.00  actor (Table	48.13	28.78  Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  0.00  0.00  0.00	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (41 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	.12 =	263.12  4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.72	(100) (101) (102) (103) (104)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction	requirement  Jan  .m  0.00  or for loss nr  0.00  m (watts) (  0.00  equirement,  0.00  actor (Table	48.13	28.78  Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  0.00  0.00  0.00	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (41 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  0.00  Σ(104)6  bled area ÷	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	(100) (101) (102) (103) (104) (105)
8c. Space cool  Heat loss rate L  Utilisation factor  Useful loss ηmL  Gains  Space cooling re  Cooled fraction  Intermittency factor	requirement  Jan  .m  0.00  or for loss nr  0.00  m (watts) (  0.00  equirement,  0.00  actor (Table	48.13	28.78  Mar  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Apr  0.00  0.00  0.00  0.00  0.00  0.00  0.00	May  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	Jun 310.58 1.00 310.08 592.40 (103)m - (1 203.27	Jul 244.50 1.00 244.42 566.05 02)m] x (41 239.30	Aug 250.13 1.00 249.97 535.98 1.)m 212.79	Sep  0.00  0.00  0.00  0.00  0.00	Oct  0.00  0.00  0.00  0.00  0.00  0.00  Σ(104)6  bled area ÷	.12 =	263.12 4.72  Dec  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00	(100) (101) (102) (103) (104) (105)

Space cooling requirement kWh/m²/year				(107) ÷ (4) = [	2.12	(108)
9b. Energy requirements - community heating scheme						
Fraction of space heat from secondary/supplementary system (1	table 11)			'0' if none	0.00	(301)
Fraction of space heat from community system				1 - (301) = [	1.00	(302)
Fraction of community heat from boilers					1.00	(303a)
Fraction of total space heat from community boilers			(3	02) x (303a) = [	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for commu				1.00	(305)	
Factor for charging method (Table 4c(3)) for community water h			[	1.00	(305a)	
Distribution loss factor (Table 12c) for community heating system	m				1.05	(306)
Space heating						
Annual space heating requirement			263.12			(98)
Space heat from boilers			(98) x (304a) x (	305) x (306) = [	276.27	(307a)
			(==) (== .=) (			] (22.2)
Water heating						
Annual water heating requirement			1883.18			(64)
Water heat from boilers			(64) x (303a) x (3	05a) x (306) = [	1542.32	(310a)
Water heat from heat pump			(64) x (303b) x (3	05a) x (306) = [	435.01	(310b)
Electricity used for heat distribution		0.01 × [	(307a)(307e) + (310	0a)(310e)] = [	22.52	(313)
Cooling System Energy Efficiency Ratio					0	(314)
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive in	put from outside		177.36			(330a)
Total electricity for the above, kWh/year					177.36	(331)
Electricity for lighting (Appendix L)					260.77	(332)
Total delivered energy for all uses	(307) + (309)	+ (310) + (312	2) + (315) + (331) + (3	32)(337b) =	2716.07	(338)
Total delivered energy for all uses  10b. Fuel costs - community heating scheme	(307) + (309)	+ (310) + (312	2) + (315) + (331) + (3	32)(337b) =	2716.07	(338)
	(307) + (309)  Fuel kWh/year	+ (310) + (312	(2) + (315) + (331) + (3 Fuel price	(337b) = [	2716.07  Fuel cost £/year	(338)
	Fuel	+ (310) + (312 x		x 0.01 =	Fuel	(338)
10b. Fuel costs - community heating scheme	Fuel kWh/year		Fuel price		Fuel cost £/year	
10b. Fuel costs - community heating scheme  Space heating from boilers	Fuel kWh/year 276.27	x	Fuel price	x 0.01 = [	Fuel cost £/year 11.71	] (340a)
10b. Fuel costs - community heating scheme  Space heating from boilers  Water heating from boilers	Fuel kWh/year 276.27 1542.32	x x	Fuel price 4.24 4.24	x 0.01 =  [ x 0.01 =  [	Fuel cost £/year 11.71 65.39	] (340a) ] (342a)
10b. Fuel costs - community heating scheme  Space heating from boilers  Water heating from boilers  Water heating from heat pump	Fuel kWh/year 276.27 1542.32 435.01	x x x	4.24 4.24 4.24	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44	] (340a) ] (342a) ] (342b)
10b. Fuel costs - community heating scheme  Space heating from boilers  Water heating from boilers  Water heating from heat pump  Space cooling	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x	4.24 4.24 4.24 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21	] (340a) ] (342a) ] (342b) ] (348)
10b. Fuel costs - community heating scheme  Space heating from boilers  Water heating from boilers  Water heating from heat pump  Space cooling  Pumps and fans	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39	] (340a) ] (342a) ] (342b) ] (348) ] (349)
10b. Fuel costs - community heating scheme  Space heating from boilers  Water heating from boilers  Water heating from heat pump  Space cooling  Pumps and fans  Electricity for lighting	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39 34.40	] (340a) ] (342a) ] (342b) ] (348) ] (349) ] (350)
10b. Fuel costs - community heating scheme  Space heating from boilers  Water heating from boilers  Water heating from heat pump  Space cooling  Pumps and fans  Electricity for lighting  Additional standing charges	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39 34.40 120.00	(340a) (342a) (342b) (348) (349) (350) (351)
Space heating from boilers Water heating from boilers Water heating from heat pump Space cooling Pumps and fans Electricity for lighting Additional standing charges Total energy cost	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39 34.40 120.00	(340a) (342a) (342b) (348) (349) (350) (351)
Space heating from boilers Water heating from boilers Water heating from heat pump Space cooling Pumps and fans Electricity for lighting Additional standing charges Total energy cost  11b. SAP rating - community heating scheme	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39 34.40 120.00 276.55	] (340a)   (342a)   (342b)   (348)   (349)   (350)   (351)
Space heating from boilers Water heating from boilers Water heating from heat pump Space cooling Pumps and fans Electricity for lighting Additional standing charges Total energy cost  11b. SAP rating - community heating scheme Energy cost deflator (Table 12)	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39 34.40 120.00 276.55	(340a) (342a) (342b) (348) (349) (350) (351) (355)
Space heating from boilers Water heating from boilers Water heating from heat pump Space cooling Pumps and fans Electricity for lighting Additional standing charges Total energy cost  11b. SAP rating - community heating scheme Energy cost deflator (Table 12) Energy cost factor (ECF)	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39 34.40 120.00 276.55	(340a) (342a) (342b) (348) (349) (350) (351) (355)
Space heating from boilers Water heating from boilers Water heating from heat pump Space cooling Pumps and fans Electricity for lighting Additional standing charges Total energy cost  11b. SAP rating - community heating scheme Energy cost deflator (Table 12) Energy cost factor (ECF) SAP value	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year 11.71 65.39 18.44 3.21 23.39 34.40 120.00 276.55	] (340a)   (342a)   (342b)   (348)   (349)   (350)   (351)   (355)   (356)   (357)
Space heating from boilers Water heating from boilers Water heating from heat pump Space cooling Pumps and fans Electricity for lighting Additional standing charges Total energy cost  11b. SAP rating - community heating scheme Energy cost deflator (Table 12) Energy cost factor (ECF) SAP value SAP rating (section 13)	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year  11.71  65.39  18.44  3.21  23.39  34.40  120.00  276.55  0.42  1.15  83.91  84	] (340a)   (342a)   (342b)   (348)   (349)   (350)   (351)   (355)   (356)   (357)
Space heating from boilers Water heating from boilers Water heating from heat pump Space cooling Pumps and fans Electricity for lighting Additional standing charges Total energy cost  11b. SAP rating - community heating scheme Energy cost deflator (Table 12) Energy cost factor (ECF) SAP value SAP rating (section 13) SAP band	Fuel kWh/year 276.27 1542.32 435.01 -1.00	x x x x	4.24 4.24 4.24 13.19 13.19 13.19	x 0.01 =	Fuel cost £/year  11.71  65.39  18.44  3.21  23.39  34.40  120.00  276.55  0.42  1.15  83.91  84	] (340a)   (342a)   (342b)   (348)   (349)   (350)   (351)   (355)   (356)   (357)

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Linissions nom other sources (space neating)						
Efficiency of boilers	93.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	297.07	x	0.216	= [	64.17	(367)
Emissions from other sources (water heating)						
Efficiency of boilers	93.00					(367a)
CO2 emissions from boilers $[(307a)+(310a)] \times 100 \div (367a) =$	1657.33	x	0.216	= [	358.22	(367)
Efficiency of heat pump	400.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 $\div$ (367b) =	108.50	x	0.519	= [	56.44	(368)
Electrical energy for community heat distribution	22.52	x	0.52	= [	11.69	(372)
Total CO2 associated with community systems					490.51	(373)
Total CO2 associated with space and water heating					490.51	(376)
Space cooling	-1.00	] x	0.52	= [	12.63	(377)
Pumps and fans	177.36	] x	0.52	= [	92.05	(378)
Electricity for lighting	260.77	x	0.52	= [	135.34	(379)
Total CO <sub>2</sub> , kg/year				(376)(382) = [	730.53	(383)
Dwelling CO₂ emission rate				(383) ÷ (4) = [	13.12	(384)
El value					90.28	
El rating (section 14)					90	(385)
El band					В	

13b. Primary energy - Community heating scheme				
	Energy kWh/year	Primary factor		Primary energy (kWh/year)
Primary energy from other sources (space heating)				
Efficiency of boilers	93.00			(367a)
Primary energy from boilers $[(307a)+(310a)] \times 100 \div (360a)$	67a) = 297.07	x 1.22	=	362.42 (367)
Primary energy from other sources (water heating)				
Efficiency of boilers	93.00			(367a)
Primary energy from boilers $[(307a)+(310a)] \times 100 \div (36a)$	67a) = 1657.33	x 1.22	=	2023.26 (367)
Efficiency of heat pump	400.00			(367b)
Primary energy from heat pump [(307b)+(310b)] $\times$ 100 ÷ (36	57b) = 108.50	x 3.07	=	333.87 (368)
Electrical energy for community heat distribution	22.52	x 3.07	=	69.12 (372)
Total primary energy associated with community systems				2788.68 (373)
Total primary energy associated with space and water heat	ing			2788.68 (376)
Space cooling	-1.00	x 3.07	=	3.07 (377)
Pumps and fans	177.36	x 3.07	=	544.50 (378)
Electricity for lighting	260.77	x 3.07	=	800.57 (379)
Primary energy kWh/year				4208.44 (383)
Dwelling primary energy rate kWh/m2/year				75.56 (384)

## 5.2 Appendix B – Citigen Correspondence

#### **David Mason**

From: White, Andrew <andrew.white@eonenergy.com>

**Sent:** 03 March 2015 10:04 **To:** Harry Thurman

**Subject:** RE: Templar House - Connection to CitiGen.

#### Morning Harry,

I can confirm that the below email is an accurate summary of our conversation. Of course, should we extend the network west towards High Holborn there may be an opportunity in the future to connect to the building to our network.

Kind regards,

#### **Andrew**

Andrew White Community Energy E.ON Energy Solutions Limited M: +44 (0) 7805 753 088 andrew.white@eonenergy.com

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**From:** Harry Thurman [mailto:Harry.Thurman@arup.com]

**Sent:** 03 March 2015 10:02

To: White, Andrew

**Subject:** RE: Templar House - Connection to CitiGen.

#### Morning Andrew,

Thank you for taking the time to discuss the potential for connecting our scheme (Templar House) to the Citigen district heating network.

We understand that based on the size of our scheme that it would not be feasible to extend the Citigen network to our site. We also understand that there are additional technical difficulties in extending the network further west beyond Farringdon Road. Therefore we will be unable to connect to the Citigen network at present and we should consider other means of providing heat to the site.

We will be designing scheme to be connect to any future district heating scheme that may become available.

I would be grateful if you could confirm that this is an accurate summary of our conversation.

Kind Regards,

#### Harry

From: White, Andrew [mailto:andrew.white@eonenergy.com]

**Sent:** 20 February 2015 16:23

To: Harry Thurman

Subject: FW: Templar House - Connection to CitiGen.

Harry,

I have been forwarded your email below regarding a possible connection to our Citigen district heating network. I will give you a call on Monday to discuss if that's OK?

Kind regards,

#### Andrew

Andrew White Community Energy E.ON Energy Solutions Limited M: +44 (0) 7805 753 088 andrew.white@eonenergy.com

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**From:** Harry Thurman [mailto:Harry.Thurman@arup.com]

**Sent:** 13 February 2015 14:45 **To:** CHP Commercial Team

**Subject:** Templar House - Connection to CitiGen.

Dear Whom It may Concern,

We are looking to develop a new scheme commercial office and residential in Holborn and wanted to enquire into the possibility of connecting to the CitiGen District Heating network that is approximately 950m away from our site?

The address is:

Templar House 81-87 High Holborn LONDON WC1V 6NU

I would be grateful if you could let me know if this is a possibility and the available capacity.

Regards,

Harry

#### **Harry Thurman**

Senior Engineer | Mechanical

13 Fitzroy Street London W1T 4BQ United Kingdom t +44 20 7755 2712 d +44 20 7755 2712 f +44 20 7755 9012 www.arup.com

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