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SEGRO PLC

Planning Application for Development at the former Nestlé Factory Nestles Avenue Hayes UB3 4RF

Energy Strategy (Industrial Scheme)

Planning Submission
Issue 7

Client Name	SEGRO PLC
Client Address	258 Bath Road Slough SL1 4DX
Property:	Former Nestlé Factory Nestles Avenue Hayes UB3 4RF
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Prepared by:	SH
Checked by:	MDC
Validated by:	MDC

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EXECUTIVE SUMMARY

This energy strategy supports the commercial part of the redevelopment known as the former Nestlé factory, Hayes. This report should be read in conjunction with the energy strategy prepared by BBS for the residential part of the proposed redevelopment. Combined, the two reports set out the proposed energy strategy for the redevelopment of the factory site in its entirety.

The energy strategy adopts a hierarchical approach using passive and low energy design technologies to reduce baseline energy demand and CO_2 emissions followed by the application of low and zero carbon technologies. This strategy is in line with the relevant London Borough of Hillingdon and GLA Policies from the London Plan, updated March 2015 and the related supplementary guidance.

In accordance with the London Plan Policy 5.2 and the London Borough of Hillingdon Policy EM1. The applicable carbon emission reduction target is 35% from a Building Regulations Part L: 2013 baseline.

The focus of this energy strategy is on CO_2 reduction by using a highly efficient building envelope with high efficiency mechanical and electrical services, along with air source heat pump (variable refrigerant flow systems) and photovoltaic cells renewable technologies. The result is a proposed development with predicted performance of:

- CO_2 emissions reduction of 47.68 % over the Building Regulations 2013 compliant baseline scheme.
- The passive/energy efficiency measures are predicted to achieve a 34.38% CO_2 reduction over the baseline building regulations compliant scheme.
- The renewable energy technologies of air source heat pumps and photovoltaic cells are predicted to achieve a 20.27 % CO_2 reduction.
- When unregulated uses are taken into account there is a predicted reduction of 40.45 % in the development's annual CO_2 emissions.
- The energy strategy is predicted using the Building Regulations calculation methodologies to achieve an annual carbon emission saving of 272.32 tonnes over the baseline scheme.

The carbon dioxide emission and savings values, for the development as a whole, are as follows:

	CO_2 Emissions (Tonnes per annum)	
	Regulated	**Unregulated**
Baseline Building Regulations 2013 Part L Compliant Development	571.16	673.18
After passive/low energy (energy demand) reduction	374.81	476.86
After CHP or decentralised heating	374.81	476.86
After renewable energy	298.84	400.86

	Regulated CO_2 Savings	
	Tonnes per annum	**%**
Savings from passive/low energy (energy demand) reduction	196.34	34.38
Savings from CHP or decentralised heating	0.00	0.00
Savings from renewable energy	75.98	20.27
Total Cumulative Savings	**272.32**	**47.68**

	Annual Shortfall/Surplus	**30 Year Cumulative Shortfall/Surplus**
	Tonnes of CO_2	Tonnes of CO_2
Total Target Savings	199.91	-
Annual Surplus	72.41	2172.30

Therefore each individual industrial unit and the commercial development as a whole comply with the London Plan 2011 updated March 2016 and London Borough of Hillingdon carbon emission reduction targets.

The free running (no mechanical cooling included in the analysis) overheating risk analysis indicates that even with the passive measures incorporated that there is a risk of overheating for each of the three TM49 design summer years.

Therefore comfort cooling to the office accommodation is proposed. The area weighted average cooling demand for the proposed office accommodation for the development is less than the Building Regulations Part L: 2013 notional building cooling demand.

The development passes the comfort cooled building overheating criteria for each of the three TM49 design summer years.

1.00 INTRODUCTION

1.01 Purpose

This report has been prepared on behalf of SEGRO PLC for the proposed redevelopment of the former Nestlé Factory, Hayes. This document assesses the proposed energy strategy and demonstrates how it seeks to satisfy the applicable London Plan and London Borough of Hillingdon Policies on energy and carbon dioxide emission.

This report supports the commercial part of the redevelopment which is shown on the architect's site layout, contained in the appendix.

This report should be read in conjunction with the energy strategy prepared by BBS for the residential part of the proposed redevelopment. Combined, the two reports set out the proposed energy strategy for the redevelopment of the factory site in its entirety.

The report contains the predicated energy and carbon emission assessment results for the commercial element of the development and identifies savings from the proposed low and zero carbon technologies to be incorporated into the scheme.

The energy and carbon dioxide emission assessment has been undertaken using dynamic simulation modelling software EDSL TAS Version 9.4. Based on the building design submitted with the planning application the modelling will identify the energy and carbon dioxide savings related to the building envelope design and efficient mechanical and electrical services systems followed by the improvement using the proposed low and zero carbon (renewable) technologies for the scheme.

1.02 Existing Building

The existing buildings on the site in the development area will be part demolished for further information see the design and access statement and the planning statement.

1.03 Proposed Development

Full planning permission for the part-demolition of existing factory buildings, associated structures, and redevelopment to provide 1,381 dwellings (Use Class C3), office, retail community and leisure uses (Use Classes A1/A3/A4/B1/B8/D1/D2), 22,663 m^2 (GEA) of commercial floor space (Use Classes B1c/B2/B8 and Data Centre (sui-generis)), amenity and play space, allotments, landscaping, access, service yards, associated car parking and other engineering works.

The four industrial units are to be built as shell warehouses with the associated office space being provided with comfort cooling and heating and fitted out to a Category A standard.

By their speculative nature the final use of the industrial units cannot be defined at this early stage. In terms of energy usage it is assumed for estimating energy usage that the shell warehouse areas will be heated although this will ultimately be dependent on the future tenants bespoke needs.

The fitting out of the industrial area for a specific process, for all of the units, would require bespoke systems to suit the tenants' individual needs arising at the time of letting, which would all require assessment under ADL2B.

The servicing strategy for the industrial units will be as follows:

- Warehouse heating — No heating, see the note below.
- Office area heating and cooling — Air source heat pumps serving refrigerant based variable refrigerant flow (VRF) comfort cooling and heating systems.
- Core area heating — Radiators fed by gas fired boiler LTHW system.
- Domestic hot water — Indirect fired via LTHW boiler system.

For thermal assessment purposes the shell warehouse areas are assumed to be heated by direct/indirect gas fired heaters. A gas service will be provided to each space but left capped off for extension by the tenant as considered necessary to serve either convector unit heaters or radiant tubular heaters. These systems are preferred by tenants as they offer the most flexibility in terms of control and efficiency in performance compared to water based systems.

2.00 POLICY REVIEW

2.01 National Policy

The National Planning Policy Framework sets out the planning policies for England that are to be taken into account within local planning policies. The framework itself does not have specific policies but identifies the purpose of achieving sustainable development.

2.02 The London Plan

The London Plan 2011 updated March 2016, identifies key policies associated with building design and energy strategy as noted below:

Policy 5.2 Minimising Carbon Dioxide Emissions

Planning Decisions

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

1 Be lean: use less energy

2 Be clean: supply energy efficiently

3 Be green: use renewable energy

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

Non-Domestic Buildings:

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

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

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

a) Calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy

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

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

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

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

Policy 5.5 Decentralised Energy Networks

Strategic

A *The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.*

Policy 5.6 Decentralised Energy in Development Proposals

Planning Decisions

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

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

1. *Connection to existing heating or cooling networks.*
2. *Site wide CHP network.*
3. *Communal heating and cooling.*

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

Policy 5.7 Renewable Energy

Strategic

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

Planning Decisions

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

Policy 5.9 Overheating and Cooling

Strategic

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

Planning Decisions

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

1. *Minimise internal heat generation through energy efficient design.*
2. *Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.*
3. *Manage the heat within the building through exposed internal thermal mass and high ceilings.*
4. *Passive ventilation.*
5. *Mechanical ventilation.*
6. *Active cooling systems (ensuring they are the lowest carbon options).*

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

2.03 GLA Supplementary Planning Guidance

The London Plan is supported by various supplementary planning guidance (SPG) that includes "Sustainable Design and Construction" dated April 2014 that relates specifically to sustainability issues.

The Sustainable Design and Construction SPG sets out essential and preferred standards for new developments encompassing a wide range of sustainability topics.

The major change to the carbon emission savings targets for the April 2014 issue of the SPG is that the overall saving target is benchmarked against a Building Regulations Part L2A: 2013 baseline and not Part L2A: 2010. This change gives a revised carbon emission reduction target of 35% less than Part L2A: 2013.

The relevant sections from the Sustainable Design and Construction SPG are as follows:

Energy and Carbon Dioxide Emissions	
Mayor's Priority	**London Plan Policy**
The overall carbon dioxide emissions from a development should be minimized through the implementation of the energy hierarchy set out in the London Plan Policy 5.2.	5.2, 5.3
Developments should be designed to meet the following Regulated carbon dioxide standards, in line with London Plan Policy 5.2.	5.2
Non Domestic Buildings • Year – Improvements beyond 2010 Building Regulations. • 1st October 2013 – 2016 – 40 per cent • 2016 – 2019 – As per Building Regulation requirements • 2019 – 2031 – Zero carbon	
Mayor's Best Practice	**London Plan Policy**
Developments should contribute to ensuring resilient energy infrastructure and a reliable energy supply, including from local low and zero carbon sources.	501, 5.5, 5.6, 5.7, 5.8, 5.17
Developers are encouraged to include innovative low and zero carbon technologies to minimize carbon dioxide emissions within developments and keep up to date with rapidly improving technologies.	5.2, 5.17
Energy Demand Assessment	
Mayor's Priority	**London Plan Policy**
Development applications are to be accompanied by an energy demand assessment.	5.2
Use Less Energy	
Mayor's Priority	**London Plan Policy**
The design of developments should prioritise passive measures.	5.2, 5.3, 5.9
Mayor's Best Practice	**London Plan Policy**
Developers should aim to achieve Part L 2013 Building Regulations requirements through design and energy efficiency alone, as far as is practical.	5.2, 5.3
Efficient Energy Supply	
Mayor's Priority	**London Plan Policy**
Where borough heat maps have identified district heating opportunities, boroughs should prepare more detailed Energy Master Plans (EMPs) to establish the extent of market competitive district heating networks.	5.5, 5.6
Mayor's Priority	**London Plan Policy**
Developers should assess the potential for their development to: • connect to an existing district heating or cooling network;	5.5, 5.6

• expand an existing district heating or cooling network, and connect to it; or • establish a site wide network, and enable the connection of existing buildings in the vicinity of the development.	
Mayor's Priority	**London Plan Policy**
Where opportunities arise, developers generating energy or waste heat should maximize long term carbon dioxide savings by feeding the decentralised energy network with low or zero carbon hot, and where required, cold water.	5.5, 5.6
Renewable Energy	
Mayor's Priority	**London Plan Policy**
Boroughs and neighbourhoods should identify opportunities for the installation of renewable energy technologies in their boroughs and neighbourhoods.	5.4, 5.7
Major development should incorporate renewable energy technologies to minimize overall carbon dioxide emissions, where feasible.	5.7
Carbon Dioxide Off-setting	
Mayor's Priority	**London Plan Policy**
Boroughs should establish a carbon off-set fund and identify suitable projects to be funded.	5.2, 5.4
Where developments do not achieve the Mayor's carbon dioxide reduction targets set out in London Plan Policy 5.2, the developer should make a contribution to the local borough's carbon dioxide off-setting fund.	5.2, 5.4
Retrofitting	
Mayor's Priority	**London Plan Policy**
Boroughs should set out policies to encourage the retrofitting of carbon dioxide and water saving measures in their borough.	5.4, 5.15
Where works to existing developments are proposed developers should retrofit carbon dioxide and water saving measures.	5.4, 5.15
Monitoring Energy Use	
Mayor's Best Practice	**London Plan Policy**
Developers are encouraged to incorporate monitoring equipment, and systems where appropriate to enable occupiers to monitor and reduce their energy use.	5.2, 5.3
Supporting a Resilient Energy Supply	
Mayor's Best Practice	**London Plan Policy**
Developers are encouraged to incorporate equipment that would enable their schemes to participate in demand side response opportunities.	5.2, 5.3

Climate Change Adaptation	
Tackling Increased Temperature and Drought	
Overheating	
Mayor's Priority	**London Plan Policy**
Developers should include measures, in the design of their schemes, in line with the cooling hierarchy set out in London Plan Policy 5.9 to prevent overheating over the schemes life-time.	5.3, 5.9

2.04 London Borough of Hillingdon

The London Borough of Hillingdon adopted in November 2012 key policies associated with climate change adaptation and mitigation as noted below:

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.
3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.
4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.
5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydro-electricity and a greater use of waste as a resource.
9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. Locating and designing development to minimise the probability and impacts of flooding

11. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water consumption.
12. Giving preference to development of previously developed land to avoid the loss of further green areas.
13. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amounted of carbon sinks [40].
14. Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

3.00 OUTLINE METHODOLOGY

3.01 Energy Strategy

The fundamental approach for the energy strategy is as follows:

- Establish the baseline energy demand in line with statutory requirements in terms of Building Regulations Part L2A : 2013 compliance using accredited thermal modelling software plus allowance for energy consumed by elements not covered in the 2013 Building Regulations.
- Adopt passive and low energy design techniques in order to reduce the energy demand for the development beyond the baseline energy demand requirements.
- Assess the potential decentralised heating, cooling and power measures available to suit this development and establish potential energy/carbon dioxide reduction for viable solutions (clean scheme).
- Assess the potential low and zero carbon (renewable) technologies to suit the development and establish potential energy/carbon dioxide reduction for viable solutions.
- Establish the anticipated energy and carbon dioxide emission reductions for the development using Building Regulations 2013 calculation methodologies.

This approach is in line with the principles detailed within the relevant policy statements and regulatory guidelines listed in section 2.00.

The methodology of this energy strategy is in accordance with the guidance set out in the GLA document “Energy Planning, Greater London Authority Guidance on preparing Energy Assessments (March 2016)”.

3.02 Energy Strategy Target

In accordance with the London Borough of Hillingdon Planning Policy the regulated energy CO_2 reduction target for the development is 35 % from the Building Regulations Part L: 2013 baseline as per the London Plan, updated March 2015, target CO_2 reduction as well as 20% reduction through the use of on-site renewable energy technology.

4.00 ENERGY DEMAND ASSESSMENT

4.01.01 General

The energy demand assessment work has been undertaken using EDSL TAS dynamic simulation software Version 9.4.1 that incorporates the SBEM calculation methodology in line with Building Regulations Part L2A : 2013 requirements in order to generate a predicted annual CO_2 emission rate.

Within the energy demand assessment the following fuel carbon dioxide emission intensity factors have been used in line with Part L2A : 2013.

Fuel	kg CO_2 / kWhr
Natural gas	0.216
Grid supplied electricity	0.519
Grid displaced electricity	0.519

4.01.02 Regulated and Un-regulated Energy

As the London Borough of Hillingdon energy polices refer to the London Plan, updated March 2015 applicable policies the planning application energy strategy will be provided in a format that reflects the recommendations of the GLA document “Energy Planning – GLA Guidance on preparing energy assessments: March 2016”.

Therefore this framework energy strategy shows how policy compliance for the “regulated” energy can be achieved at the development and makes reference to the estimated “un-regulated” energy usage by means of energy benchmarks.

For clarity “regulated” and “un-regulated” energy are summarised as follows:

- Regulated Energy — This is the energy covered by Approved Document L2A of the Building Regulations i.e. the energy used in heating, cooling, fans and pumps plus domestic hot water
- Un-regulated Energy — This is energy used within a building that is not covered by the Building Regulations i.e. the energy used for general small power loads, lifts, external lighting, catering electricity etc.

The planning policy CO_2 reduction targets are based in “regulated” energy only. Hence the % CO_2 emission savings target is not adversely affected by the estimated “un-regulated” energy in a building.

The assessed un-regulated energy uses for the proposed uses at the site are as follows:

Industrial Unit:
General small power
Lifts
External lighting
Catering electricity

4.01.03 Energy Benchmarks

The "un-regulated" energy use and benchmarks for this framework energy strategy have been derived from data and guidance taken from the following Chartered Institute of Building Services Engineers (CIBSE) documents:

1. CIBSE Guide F – Energy Efficiency in Buildings: 2012

2. CIBSE Technical Memorandum – Energy Benchmarks TM46: 2008

The un-regulated energy use values have been derived from the CIBSE Guide F Benchmark Section. The specific benchmarks used and the resultant estimated un-regulated energy values are as follows:

Industrial Unit: Industrial unit benchmarks good practice type 5 (distribution and warehouse) of 9.0 kWh/m^2/year that equates to 4.65 kgCO_2/m^2

4.02 Baseline Scheme

The baseline demand is the Building Regulations Part L2A: 2013 target emission rate (TER).

The Part L2A: 2013 TER is derived from the thermal model based on the National Calculation Methodology (NCM). The review has been carried out utilising the TAS dynamic thermal modelling software version 9.4.1 that has achieved accreditation from the Department of Communities and Local Government (DCLG).

4.02.01 Unit 1

The baseline CO_2 emissions for unit 1 are modelled as follows:-

	CO_2 Emission (kg CO_2/m^2/year)
Heating	5.81
Cooling	0.48
Fans and Pumps	0.75
Lighting	17.06
Domestic Hot Water	1.07
Part L2A: 2013 TER	**25.17**
Unregulated Uses	4.65
Total	**29.82**

The annual CO_2 emission resulting from the baseline demand, for unit 1, equates to 192.15 tonnes without un-regulated energy uses and then 227.66 tonnes when un-regulated energy uses are taken into account.

4.02.02 Unit 2

The baseline CO_2 emissions for unit 2 are modelled as follows:-

	CO_2 Emission (kg CO_2/m^2/year)
Heating	8.86
Cooling	0.65
Fans and Pumps	1.30
Lighting	17.89
Domestic Hot Water	1.02
Part L2A: 2013 TER	**29.71**
Unregulated Uses	4.65
Total	**34.36**

The annual CO_2 emission resulting from the baseline demand, for unit 2, equates to 67.26 tonnes without un-regulated energy uses and then 77.79 tonnes when un-regulated energy uses are taken into account.

4.02.03 Unit 3

The baseline CO_2 emissions for unit 3 are modelled as follows:-

	CO_2 Emission (kg CO_2/m^2/year)
Heating	8.75
Cooling	0.48
Fans and Pumps	1.00
Lighting	17.43
Domestic Hot Water	1.02
Part L2A: 2013 TER	**28.69**
Unregulated Uses	4.65
Total	**33.34**

The annual CO_2 emission resulting from the baseline demand, for unit 3, equates to 89.55 tonnes without un-regulated energy uses and then 104.07 tonnes when un-regulated energy uses are taken into account.0

4.02.04 Unit 4

The baseline CO_2 emissions for unit 4 are modelled as follows:-

	CO_2 Emission (kg CO_2/m^2/year)
Heating	5.62
Cooling	0.70
Fans and Pumps	0.96
Lighting	16.57

	CO_2 Emission (kg CO_2/m^2/year)
Domestic Hot Water	1.05
Part L2A: 2013 TER	**24.91**
Unregulated Uses	4.65
Total	**29.56**

The annual CO_2 emission resulting from the baseline demand, for unit 4, equates to 222.19 tonnes without un-regulated energy uses and then 263.66 tonnes when un-regulated energy uses are taken into account.

4.02.05 Development

Combining the baseline CO_2 emissions for each of the units gives the following development CO_2 emissions:

	CO_2 Emission (kg CO_2/m^2/year)
Heating	6.47
Cooling	0.59
Fans & pumps	0.93
Lighting	17.00
Domestic Hot Water	1.05
Part L2A: 2013 TER	**26.03**
Unregulated Uses	4.65
Total	**30.68**

The annual CO_2 emission resulting from the baseline demand, for the development, equates to 560.76 tonnes without un-regulated energy uses and then 660.04 tonnes when un-regulated energy uses are taken into account.

4.03 Energy Efficiency Measures

The energy strategy prioritises the reduction in energy consumption and hence CO_2 emissions through the building envelope design together with the use of efficient mechanical and electrical services.

The passive and low energy design principles that have been adopted in the current design include:

- High performance glazing. The 'U' values and 'G' values used in the model are as follows:

  Glazing (windows) = 1.50 W/m²K (g = 0.30, LT = 0.60)
  Glazing (rooflights) = 1.70 W/m²K (g = 0.55, LT = 0.60)

- Improved building fabric. The 'U' values used in the model are as follows:

External Walls	=	0.26 W/m²K
Ground Floor	=	0.22 W/m²K
Roof	=	0.18 W/m²K
Pedestrian Door	=	2.2 W/m²K
Vehicle	=	1.5 W/m²K

- Low building air leakage rate (3 $m^3/hr/m^2$ at 50 Pa which represents 70 % improvement over the minimum 2013 Building Regulations requirements)
- Variable speed fans and pumps
- Low energy lighting (LED) lighting to the office, core and warehouse areas.
- Automatic lighting control with occupancy and daylight dimming controls

4.03.01 Unit 1

The Building Regulations thermal model analysis identifies the following CO_2 emissions for unit 1:-

	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**
Heating	5.81	2.83
Cooling	0.48	0.60
Fans and pumps	0.75	0.87
Lighting	17.06	11.26
Domestic Hot Water	1.07	1.07
Part L2A : 2013 Total	**25.17**	**16.63**
Unregulated Power	4.65	4.65
Total	**29.82**	**21.28**

The comparison of the energy efficient scheme against the baseline scheme identifies that for unit 1 there is a predicted 33.92 % improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted improvement of 28.63 % when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to 126.98 tonnes without un-regulated uses and then 162.49 tonnes when un-regulated uses are taken into account.

4.03.02 Unit 2

The Building Regulations thermal model analysis identifies the following CO_2 emissions for unit 2:

	Baseline Scheme (kg CO_2/m^2/year)	Lean Scheme (kg CO_2/m^2/year)
Heating	8.86	3.40
Cooling	0.65	0.88
Fans and pumps	1.30	1.47
Lighting	17.89	11.90
Domestic Hot Water	1.02	1.02
Part L2A : 2013 Total	**29.71**	**18.68**
Unregulated Power	4.65	4.65
Total	**34.36**	**23.33**

The comparison of the energy efficient scheme against the baseline scheme identifies that for unit 2 there is a predicted 37.14% improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted improvement of 32.11 % when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to 42.28 tonnes without un-regulated uses and then 52.81 tonnes when un-regulated uses are taken into account.

4.03.03 Unit 3

The Building Regulations thermal model analysis identifies the following CO_2 emissions for unit 3:-

	Baseline Scheme (kg CO_2/m^2/year)	Lean Scheme (kg CO_2/m^2/year)
Heating	8.75	3.40
Cooling	0.48	0.64
Fans and pumps	1.00	1.07
Lighting	17.43	11.51
Domestic Hot Water	1.02	1.03
Part L2A : 2013 Total	**28.69**	**17.64**
Unregulated Power	4.65	4.65
Total	**33.34**	**22.29**

The comparison of the energy efficient scheme against the baseline scheme identifies that for unit 3 there is a predicted 38.51 % improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted improvement of 33.14 % when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to 55.07 tonnes without un-regulated uses and then 69.58 tonnes when un-regulated uses are taken into account.

4.03.04 Unit 4

The Building Regulations thermal model analysis identifies the following CO_2 emissions for unit 4:-

	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**
Heating	5.62	2.90
Cooling	0.70	0.88
Fans and pumps	0.96	1.14
Lighting	16.57	10.90
Domestic Hot Water	1.05	1.05
Part L2A : 2013 Total	**24.91**	**16.87**
Unregulated Power	4.65	4.65
Total	**29.56**	**21.52**

The comparison of the energy efficient scheme against the baseline scheme identifies that for unit 4 there is a predicted 32.27 % improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted improvement of 27.20 % when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to 150.48 tonnes without un-regulated uses and then 191.96 tonnes when un-regulated uses are taken into account.

4.03.05 Development

Combining the Building Regulations thermal model analysis gives for each of the four units the following CO_2 emissions for the development:-

	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**
Heating	6.47	3.00
Cooling	0.59	0.75
Fans and pumps	0.93	1.07
Lighting	17.00	11.21
Domestic Hot Water	1.05	1.05
Part L2A : 2013 Total	**26.03**	**17.08**
Unregulated Power	4.65	4.65
Total	**30.68**	**21.78**

The comparison of the energy efficient scheme against the baseline scheme identifies that for the development there is a predicted 34.38 % improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted improvement of 29.17 % when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to 374.81 tonnes without un-regulated uses and then 476.84 tonnes when un-regulated uses are taken into account.

5.00 DECENTRALISED HEATING, COOLING AND POWER ASSESSMENT

5.01 General

The potential use of decentralised heating, cooling and power for the building has been assessed in relation to the following:

- Decentralised heating
- Decentralised cooling
- Combined heat and power (CHP)
- Combined cooling heat and power (CCHP/trigeneration)

5.02 Decentralised Heating and Cooling

Decentralised heating and cooling relates to a central system that provides the necessary heating and cooling water to more than one use or part of a building or to more than one building. For example a decentralised heating system can comprise central boiler plant that provides heat to separate dwellings and similarly a decentralised cooling system can comprise central refrigeration plant that provides cooling to individual retail units in a shopping centre.

Two types of decentralised heating and cooling schemes have been considered for the development.

1. Connection to a district energy network (DEN)

2. The provision of a development decentralised energy centre

The regulated energy heating demands per use (heating and domestic hot water) have been extracted from the NCM calculations and are scheduled below. For clarity the space heating demand is shown including and excluding the warehouse area as the tenants have a free choice as to whether they require heating to the warehouse area.

	Heating Demand (Including Warehouse)							
	Unit 1		**Unit 2**		**Unit 3**		**Unit 4**	
	kwh/m²	**kwh**	**kwh/m²**	**kwh**	**kwh/m²**	**kwh**	**kwh/m²**	**kwh**
Heating	12.62	96359	15.14	34278	15.08	47068	12.88	114883
Domestic Hot Water	4.50	34359	4.29	9713	4.31	13453	4.41	39335
Total	-	130718	-	43991	-	60521	-	154218

	Heating Demand (Excluding Warehouse)							
	Unit 1		Unit 2		Unit 3		Unit 4	
	kwh/m²	kwh	kwh/m²	kwh	kwh/m²	kwh	kwh/m²	kwh
Heating	8.72	6961	7.77	3048	12.55	6178	8.89	13057
Domestic Hot Water	4.5	34359	4.29	9713	4.13	13453	4.41	39335
Total	-	41320	-	12761	-	19631	-	52392

District Energy Network

Investigations into existing or proposed district energy networks to provide decentralised heating and / or cooling to the development has established that there are no such current infrastructure arrangements within a reasonable distance from the development site.

The London Heat Map has been reviewed and there is not a suitable potential decentralised energy scheme (DES) available.

Therefore the DES is not a viable option for the development site.

Decentralised Energy Centre

The provision of a decentralised energy centre (DEC) to serve the industrial development incorporating a gas fired CHP to provide the heating and hot water base load for the development and an air cooled chiller to provide chilled water to facilitate the comfort cooling of the development has been reviewed and concluded as not viable for the development for the following reasons:

- When compared to the proposed variable refrigerant flow (VRF) air source heat pump comfort cooling and heating system, the thermal distribution pumping energy and the heat loss/gain of the distribution pipework actually increases the carbon emissions from the whole development when compared to the proposed solution.
- The electrical output of a central CHP cannot be distributed in a fair manner to all of the industrial units.
- The heating load to the warehouse element of the industrial unit may not ever be realised. The warehouse element of the industrial unit will be provided on a shell and core basis with the area being unheated. The future tenant may or may not wish to heat the warehouse. The developer's experience is that it is very common for the warehouse area to remain unheated.
- A low temperature hot water (LTHW) based system would not be the preferred choice of heating medium if a tenant chose to heat the warehouse area. LTHW as the primary heating medium means that a convective heating system would need to be provided to the warehouse area. Convective heating systems are not best suited for use in tall spaces as excessive temperature gradients will occur between the warehouse floor and the underside of the roof. Direct gas fired heating installations are preferred by tenants.
- The developer's financial appraisal, for the current market conditions, is based on minimum service charges being passed on to the prospective tenant for the industrial unit. Therefore each of the four industrial units needs to be a self-serviced standalone unit rather than one provided with a communal heating system, for a service charge, by the landlord.

- The additional plant central plant room and external plant space along with the below ground distribution heating and cooling pipework adds a significant capital cost to the project, which would have an adverse effect on the scheme financial viability.

A heating connection from the residential scheme energy centre has also been reviewed. The review is based on the energy centre replacing the local gas fired boilers that serve the core area heating and domestic hot water load in each of the industrial units.

The heating demand for both heating supply options is the same. However the district heating system will have additional carbon emissions associated with the extra over pipework frictional pump losses and the heat losses from the buried distribution heating mains. These additional carbon emissions are estimated as being circa 18.35 tonnes of CO_2 per year (see the appendix for details of the calculation).

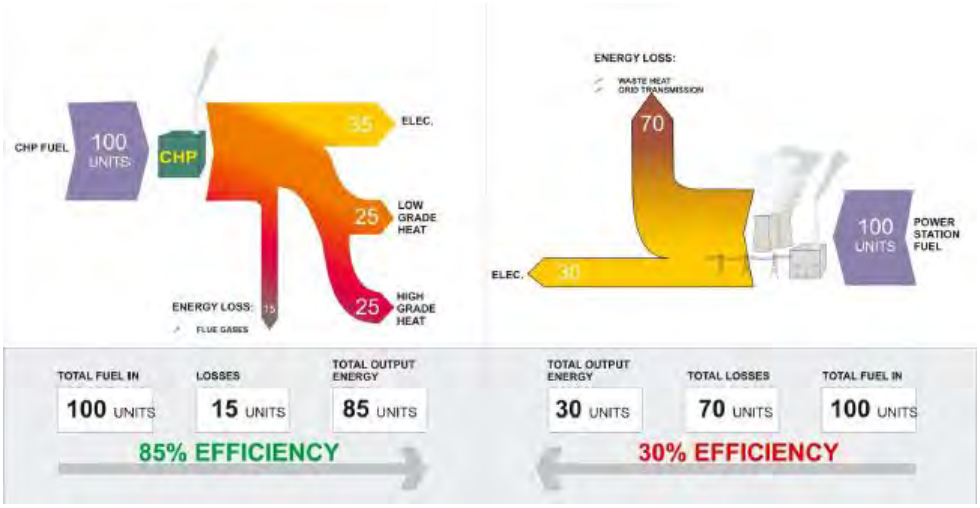
This additional 18.5 tonnes of CO_2 per year equates to 5.17% of the 'green' scheme regulated energy carbon emissions for the industrial development.

Hence a connection to the residential scheme district energy network is deemed to be not viable.

5.03 Combined Heat and Power

Combined Heat and Power (CHP) generates electricity on site and recovers a proportion of the waste heat for use in heating and/or hot water generation for the building. This allows the overall efficiency to be significantly greater than the electricity generated via power stations feeding the National Grid. The CHP plant typically uses gas as the primary energy source and often incorporates a thermal store. Biomass fuelled CHP is possible however this is typically only for larger schemes that can accommodate a CHP unit that has a minimum thermal output of 50 to 100kW.

The requirement for one of the industrial units would be a CHP unit with a thermal output in the range of 8 to 12kW. This thermal output requirement is too small for a biomass CHP to be applicable and commercially available.



CHP systems are typically considered only to be viable where they are able to run for at least 5000 hours per annum and have an appropriate year round heating demand.

For the industrial units the domestic hot water requirement is low along with the relatively low heating demand for the core areas as the offices are heated via the air source heat pumps (variable refrigerant flow systems). Therefore due to the low heat demand a CHP plant will not operate for the recommended minimum 5000 hours per annum run time. Hence the use of a CHP plant is not considered to be a viable technology for the industrial units.

5.04 Combined Cooling, Heat and Power

Combined Cooling, Heat and Power (CCHP) that is often referred to as trigeneration uses the same principles as detailed above for a CHP system however the heat produced is also used to generate cooling via an absorption chiller. The CCHP plant can make use of heat generated by the CHP plant in buildings with a cooling demand.

Similar to CHP plant the CCHP system is typically considered only to be viable where they are able to run for at least 5,000 hours per year and have an appropriate year round usage for the heat generated from the CCHP plant.

The absorption chiller incorporated within CCHP scheme has a very low efficiency and the intention is for the CHP to be used to heat the majority of the domestic hot water base demand requirements. In addition the proposed comfort cooling systems via air source heat pumps (variable refrigerant flow systems) provide a solution with lower carbon emissions for the development. Therefore a CCHP plant is not considered suitable for the development.

5.05 Decentralised Heating, Cooling and Power Analysis

For the reasons noted above there are no economically viable or carbon emission reduction benefit decentralised heating, cooling and power sources applicable to the development.

6.00 COOLING AND OVERHEATING

6.01 The Cooling Hierarchy

Based on the headings set out in the London Plan Policy 5.9 the passive and energy efficient design measures noted below are proposed for each of the industrial units to help limit any overheating without the need for comfort cooling.

Minimising internal heat generation through energy efficient design:	Section 4.03 of this Energy Strategy summarises the energy efficient design proposed to be incorporated in to the development. Further information is included below.
Reducing the amount of heat entering the building in summer:	The glazing U value is better than the Building Regulations Part L2A: 2013 minimum requirements. As shown on the Unit 1 BRUKL, included in the appendix a U value of 1.5 W/m^2 K is proposed. The glazing also has a good 'g' value of 0.366. In addition to this the roof and wall U values, as shown on the BRUKLs included in the appendix are better than the Building Regulations Part L2A: 2013 minimum requirements.
Use of thermal mass and high ceilings to manage the heat within the building:	The entrance / reception to each unit is a double height space with the potential occupied zone being at the ground floor of the space. The first floor area open to the double height entrance / reception is circulation space only and hence not permanently occupied.
Passive ventilation:	Passive ventilation techniques such as stack ventilation are not proposed. However each unit has openable windows to the office accommodation to allow the use of natural ventilation. The warehouse areas can be naturally ventilated via the vehicular and pedestrian access doors.
Mechanical ventilation:	The office accommodation is to be mechanically ventilated. The supply and extract ventilation system will incorporate heat recovery between the intake and exhaust air.

6.02 Over Heating Risk Analysis

In accordance with London Plan policy 5.9 an overheating risk analysis has been undertaken on the office accommodation for all four units. A separate Overheating Risk Analysis Report for the industrial element of the scheme has been provided with the planning submission. Full details of the analysis can be found in this report. For ease of reference the conclusions of the separate Overheating Risk Analysis Report are repeated below.

The office accommodation to each of the four industrial units have been analysed for the overheating risk in free running mode and mechanically comfort cooled mode in accordance

with the requirements of TM52 and against the three GLA recommended TM49 design summer years.

For the free running criteria:

- All four units have a risk of overheating due to failing each of the three TM52 criterion.

The modelling already includes the appropriate passive measures to help mitigate the overheating risk. The measures included are summarised below:

- Openable windows albeit with a restricted opening to the office accommodation.
- High performance glazing that has a 'U' value of 1.50 W/m^{2}K and a 'g' value of 0.30.
- LED lighting to reduce internal casual heat gains.
- Solar shading is provided by an overhang at the upper level of the office accommodation to each of the units.

The provision of openable windows will be maintained in each of the units to allow the future tenants the choice of operating the building in free running mode as the prevailing weather conditions allow.

To alleviate the predicted overheating the office accommodation in each of the industrial units will be provided with comfort cooling. The office accommodation in each of the units passes the TM52 mechanical cooled building overheating criteria.

Therefore, the proposed comfort cooling systems to the office accommodation are appropriate for inclusion in each of the four industrial units.

This report accounts for all relevant design features and includes for the anticipated building usage. Should the final design and/or use of the building differ from the described, or should the actual weather differ from the accredited weather files, then actual internal temperatures may occur beyond those predicted.

6.03 Active Cooling

The predicted cooling demand for the development has been assessed against the Building Regulations Part L2A notional cooling demand as set out below.

As the buildings under consideration are industrial units as per GLA guidance on preparing energy assessments the opportunities to reduce the risk of overheating and therefore the cooling demands in warehouse areas is limited. Hence the cooling demand comparison has been undertaken on the permanently occupied office and core areas of the building only. The comparison for each of the industrial units is tabulated below:

	Area weighted average building cooling demand (MJ/m2)				
	Unit 1	Unit 2	Unit 3	Unit 4	Development
Actual Building	176.6	218.1	153.1	178.1	178.8
Notional Building	202.4	202.8	167.1	192.3	192.2

As can be seen from the above the predicted cooling demand for the whole industrial development is less than the notional cooling demand. Hence additional passive / energy efficiency measures, over and above those listed in Section 6.02 and included in the scheme do not need to be incorporated into the scheme.

It is acknowledged that Unit 2, the unit with south facing office accommodation has an actual cooling demand that is 7.5% greater than the notional building however this compensated by the overall development reduction of 7.0%.

As the overheating risk analysis indicates that the overheating may occur the office accommodation is to be comfort cooled by a variable refrigerant flow (VRF) simultaneous heating and comfort cooling air source heat pump system. The plant efficiencies are set out in section 7.07 of this report.

The VRF system has been proposed as this is a lower carbon option for providing comfort cooling. This lower carbon comfort cooling option is shown in section 7.09.05 of this report as the reduction in the associated predicted 'cooling' carbon emissions between the 'lean' scheme and the 'green' scheme. The 'lean' scheme is based on utilising traditional air cooled chillers to produce chilled water to serve fan coil units. With the 'green' scheme using VRF air source heat pumps to show the predicted carbon reduction with this form of comfort cooling. The reduction in carbon emissions is circa 32%.

7.00 RENEWABLE ENERGY ASSESSMENT

7.01 General

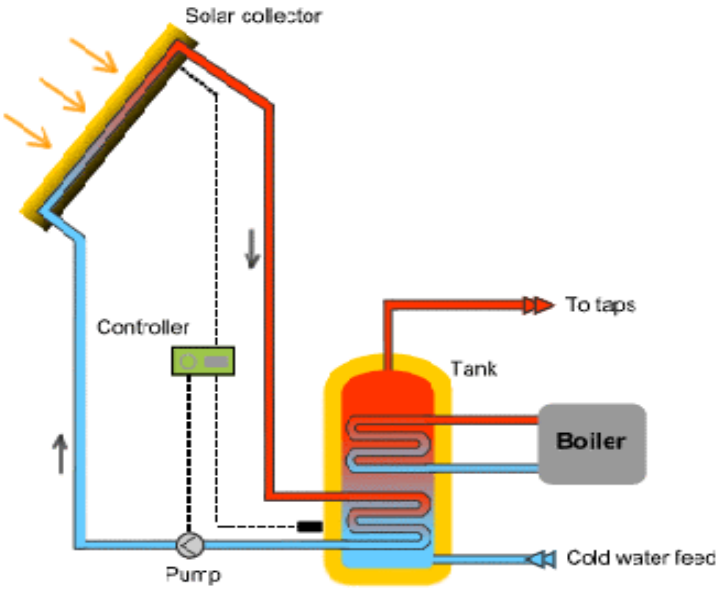
The potential use of renewable energy technology has been undertaken for the following:

- Solar water heating
- Wind turbines
- Photovoltaic cells
- Biomass
- Ground source heating and cooling
- Air source heating and cooling
- Fuel cell

7.02 Solar Water Heating

Solar thermal panels utilise the suns energy to generate hot water for use within the building. The panels are commonly provided in either flat plate or evacuated tube arrangements. The panels are ideally located facing south at an approximate 30° inclination angle in areas where they are not subjected to shade.

The development has the potential to use solar water heating to pre-heat the domestic hot water service, and hence it is considered viable for the development.



Each of the four units has the potential to use solar water heating to pre-heat the domestic hot water service. However as an industrial unit's domestic hot water demand is low the available roof area is better served by being populated with photovoltaic cells (see section 6.04).

7.03 Wind Turbines

Wind turbines generate electrical energy derived from kinetic energy provided by the local wind resource. The performance of wind turbines depends greatly on the wind speed and turbulence that in turn is influenced by the terrain and installation height.

In urban areas non-laminar wind flow occurs as a result of turbulence due primarily to adjacent buildings. There is growing evidence of urban wind turbines failing to perform in line with manufacturer's estimated outputs and as a result wind turbines are likely to produce only modest power outputs with corresponding low carbon dioxide emission reduction within urban sites.

For the reasons detailed above wind turbines are not considered viable for the development.

7.04 Photovoltaic Cells

Photovoltaic (PV) panels utilise the sun's energy to generate electricity. The optimum location for PV panels is south facing at an approximate 30° inclination angle in areas where they are not subjected to shade.

Each of the four units has unshaded roof area that could be utilised for PV panels. The industrial/warehouse units have been modelled in the lean option with 15% roof lights and thus the amount of roof area available to use for PV and solar thermal panels is partly restricted. That aside it is considered that PV's could be successfully integrated at roof level running with the inclined roof angles to the industrial/warehouse units.

The following quantity of PV is required to meet the target 20% reduction from onsite renewable energy technology in addition to the air source heat pump systems referred to in Section 7.07:

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**
PV panel area	245 m^2	72 m^2	105 m^2	265 m^2
Approximate peak electrical output	49 kWp	14.4 kWp	21 kWp	53 kWp
Predicted annual carbon emission reduction	2.61 $kgCO_2/m^2$	2.59 $kgCO_2/m^2$	2.74 $kgCO_2/m^2$	2.41 $kgCO_2/m^2$
	19.93 Tonnes CO_2/year.	5.86 Tonnes CO_2/year.	8.55 Tonnes CO_2/year.	21.50 Tonnes CO_2/year.
Offset of the lean scheme CO_2 emissions.	15.69 %	13.87 %	15.53 %	14.28 %

7.05 Biomass

Biomass is considered to be a renewable fuel source as the CO_2 absorbed during the growth period is assessed as being approximately equal to the CO_2 emitted during combustion and hence deemed "carbon neutral". Biomass for boilers is typically wood either in chip or pellet form.

Biomass boilers require fuel storage together with associated transportation and delivery to the store location. Biomass boilers also increase the NOx emissions when compared to gas fired boilers.

As noted in section 5.03 of this report the base heating demand for the industrial units is low. The plant space requirements for a biomass installation are large when compared to a gas fired boiler installation. Therefore utilising a biomass solution would be an inefficient use of space for this development.

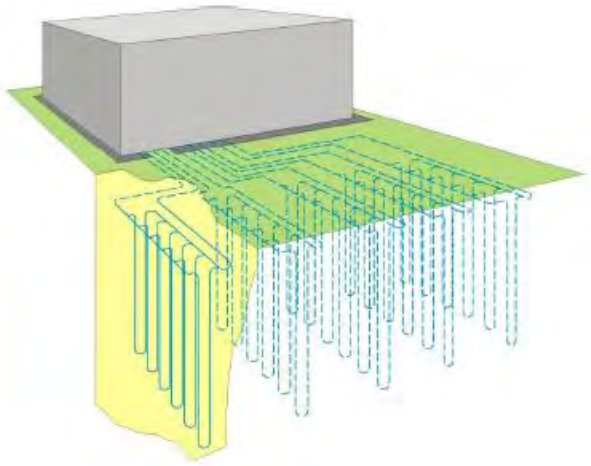
A communal heating system is not appropriate for the commercial development, see section 5.02 of this report. When considering a biomass solution this is exacerbated by the additional plant area requirements for the fuel storage and delivery.

For this development there is no realistic space within the overall development for the fuel storage together with the site constraints related to the associated delivery requirements. In addition there are on-going concerns with regard to the potential impact on local air quality.

For the reasons defined above the use of biomass is not considered viable for the development.

7.06 Ground Source Heating and Cooling

Ground source heating and cooling systems utilises the principle during heating mode of upgrading heat from the ground to a usable temperature and during cooling mode of rejecting heat from the building into the ground. There are two primary methods utilising either open or closed loop systems.



The open loop system extracts water, typically from the chalk aquifer, and uses this water in either the heating or cooling process before rejecting this heat back to the aquifer in a separate borehole. The open loop system requires licence approval from the Environment Agency that typically has a 10 year duration.

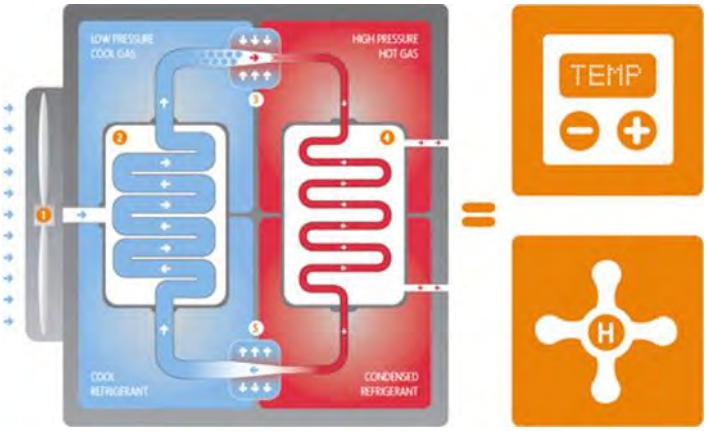
The closed loop system dissipates heat to or extracts heat from the ground via pipework circuits that are typically inserted into vertical boreholes. These generally do not require Environment Agency licences as no extraction of water from the aquifer takes place.

Generally for both the open and closed loop options heat pumps are used in order to generate the heating and cooling water temperatures needed within a building.

GSHP are technically viable for use at the development. However as air source heat pumps in their variable refrigerant flow (VRF) format are also technically viable the GSHP solution, which is considerably more expensive to install, has not been considered viable for the development.

7.07 Air Source Heating and Cooling

Air sourced heat pump (ASHP) works on the same principals as a ground source heat pump (GSHP) however the medium in which heat is extracted is the external air rather than the ground. The ASHP can be reversed to provide cooling when required. ASHP will generally have a lower seasonal coefficient of performance when compared to GSHP.



Air source heat pumps in their variable refrigerant volume (VRF) format are suitable for use in the development. They will provide the heating and comfort cooling to the office and core areas in each unit.

The COPs and SEERs incorporated into the thermal model are as follows:

COP	SEER
4.83	5.69

The thermal modelling has indicated that the annual electricity input to the ASHPs and the predicted carbon emission reductions are:

	Unit 1	Unit 2	Unit 3	Unit 4
ASHP electricity input	6960 kWh/year	3133 kWh/year	3047 kWh/year	12041 kWh/year
Predicted annual carbon emission reduction	0.78 $kgCO_2/m^2$	1.19 $kgCO_2/m^2$	0.83 $kgCO_2/m^2$	1.00 $kgCO_2/m^2$
	5.94 Tonnes CO_2/year.	2.70 Tonnes CO_2/year.	2.59 Tonnes CO_2/year.	8.91 Tonnes CO_2/year.
Offset of the lean scheme CO_2 emissions.	4.68 %	6.39 %	4.70 %	5.92 %

7.08 Fuel Cell

The fuel cell technology essentially converts chemical energy into both electrical and heat energy. The cell needs to be continually supplied with hydrogen (derived from either a piped or storage source) and oxygen (derived from air) which are combined and the chemical reaction produces electrical energy, heat energy and water vapour.

The fuel cell requires a hydrogen fuel source that can either be from a piped source (not currently available) or from stored gas. However the more usual approach currently in the UK is to use natural gas in order to generate the hydrogen required to operate the fuel cell.

Fuel cells have various commercial and technical limitations. There is a high initial capital cost together with there being few established suppliers and a very limited specialist design, installation and maintenance capabilities. Certain fuel cell elements require regular replacement imposing a significant on-going cost implication. The fuel cells themselves are generally large, heavy and require fresh air ventilation.

Due to the initial capital cost, space requirements and on-going maintenance costs fuel cells are not considered viable for this development.

7.09 Renewable Energy Analysis

The proposed renewable energy sources for the development are:

Unit 1

Air source heat pumps	- ASHPs in their variable refrigerant flow (VRF) format will provide the heating and cooling requirements of the office areas.

Photovoltaic Panels	-	245m^2 of PV panels to provide a contribution to the electricity demand.

Unit 2

Air source heat pumps	-	ASHPs in their variable refrigerant flow (VRF) format will provide the heating and cooling requirements of the office areas.
Photovoltaic Panels	-	72m^2 of PV panels to provide a contribution to the electricity demand.

Unit 3

Air source heat pumps	-	ASHPs in their variable refrigerant flow (VRF) format will provide the heating and cooling requirements of the office areas.
Photovoltaic Panels	-	105m^2 of PV panels to provide a contribution to the electricity demand.

Unit 4

Air source heat pumps	-	ASHPs in their variable refrigerant flow (VRF) format will provide the heating and cooling requirements of the office areas.
Photovoltaic Panels	-	265m^2 of PV panels to provide a contribution to the electricity demand.

7.09.01 Unit 1

The thermal model for unit 1 has been repeated incorporating the renewable energy technologies and the results are:

	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**	**LZC Scheme (kg CO_2/m^2/year)**
Heating	5.81	2.83	2.76
Cooling	0.48	0.60	0.41
Fans and pumps	0.75	0.87	0.35
Lighting	17.06	11.26	11.26
Domestic Hot Water	1.07	1.07	1.07
Displaced Electricity	0.00	0.00	-2.61
Part L2A : 2013 Total	**25.17**	**16.63**	**13.24**
Unregulated Power	4.65	4.65	4.65
Total	**29.82**	**21.28**	**17.89**

The annual CO_2 emissions for the unit 1 incorporating renewable energy technologies are 13.24 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme is 20.37 %.

The annual CO_2 emissions allowing for un-regulated energy uses with the renewable energy technologies are 17.89 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme when un-regulated energy uses are incorporated is 15.92 %.

The annual CO_2 emissions resulting from the green scheme with renewable energy technologies equates to 101.11 tonnes without un-regulated uses and then 136.62 tonnes when un-regulated uses are taken into account.

7.09.02 Unit 2

The thermal model for unit 2 has been repeated incorporating the renewable energy technologies and the results are:

	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**	**LZC Scheme (kg CO_2/m^2/year)**
Heating	8.86	3.40	3.30
Cooling	0.65	0.88	0.61
Fans and pumps	1.30	1.47	0.66
Lighting	17.89	11.90	11.90
Domestic Hot Water	1.02	1.02	1.02
Displaced Electricity	0.00	0.00	-2.59
Part L2A : 2013 Total	**29.71**	**18.68**	**14.89**
Unregulated Power	4.65	4.65	4.65
Total	**34.36**	**23.33**	**19.54**

The annual CO_2 emissions for the unit 2 incorporating renewable energy technologies are 14.89 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme is 20.26%.

The annual CO_2 emissions allowing for un-regulated energy uses with the renewable energy technologies are 19.54 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme when un-regulated energy uses are incorporated is 16.22%.

The annual CO_2 emissions resulting from the green scheme with renewable energy technologies equates to 33.72 tonnes without un-regulated uses and then 44.25 tonnes when un-regulated uses are taken into account.

7.09.03 Unit 3

The thermal model for unit 3 has been repeated incorporating the renewable energy technologies and the results are:

	Baseline Scheme (kg CO_2/m^2/year)	Lean Scheme (kg CO_2/m^2/year)	LZC Scheme (kg CO_2/m^2/year)
Heating	8.75	3.40	3.28
Cooling	0.48	0.64	0.44
Fans and pumps	1.00	1.07	0.56
Lighting	17.43	11.51	11.51
Domestic Hot Water	1.02	1.03	1.03
Displaced Electricity	0.00	0.00	-2.74
Part L2A : 2013 Total	**28.69**	**17.64**	**14.07**
Unregulated Power	4.65	4.65	4.65
Total	**33.34**	**22.29**	**18.72**

The annual CO_2 emissions for the unit 3 incorporating renewable energy technologies are 14.07 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme is 20.23%.

The annual CO_2 emissions allowing for un-regulated energy uses with the renewable energy technologies are 18.72 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme when un-regulated energy uses are incorporated is 16.01%.

The annual CO_2 emissions resulting from the green scheme with renewable energy technologies equates to 43.93 tonnes without un-regulated uses and then 58.44 tonnes when un-regulated uses are taken into account.

7.09.04 Unit 4

The thermal model for unit 4 has been repeated incorporating the renewable energy technologies and the results are:

	Baseline Scheme (kg CO_2/m^2/year)	Lean Scheme (kg CO_2/m^2/year)	LZC Scheme (kg CO_2/m^2/year)
Heating	5.62	2.90	2.79
Cooling	0.70	0.88	0.61
Fans and pumps	0.96	1.14	0.52
Lighting	16.51	10.90	10.90
Domestic Hot Water	1.05	1.05	1.05
Displaced Electricity	0.00	0.00	-2.41
Part L2A : 2013 Total	**24.91**	**16.87**	**13.46**
Unregulated Power	4.65	4.65	4.65
Total	**29.56**	**21.52**	**18.11**

The annual CO_2 emissions for the unit 4 incorporating renewable energy technologies are 13.46 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme is 20.20%.

The annual CO_2 emissions allowing for un-regulated energy uses with the renewable energy technologies are 18.11 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme when un-regulated energy uses are incorporated is 15.84%.

The annual CO_2 emissions resulting from the green scheme with renewable energy technologies equates to 120.08 tonnes without un-regulated uses and then 161.56 tonnes when un-regulated uses are taken into account.

7.09.05 Development

The combined thermal model analysis for the development gives the following results:

	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**	**LZC Scheme (kg CO_2/m^2/year)**
Heating	6.47	3.00	2.90
Cooling	0.59	0.75	0.51
Fans and pumps	0.93	1.07	0.48
Lighting	17.00	11.21	11.21
Domestic Hot Water	1.05	1.05	1.05
Displaced Electricity	0.00	0.00	-2.55
Part L2A : 2013 Total	**26.03**	**17.08**	**13.62**
Unregulated Power	4.65	4.65	4.65
Total	**30.68**	**21.73**	**18.27**

The annual CO_2 emissions for the development incorporating renewable energy technologies are 13.62 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme is 20.27%.

The annual CO_2 emissions allowing for un-regulated energy uses with the renewable energy technologies are 18.27 kg CO_2/m^2.

The improvement with renewable energy technologies over the lean scheme when un-regulated energy uses are incorporated 15.93%.

The annual CO_2 emissions resulting from the green scheme with renewable energy technologies equates to 298.84.tonnes without un-regulated uses and then 400.86 tonnes when un-regulated uses are taken into account.

8.00 OVERALL BUILDING ANALYSIS

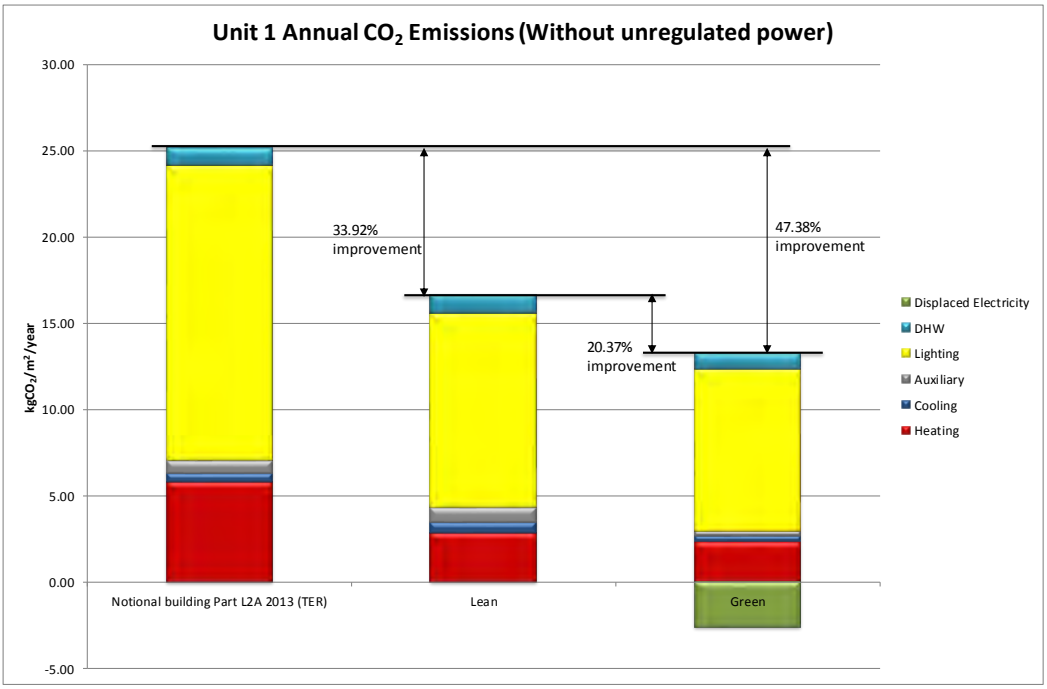
8.01 Carbon Reduction – Unit 1

The overall building analysis for unit 1 can then be summarised as follows:

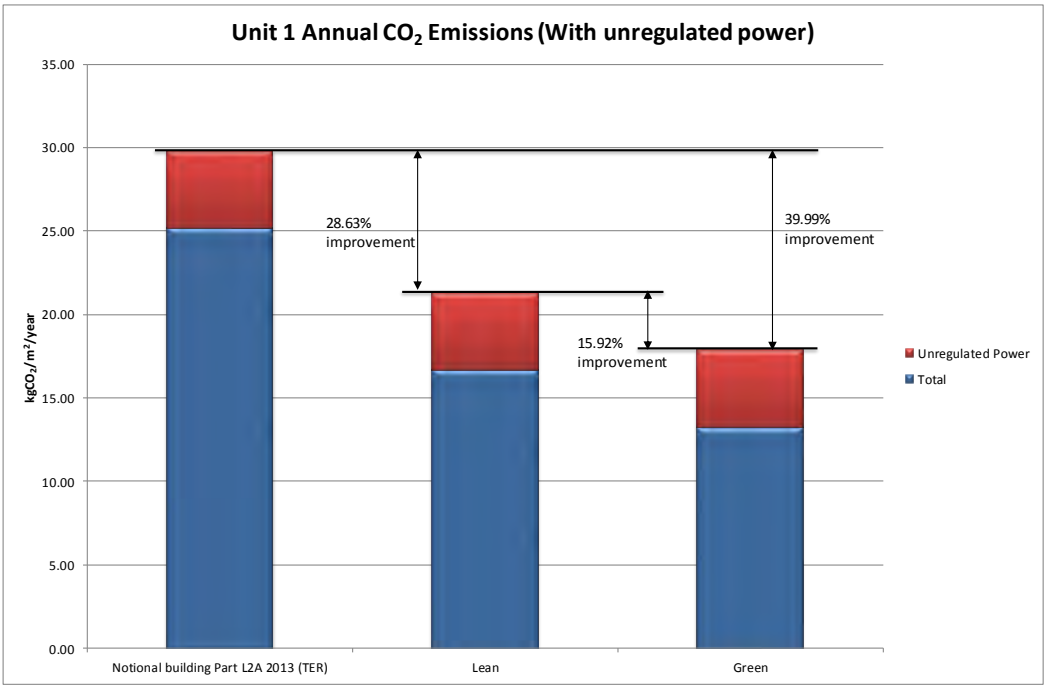
	kg CO_2/m^2		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	25.17	16.63	13.24
Allowing for Un-regulated Uses	29.82	21.28	17.89

These values are shown in diagrammatic form below that shows the following principles:

- The proposed scheme (LZC) assessment shows a predicted improvement of 47.38 % when compared to the baseline scheme
- The renewable energy technologies shows a predicted improvement of 20.37 % over the lean scheme
- When un-regulated energy uses are taken into account the predicted overall improvement is 39.99 % compared to the baseline scheme with renewable energy technologies showing a predicted 15.92 % improvement over the lean scheme.



Based on the regulated power results indicated above the proposed scheme incorporating a renewable energy technologies provides a carbon emissions reduction of 47.38 % when compared to the baseline Building Regulation 2013 (TER) compliant scheme.



The predicted annual CO_2 emissions data is as follows:

	Tonnes CO_2/year		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	192.15	126.98	101.11
Allowing for Un-regulated Uses	227.66	162.49	136.62

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO_2 Emission (tonnes CO_2/year)	**With Un-Regulated Uses CO_2 Emission (tonnes CO_2/year)**
Baseline scheme	192.15	227.66
LZC Scheme	101.11	136.62
Saving over baseline scheme	**91.04**	**91.04**

The regulated energy carbon emission savings when compared to the target savings are as follows:

	Regulated CO_2 Savings	
	Tonnes per Annum	**%**
Total Cumulative Savings	91.04	47.38
Total Target Savings	67.25	35.00
Annual Surplus	23.79	12.38

Hence there is a predicted annual surplus of 23.79 tonnes CO_2/year. This equates to a 30 year cumulative surplus of 713.7 tonnes CO_2.

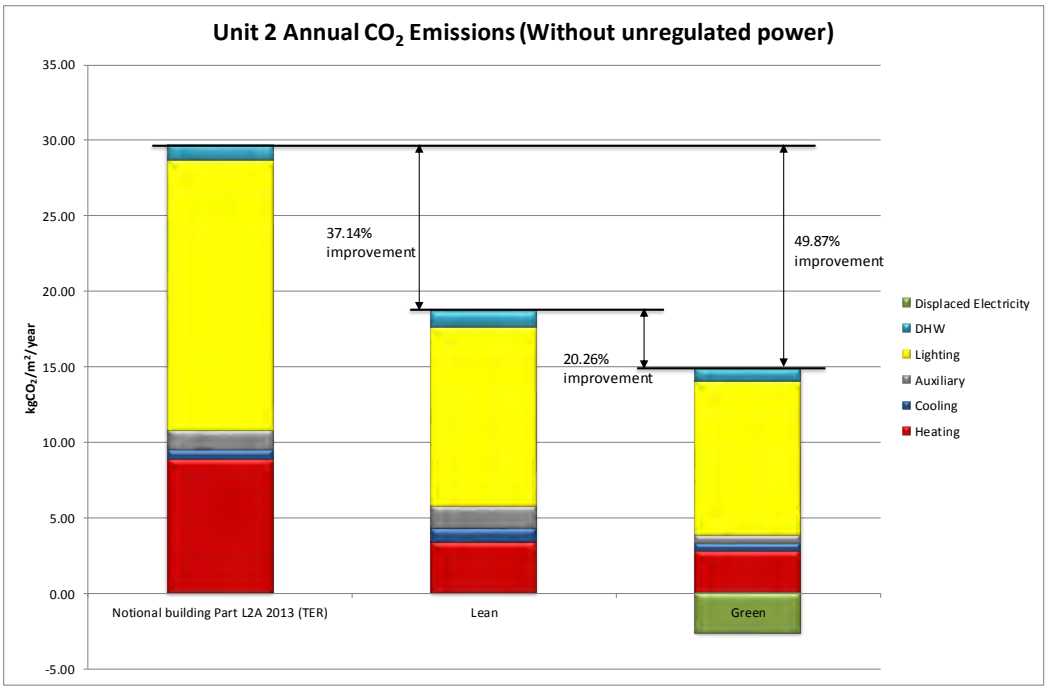
8.02 Carbon Reduction – Unit 2

The overall building analysis for unit 2 can then be summarised as follows:

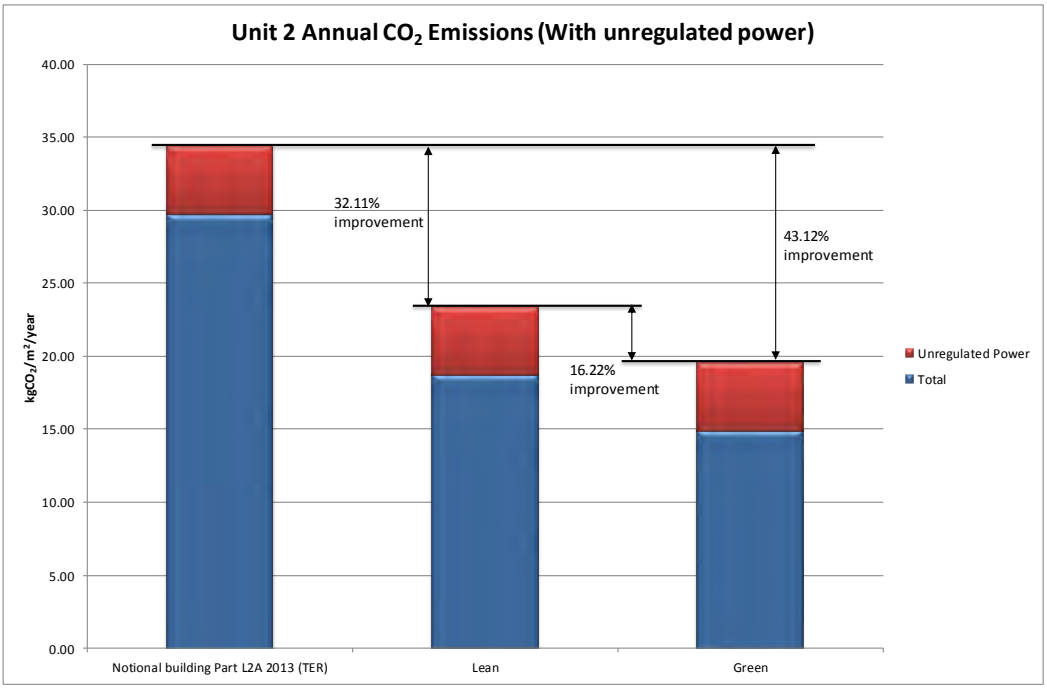
	kg CO_2/m^2		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	29.71	18.68	14.89
Allowing for Un-regulated Uses	34.36	23.33	19.54

These values are shown in diagrammatic form below that shows the following principles:

- The proposed scheme (LZC) assessment shows a predicted improvement of 49.87% when compared to the baseline scheme
- The renewable energy technologies shows a predicted improvement of 20.26% over the lean scheme
- When un-regulated energy uses are taken into account the predicted overall improvement is 43.12% compared to the baseline scheme with renewable energy technologies showing a predicted 16.22% improvement over the lean scheme.



Based on the regulated power results indicated above the proposed scheme incorporating a renewable energy technologies provides a carbon emissions reduction of 49.87% when compared to the baseline Building Regulation 2013 (TER) compliant scheme.



The predicted annual CO_2 emissions data is as follows:

	Tonnes CO_2/year		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	67.26	42.28	33.72
Allowing for Un-regulated Uses	77.79	52.81	44.25

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO_2 Emission (tonnes CO_2/year)	**With Un-Regulated Uses CO_2 Emission (tonnes CO_2/year)**
Baseline scheme	67.26	77.79
LZC Scheme	33.72	44.25
Saving over baseline scheme	**33.55**	**33.55**

The regulated energy carbon emission savings when compared to the target savings are as follows:

	Regulated CO_2 Savings	
	Tonnes per Annum	**%**
Total Cumulative Savings	33.55	49.87
Total Target Savings	23.55	35.00
Annual Surplus	10.00	14.87

Hence there is a predicted annual surplus of 10.00 tonnes CO_2/year. This equates to a 30 year cumulative surplus of 300.0 tonnes CO_2.

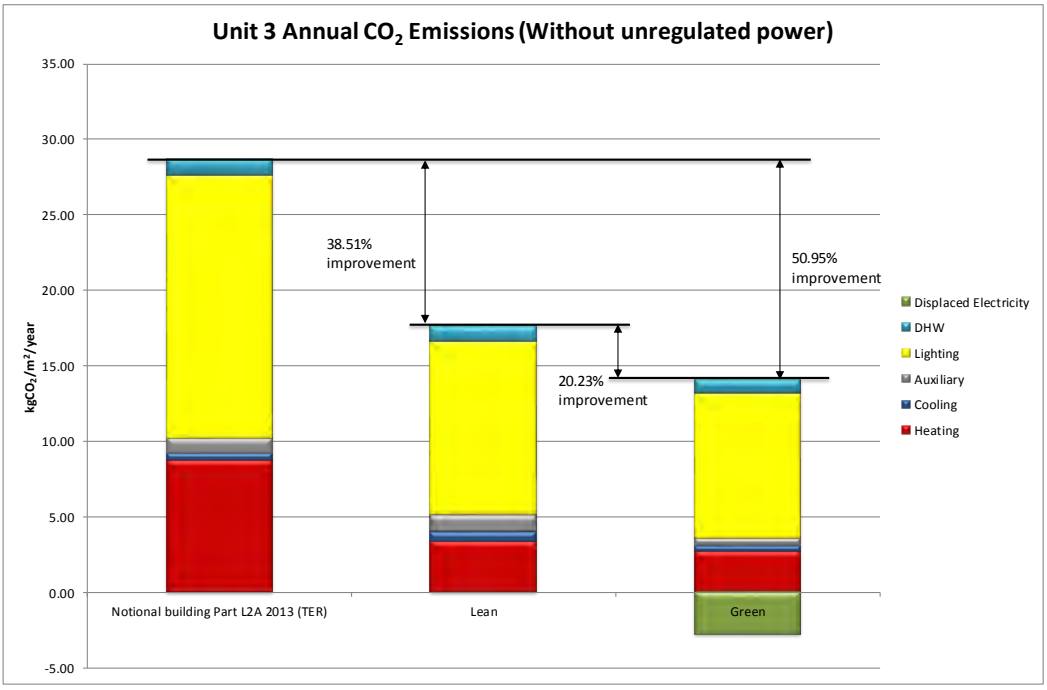
8.03 Carbon Reduction – Unit 3

The overall building analysis for unit 3 can then be summarised as follows:

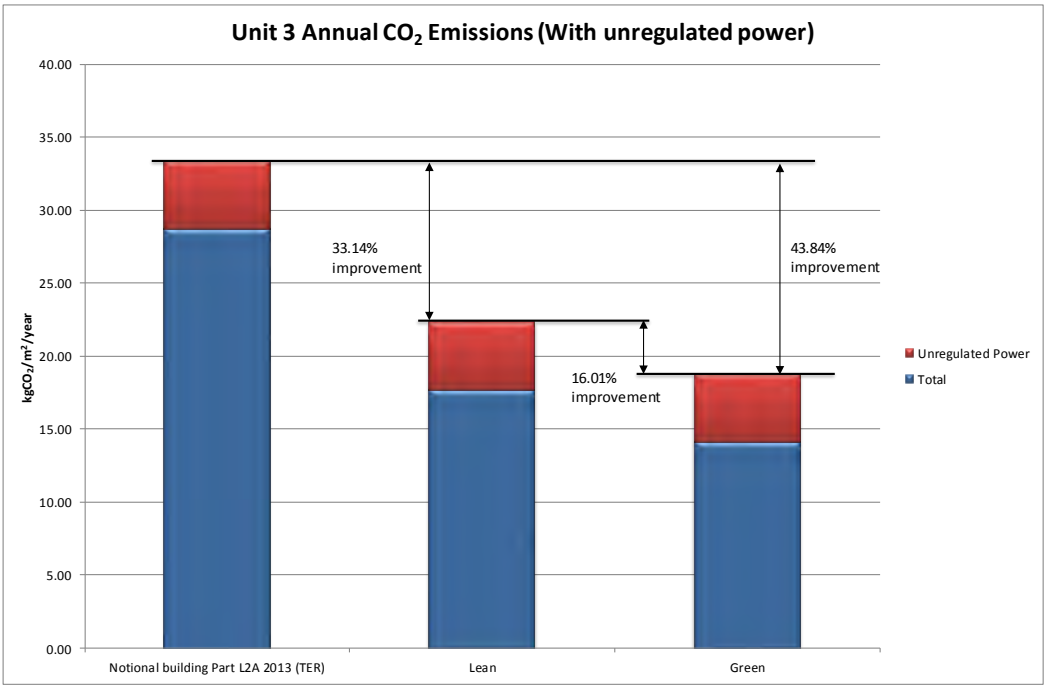
	kg CO_2/m^2		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	28.69	17.64	14.07
Allowing for Un-regulated Uses	33.34	22.29	18.72

These values are shown in diagrammatic form below that show the following principles:

- The proposed scheme (LZC) assessment shows a predicted improvement of 50.95% when compared to the baseline scheme
- The renewable energy technologies shows a predicted improvement of 20.23% over the lean scheme
- When un-regulated energy uses are taken into account the predicted overall improvement is 43.84% compared to the baseline scheme with renewable energy technologies showing a predicted 16.01% improvement over the lean scheme



Based on the regulated power results indicated above the proposed scheme incorporating a renewable energy technologies provides a carbon emissions reduction of 50.95% when compared to the baseline Building Regulation 2013 (TER) compliant scheme.



The predicted annual CO_2 emissions data is as follows:

	Tonnes CO_2/year		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	89.55	55.07	43.93
Allowing for Un-regulated Uses	104.07	69.58	58.44

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO_2 Emission (tonnes CO_2/year)	**With Un-Regulated Uses CO_2 Emission (tonnes CO_2/year)**
Baseline scheme	89.55	104.07
LZC Scheme	43.93	58.44
Saving over baseline scheme	**45.63**	**45.63**

The regulated energy carbon emission savings when compared to the target savings are as follows:

	Regulated CO_2 Savings	
	Tonnes per Annum	**%**
Total Cumulative Savings	45.63	50.95
Total Target Savings	31.35	35.00
Annual Surplus	14.28	15.95

Hence there is a predicted annual surplus of 14.28 tonnes.CO_2/year. This equates to a 30 year cumulative surplus of 428.4 tonnes CO_2.

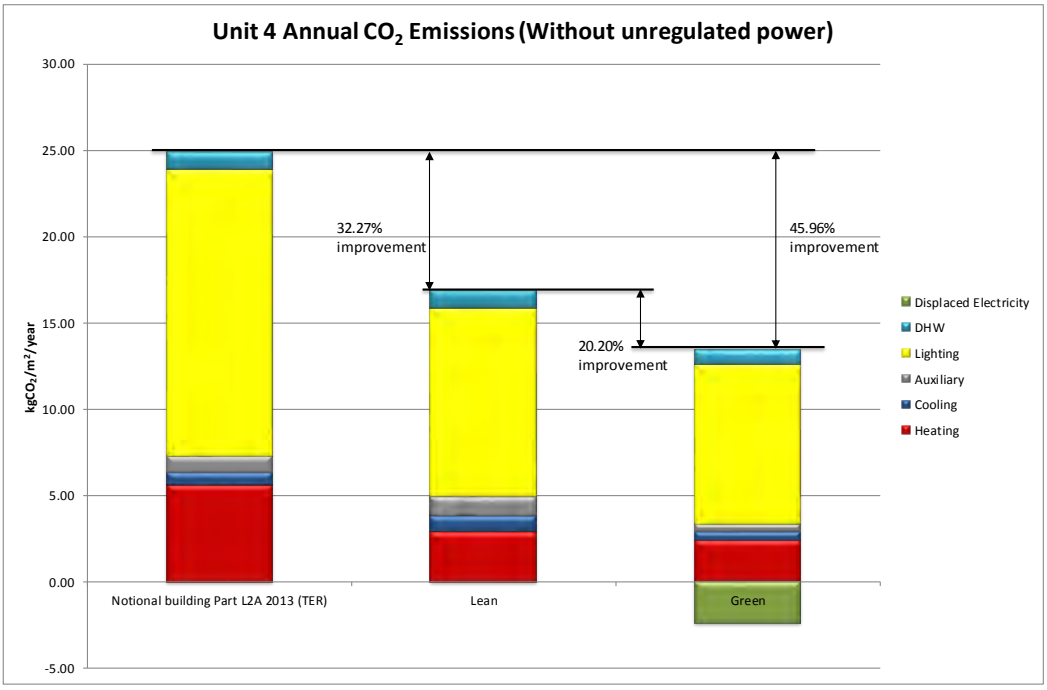
8.04 Carbon Reduction – Unit 4

The overall building analysis for unit 4 can then be summarised as follows:

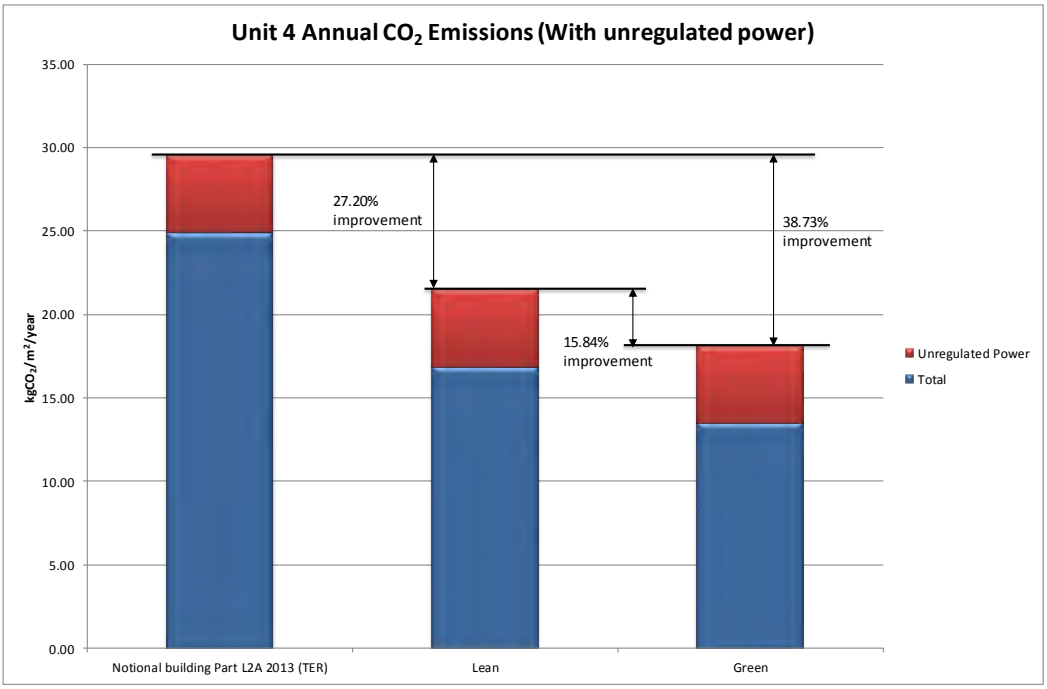
	kg CO_2/m^2		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	24.91	16.87	13.46
Allowing for Un-regulated Uses	29.56	21.52	18.11

These values are shown in diagrammatic form below that show the following principles:

- The proposed scheme (LZC) assessment shows a predicted improvement of 45.96% when compared to the baseline scheme
- The renewable energy technologies shows a predicted improvement of 20.20% over the lean scheme
- When un-regulated energy uses are taken into account the predicted overall improvement is 38.73% compared to the baseline scheme with renewable energy technologies showing a predicted 15.84% improvement over the lean scheme



Based on the regulated power results indicated above the proposed scheme incorporating a renewable energy technologies provides a carbon emissions reduction of 45.96% when compared to the baseline Building Regulation 2013 (TER) compliant scheme.



The predicted annual CO_2 emissions data is as follows:

	Tonnes CO_2/year		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	222.19	150.48	120.08
Allowing for Un-regulated Uses	263.66	191.96	161.56

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO_2 Emission (tonnes CO_2/year)	**With Un-Regulated Uses CO_2 Emission (tonnes CO_2/year)**
Baseline scheme	222.19	263.66
LZC Scheme	120.08	161.56
Saving over baseline scheme	**102.11**	**102.11**

The regulated energy carbon emission savings when compared to the target savings are as follows:

	Regulated CO_2 Savings	
	Tonnes per Annum	**%**
Total Cumulative Savings	102.11	45.96
Total Target Savings	77.77	35.00
Annual Surplus	24.34	10.96

Hence there is a predicted annual surplus of 24.34 tonnes.CO_2/year. This equates to a 30 year cumulative surplus of 730.2 tonnes CO_2.

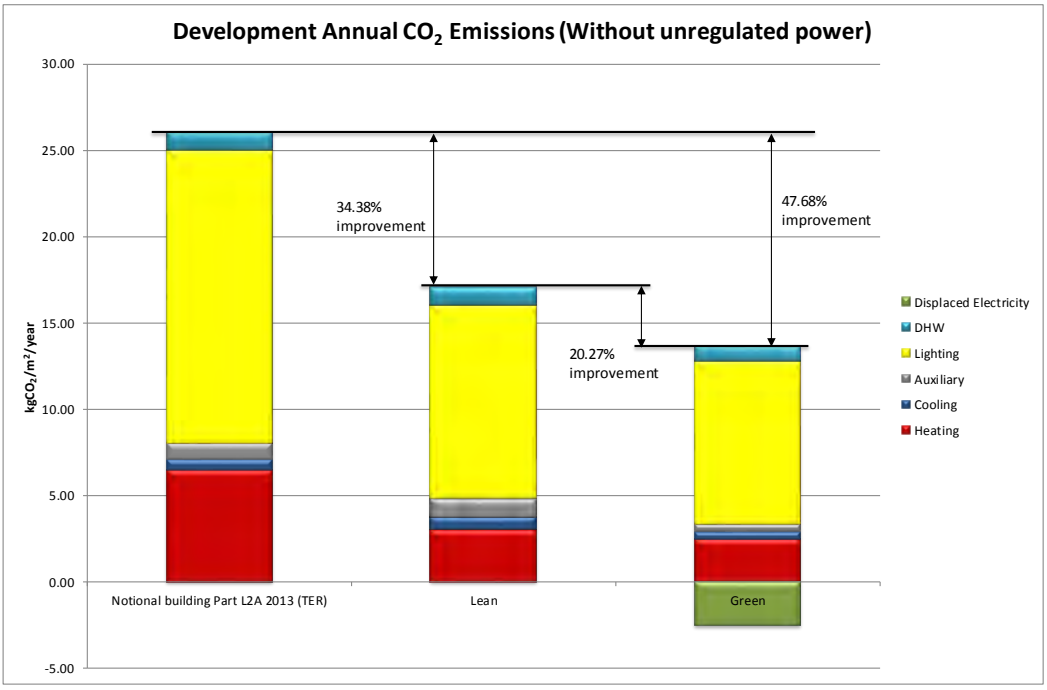
8.05 Carbon Reduction – Development

The overall building analysis for the development can then be summarised as follows:

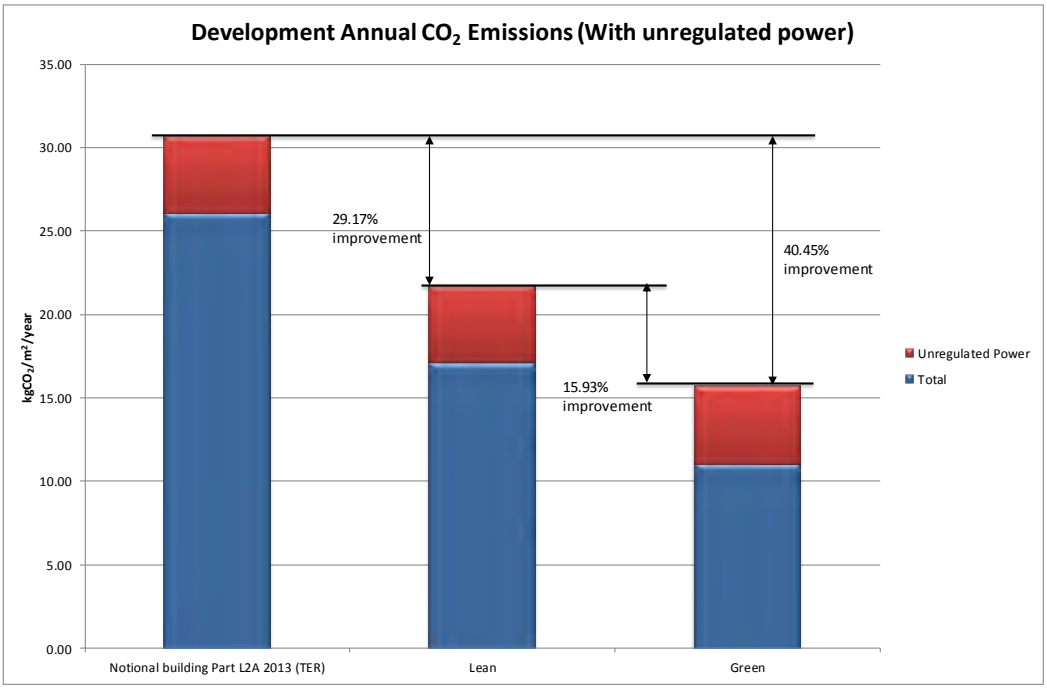
	kg CO_2/m^2		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	26.03	17.08	13.62
Allowing for Un-regulated Uses	30.68	21.73	18.27

These values are shown in diagrammatic form below that show the following principles:

- The proposed scheme (LZC) assessment shows a predicted improvement of 47.68% when compared to the baseline scheme
- The renewable energy technologies shows a predicted improvement of 20.27% over the lean scheme
- When un-regulated energy uses are taken into account the predicted overall improvement is 40.45% compared to the baseline scheme with renewable energy technologies showing a predicted 15.93% improvement over the lean scheme.



Based on the regulated power results indicated above the proposed scheme incorporating renewable energy technologies provides a carbon emissions reduction of 47.68% when compared to the baseline Building Regulation 2013 (TER) compliant scheme.



The predicted annual CO_2 emissions data is as follows:

	Tonnes CO_2/year		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**LZC Scheme**
Building Regulations Compliant	571.16	374.81	298.84
Allowing for Un-regulated Uses	673.18	476.84	400.86

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO_2 Emission (tonnes CO_2/year)	**With Un-Regulated Uses CO_2 Emission (tonnes CO_2/year)**
Baseline scheme	571.16	673.18
LZC Scheme	298.84	400.86
Saving over baseline scheme	**272.32**	**272.32**

The regulated energy carbon emission savings when compared to the target savings are as follows:

	Regulated CO_2 Savings	
	Tonnes per Annum	**%**
Total Cumulative Savings	272.32	47.68
Total Target Savings	199.91	35.00
Annual Surplus	72.41	12.68

Hence there is a predicted annual surplus of 72.41 tonnes CO_2/year. This equates to a 30 year cumulative surplus of 2172.3 tonnes CO_2.

9.00 CONCLUSIONS

This report has been prepared on behalf of SEGRO PLC for the proposed redevelopment of the former Nestlé Factory, Hayes. This document assesses the proposed energy strategy and demonstrates how it seeks to satisfy the applicable London Plan and London borough of Hillingdon Policies on energy and carbon dioxide emission. This report supports the commercial part of the redevelopment.

This report supports the commercial part of the redevelopment which is shown on the architect's site layout contained in the appendix.

This report should be read in conjunction with the energy strategy prepared by BBS for the residential part of the proposed redevelopment. Combined, the two reports set out the proposed energy strategy for the redevelopment of the factory site in its entirety.

In line with the relevant planning policies and guidelines the energy strategy for the proposed development has adopted a hierarchical approach of using passive and low energy design technologies to reduce the baseline energy demand and hence CO_2 emissions followed by the application of low and zero carbon technologies as appropriate.

The focus of the energy strategy is on CO_2 reduction from the building by adopting a highly efficient building envelope solution together with high efficiency mechanical and electrical services incorporating heat recovery. The renewable energy technologies assessment is based on using solutions that are technically proven with low maintenance implications taking into account the energy efficiency strategies being proposed in the current design.

The analysis has shown that by incorporating passive and low energy design measures there is a predicted reduction in each individual unit and the development's annual CO_2 emissions, as indicated in the table below, from the baseline scheme.

	Regulated CO_2 Savings	
	Tonnes CO_2	**%**
Unit 1	65.17	33.92
Unit 2	24.98	37.14
Unit 3	34.49	38.51
Unit 4	71.70	32.27
Development	**196.34**	**34.38**

This is achieved by the following elements:

- High performance glazing
- Improved building fabric
- Low building air leakage rate ($3m^3/hr/m^2$ at 50 Pa which represents a 70% improvement over the minimum Building Regulations requirements)
- Variable speed fans and pumps
- Low energy lighting
- Automatic lighting control with occupancy and daylight dimming controls

The decentralised heating, cooling and power assessment has indicated that the application of these systems and technologies are either not available to the scheme or are not viable for the scheme.

The free running overheating risk analysis indicates that even with the passive measures incorporated there is a risk of overheating for each of the three TM49 design summer years.

Therefore comfort cooling to the office accommodation is proposed. The area weighted average cooling demand for the proposed office accommodation for the development is less than the Building Regulations Part L: 2013 notional building cooling demand.

The development passes the comfort cooled building overheating criteria for each of the three TM49 design summer years.

The potential renewable energy technologies have been assessed taking into account the particular development constraints. The strategy is to utilise:

- Variable refrigerant flow (VRF) air source heat pumps to provide the heating and cooling requirements
- Photovoltaic cells to provide a contribution to the electrical demand.

The analysis has shown that by incorporating these renewable energy technologies in addition to the passive and low energy design measures there is a predicted reduction of annual CO_2 emissions from the baseline scheme as indicated in the table below:

	Regulated CO_2 Savings	
	Tonnes CO_2	**%**
Unit 1	91.04	47.38
Unit 2	33.55	49.87
Unit 3	45.63	50.95
Unit 4	102.11	45.96
Development	**272.32**	**47.68**

The renewable energy technologies are currently predicted to achieve a 20.27% reduction in carbon emissions.

When the un-regulated uses are factored into the analysis then there is an overall predicted reduction of 40.45% in the development annual CO_2 emissions, with the renewable energy component showing a 15.93% reduction.

The overall energy strategy identifies a predicted annual carbon emission saving of 272.32 tonnes over the baseline scheme (without unregulated energy).

The regulated energy annual carbon emission surplus/shortfall when compared to the 35 % saving target are as tabulated below:

	Annual Surplus (Tonnes per Annum)
Unit 1	23.79
Unit 2	10.00
Unit 3	14.28
Unit 4	24.34
Development	**72.41**

This is equivalent to a 30 year cumulative surplus of 2172.3 tonnes of CO_2.

Therefore each individual unit and the development as a whole comply with the London Plan 2011 updated March 2016 and London Borough of Hillingdon carbon emission reduction targets.

APPENDIX 1

DEN Pre-Insulated Pipe Heat Loss and Pump Head Annual Carbon Emissions.

DEN Pre insulated pipe heat loss and pump head annual carbon emissions										
Industrial units served from remote central energy centre in the residential development										
DEN pipework length from central energy centre to industrial							=	1900 m		
Core area heating and HW load assessment							=	84 kW		
Flowrate at 20°C temperature differential =							=	1.0 kg/s		
Pipe-in-pipe diameter							=	50 mm		
Assumed ground year round temperature							=	10°C		
Assumed LTHW: ground temperature differential							=	50°C		
Assumed pump efficiency							=	65%		
Assumed energy centre heat source efficency							=	93%		
Gas carbon conversion factor							=	0.216 kgCO2/kWh		
Grid electricity carbon conversion factor							=	0.519 kgCO2/kWh		
From Uponor Thermo tables:										
Heat loss/m at water/ground temperature differential							=	15 W/m		
Total heat loss			=	19 x 1900			=	28,500 W		
Annual energy loss			=	28.5 x 2600			=	74,100 kWh/yr		
Heat source input							=	79,677 kWh/yr		
Heat loss carbon emissions			=	0.216 x 79677			=	17,210 kgCO_2/yr		
Pipework pressure loss / metre							=	0.144 kPa/m		
Frictional resistance of DEN pipework including ancillaries										
			=	0.144 x 1900 x 2			=	547 kPA		
Pump input power		=	547000 x (1.0 / 1000) / 0.65				=	844 W		
Annual energy pump loss			=	0.844 x 2600			=	2195 kWh/yr		
Pump power carbon emissions							=	1139 kgCO_2/yr		
Total gas + electricity carbon emissions							=	18,350 kgCO_2/yr		
							=	18.35 Tonnes CO_2/yr		
Industrial development 'green' scheme regulated energy carbon emissions										
							=	354.68 Tonnes CO2/yr		
DEN pipework carbon emissions as a percentage of the development carbon emissions										
							=	5.17%		

APPENDIX 2

Site Layout Plan

BARRATT LONDON

SEGRO

FORMER NESTLE FACTORY, HAYES
ILLUSTRATIVE SITE LAYOUT PLAN

MS 100

D6

APPENDIX 3

Unit 1 – BRUKL Report Lean
Unit 1 – BRUKL Report Green
Unit 2 – BRUKL Report Lean
Unit 2 – BRUKL Report Green
Unit 3 – BRUKL Report Lean
Unit 3 – BRUKL Report Green
Unit 4 – BRUKL Report Lean
Unit 4 – BRUKL Report Green

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 1 - Lean Scheme

As designed

Date: Thu Jan 19 10:34:21 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	25.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	25.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	18.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.65	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.91	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (10 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	3.9	-	1.6	0.65
Standard value	0.91*	2.6	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- New DHW Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Lobby 1	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 1S	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1S	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int GrS	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per GrS	-	-	-	-	-	-	-	0.3	-	-	N/A
Lobby 2	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 5	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 6	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Warehouse Unit 1	80	-	-	37721
Staircase 1	-	80	-	117
Staircase 2	-	80	-	129
Toilets 1	-	80	-	134
Toilets 2	-	80	-	107
Toilets 3	-	80	-	147
Toilets 4	-	80	-	122
Lobby 1	-	80	22	228
Office_Int 1N	80	-	-	714
Office_Int 1S	80	-	-	1184
Office_Per 1N	80	-	-	436
Office_Per 1S	80	-	-	307
Corridor 1	-	80	-	36
Office_Int GrS	80	-	-	192
Office_Per GrS	80	-	-	307
Lobby 2	-	80	22	199
Corridor 2	-	80	-	45
Office_Per 5	80	-	-	299
Office_Per 6	80	-	-	470

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?
Warehouse Unit 1	YES (+12%)	NO
Lobby 1	YES (+25%)	NO
Office_Int 1N	NO (-85%)	NO
Office_Int 1S	YES (+54%)	NO
Office_Per 1N	NO (-12%)	NO
Office_Per 1S	YES (+17%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Office_Int GrS	NO (-6%)	NO
Office_Per GrS	YES (+19%)	NO
Lobby 2	YES (+18%)	NO
Office_Per 5	YES (+21%)	NO
Office_Per 6	YES (+24%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	7635	7635
External area [m²]	18720	18720
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	6131	6186
Average U-value [W/m²K]	0.33	0.33
Alpha value* [%]	1.47	1.47

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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	11.51	26.89
Cooling	1.34	0.95
Auxiliary	1.87	1.48
Lighting	25.96	33.71
Hot water	4.97	4.95
Equipment*	42.87	42.87
TOTAL**	**45.64**	**67.98**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	58.72	100.48
Primary energy* [kWh/m²]	107.39	147.03
Total emissions [kg/m²]	18.3	25.2

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	44.6	0	14.4	0	17	0.86	0	0.95	0
	Notional	49.6	0	16.8	0	22.2	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	102.2	0	33	0	1.3	0.86	0	0.95	0
	Notional	78.9	0	26.8	0	1.3	0.82	0	----	----
[ST] Flued forced-convection air heaters, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	40.6	0	12.3	0	0	0.92	0	0.92	0
	Notional	93.6	0	30.2	0	0	0.86	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	20.7	238.2	6.7	17.7	21.9	0.86	3.73	0.95	3.9
	Notional	25.8	164.4	8.8	12.7	15.8	0.82	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	W_D_GF
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 1 - Green Scheme

As designed

Date: Tue Mar 28 12:05:59 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	24.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	24.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	13.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.65	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	0.3	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	1	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (10 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.83	5.69	-	1.5	0.65
Standard value	2.5*	2.6	N/A	1.5^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

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

1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Warehouse Unit 1	95	-	-	31765
Staircase 1	-	90	-	104
Staircase 2	-	90	-	114

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Toilets 1	-	90	-	119
Toilets 2	-	90	-	95
Toilets 3	-	90	-	131
Toilets 4	-	90	-	109
Lobby 1	-	90	22	203
Office_Int 1N	95	-	-	602
Office_Int 1S	95	-	-	997
Office_Per 1N	95	-	-	367
Office_Per 1S	95	-	-	259
Corridor 1	-	90	-	32
Office_Int GrS	95	-	-	162
Office_Per GrS	95	-	-	259
Lobby 2	-	90	22	177
Corridor 2	-	90	-	40
Office_Per 5	95	-	-	252
Office_Per 6	95	-	-	396

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?
Warehouse Unit 1	YES (+11%)	NO
Lobby 1	YES (+2%)	NO
Office_Int 1N	NO (-93%)	NO
Office_Int 1S	YES (+5%)	NO
Office_Per 1N	NO (-26%)	NO
Office_Per 1S	YES (+0%)	NO
Office_Int GrS	NO (-23%)	NO
Office_Per GrS	YES (+1%)	NO
Lobby 2	NO (-3%)	NO
Office_Per 5	YES (+4%)	NO
Office_Per 6	YES (+4%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	7635	7635
External area [m^2]	18720	18720
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	5
Average conductance [W/K]	6131	6186
Average U-value [W/m^2K]	0.33	0.33
Alpha value* [%]	1.47	1.47

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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/m^2]

	Actual	Notional
Heating	12.66	26.46
Cooling	0.81	0.95
Auxiliary	0.69	0.57
Lighting	22.24	33.71
Hot water	4.97	4.95
Equipment*	42.87	42.87
TOTAL**	**41.37**	**66.64**

* 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^2]

	Actual	Notional
Photovoltaic systems	5.03	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	62.14	100.48
Primary energy* [kWh/m^2]	92.76	144.17
Total emissions [kg/m^2]	13.2	24.7

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	46.3	0	14.9	0	15.7	0.86	0	0.95	0
	Notional	49.6	0	16.8	0	20.9	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	113.8	0	36.7	0	1.3	0.86	0	0.95	0
	Notional	78.9	0	26.8	0	1.3	0.82	0	----	----
[ST] Central heating using air distribution, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	46.5	0	14	0	0	0.92	0	0.92	0
	Notional	93.6	0	30.2	0	0	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	22	210.9	1.3	10.8	6.4	4.62	5.44	4.83	5.69
	Notional	25.8	164.4	3	12.7	4	2.43	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	W_D_GF
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 2 - Lean Scheme

As designed

Date: Tue Jan 24 14:56:23 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	29.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	29.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	18.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.63	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	1	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (5 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	3.9	-	1.6	0.65
Standard value	0.91*	2.6	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- New DHW Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Lobby 1	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Lobby 2	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1S	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Warehouse Unit 1	95	-	-	9088
Staircase 1	-	90	-	103
Toilets 1	-	90	-	104
Toilets 2	-	90	-	83
Toilets 3	-	90	-	116
Toilets 4	-	90	-	97
Lobby 1	-	90	22	184
Office_Int 1N	95	-	-	452
Office_Per 1N	95	-	-	409
Corridor 1	-	90	-	31
Lobby 2	-	90	22	158
Corridor 2	-	90	-	39
Plant Room 1	90	-	-	82
Office_Per 1S	95	-	-	232

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?
Warehouse Unit 1	YES (+12%)	NO
Lobby 1	YES (+13%)	NO
Office_Int 1N	NO (-91%)	NO
Office_Per 1N	NO (-11%)	NO
Lobby 2	YES (+3%)	NO
Office_Per 1S	NO (-5%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2264	2264
External area [m^2]	6520	6520
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	7
Average conductance [W/K]	2113	2119
Average U-value [W/m^2K]	0.32	0.32
Alpha value* [%]	2.47	2.47

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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/m^2]

	Actual	Notional
Heating	15.75	41.01
Cooling	1.75	1.28
Auxiliary	2.9	2.56
Lighting	23.51	35.35
Hot water	4.74	4.72
Equipment*	43.16	43.16
TOTAL**	**48.65**	**84.91**

* 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^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	79.2	150.77
Primary energy* [kWh/m^2]	109.29	173.09
Total emissions [kg/m^2]	18.7	29.7

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	47.1	0	15.2	0	17	0.86	0	0.95	0
	Notional	58.9	0	20	0	22.2	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	52.4	0	16.9	0	1	0.86	0	0.95	0
	Notional	54.7	0	18.6	0	1	0.82	0	----	----
[ST] Flued forced-convection air heaters, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	58.8	0	17.8	0	0	0.92	0	0.92	0
	Notional	152.5	0	49.3	0	0	0.86	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	23.9	225.5	7.7	16.8	22	0.86	3.73	0.95	3.9
	Notional	32.1	159.4	10.9	12.3	17.1	0.82	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	W_D_GF
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 2 - Green Scheme

As designed

Date: Tue Mar 28 12:20:09 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	29
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	29
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	14.9
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.63	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	0.3	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	1	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (5 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.83	5.69	-	1.5	0.65
Standard value	2.5*	2.6	N/A	1.5^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

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

1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Warehouse Unit 1	95	-	-	9088
Staircase 1	-	90	-	103
Toilets 1	-	90	-	104

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Toilets 2	-	90	-	83
Toilets 3	-	90	-	116
Toilets 4	-	90	-	97
Lobby 1	-	90	22	184
Office_Int 1N	95	-	-	452
Office_Per 1N	95	-	-	409
Corridor 1	-	90	-	31
Lobby 2	-	90	22	158
Corridor 2	-	90	-	39
Plant Room 1	90	-	-	82
Office_Per 1S	95	-	-	232

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?
Warehouse Unit 1	YES (+12%)	NO
Lobby 1	YES (+13%)	NO
Office_Int 1N	NO (-91%)	NO
Office_Per 1N	NO (-11%)	NO
Lobby 2	YES (+3%)	NO
Office_Per 1S	NO (-5%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2264	2264
External area [m^2]	6520	6520
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	7
Average conductance [W/K]	2113	2119
Average U-value [W/m^2K]	0.32	0.32
Alpha value* [%]	2.47	2.47

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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/m^2]

	Actual	Notional
Heating	15.06	40.25
Cooling	1.2	1.28
Auxiliary	1.3	1.21
Lighting	23.51	35.35
Hot water	4.74	4.72
Equipment*	43.16	43.16
TOTAL**	**45.8**	**82.81**

* 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^2]

	Actual	Notional
Photovoltaic systems	4.99	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	79.2	150.77
Primary energy* [kWh/m^2]	102.28	168.81
Total emissions [kg/m^2]	14.9	29

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	47.1	0	15.2	0	17	0.86	0	0.95	0
	Notional	58.9	0	20	0	22.2	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	52.4	0	16.9	0	1	0.86	0	0.95	0
	Notional	54.7	0	18.6	0	1	0.82	0	----	----
[ST] Central heating using air distribution, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	58.8	0	17.8	0	0	0.92	0	0.92	0
	Notional	152.5	0	49.3	0	0	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	23.9	225.5	1.4	11.5	6.6	4.62	5.44	4.83	5.69
	Notional	32.1	159.4	3.7	12.3	4.1	2.43	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	W_D_GF
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 3 - Lean Scheme

As designed

Date: Tue Jan 24 15:07:42 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	28.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	28.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	17.6
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.63	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	1	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	3.9	-	1.6	0.65
Standard value	0.91*	2.6	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- New DHW Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Lobby 1	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1S	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per GrS	-	-	-	-	-	-	-	0.3	-	-	N/A
Lobby 2	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Warehouse Unit 1	95	-	-	12492
Staircase 1	-	90	-	100
Toilets 1	-	90	-	103
Toilets 2	-	90	-	108
Toilets 3	-	90	-	117
Toilets 4	-	90	-	122
Lobby 1	-	90	22	165
Office_Int 1N	95	-	-	597
Office_Per 1N	95	-	-	304
Corridor 1	-	90	-	41
Corridor 2	-	90	-	51
Plant Room 1	90	-	-	55
Staircase 2	-	90	-	111
Office_Per 1S	95	-	-	234
Office_Per GrS	95	-	-	348
Lobby 2	-	90	22	142

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?
Warehouse Unit 1	YES (+10%)	NO
Lobby 1	NO (-8%)	NO
Office_Int 1N	NO (-60%)	NO
Office_Per 1N	NO (-40%)	NO
Office_Per 1S	NO (-30%)	NO
Office_Per GrS	NO (-28%)	NO
Lobby 2	NO (-14%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	3121	3121
External area [m^2]	8464	8464
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	7
Average conductance [W/K]	2792	2780
Average U-value [W/m^2K]	0.33	0.33
Alpha value* [%]	2.28	2.27

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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/m^2]

	Actual	Notional
Heating	15.73	40.52
Cooling	1.27	0.95
Auxiliary	2.11	1.97
Lighting	22.74	34.45
Hot water	4.76	4.74
Equipment*	42.19	42.19
TOTAL**	**46.61**	**82.64**

* 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^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	72.22	144.65
Primary energy* [kWh/m^2]	103.18	167.1
Total emissions [kg/m^2]	17.6	28.7

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	51.9	0	16.8	0	17	0.86	0	0.95	0
	Notional	72.2	0	24.5	0	22.2	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	97	0	31.3	0	1.1	0.86	0	0.95	0
	Notional	88.1	0	29.9	0	1.2	0.82	0	----	----
[ST] Flued forced-convection air heaters, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	55.1	0	16.6	0	0	0.92	0	0.92	0
	Notional	146.5	0	47.3	0	0	0.86	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	31.2	189.6	10.1	14.1	17.8	0.86	3.73	0.95	3.9
	Notional	33.6	137.3	11.4	10.6	14.6	0.82	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	W_D_GF
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 3 - Green Scheme

As designed

Date: Tue Mar 28 12:26:45 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	28.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	28.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	14.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.63	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	0.3	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	1	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.83	5.69	-	1.5	0.65
Standard value	2.5*	2.6	N/A	1.5^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

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

1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Warehouse Unit 1	95	-	-	12492
Staircase 1	-	90	-	100
Toilets 1	-	90	-	103

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Toilets 2	-	90	-	108
Toilets 3	-	90	-	117
Toilets 4	-	90	-	122
Lobby 1	-	90	22	165
Office_Int 1N	95	-	-	597
Office_Per 1N	95	-	-	304
Corridor 1	-	90	-	41
Corridor 2	-	90	-	51
Plant Room 1	90	-	-	55
Staircase 2	-	90	-	111
Office_Per 1S	95	-	-	234
Office_Per GrS	95	-	-	348
Lobby 2	-	90	22	142

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?
Warehouse Unit 1	YES (+10%)	NO
Lobby 1	NO (-8%)	NO
Office_Int 1N	NO (-60%)	NO
Office_Per 1N	NO (-40%)	NO
Office_Per 1S	NO (-30%)	NO
Office_Per GrS	NO (-28%)	NO
Lobby 2	NO (-14%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	3121	3121
External area [m^2]	8464	8464
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	7
Average conductance [W/K]	2792	2780
Average U-value [W/m^2K]	0.33	0.33
Alpha value* [%]	2.28	2.27

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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/m^2]

	Actual	Notional
Heating	14.95	39.84
Cooling	0.87	0.95
Auxiliary	1.1	1.03
Lighting	22.74	34.45
Hot water	4.76	4.74
Equipment*	42.19	42.19
TOTAL**	**44.42**	**81.01**

* 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^2]

	Actual	Notional
Photovoltaic systems	5.28	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	72.22	144.65
Primary energy* [kWh/m^2]	98.33	164.05
Total emissions [kg/m^2]	14.1	28.2

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	51.9	0	16.8	0	17	0.86	0	0.95	0
	Notional	72.2	0	24.5	0	22.2	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	97	0	31.3	0	1.1	0.86	0	0.95	0
	Notional	88.1	0	29.9	0	1.2	0.82	0	----	----
[ST] Flued forced-convection air heaters, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	55.1	0	16.6	0	0	0.92	0	0.92	0
	Notional	146.5	0	47.3	0	0	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	31.2	189.6	1.9	9.7	6.5	4.62	5.44	4.83	5.69
	Notional	33.6	137.3	3.8	10.6	4.1	2.43	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	W_D_GF
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 4 - Lean Scheme

As designed

Date: Tue Jan 24 15:21:37 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	24.9
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	24.9
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	16.9
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.64	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	1.5	1.5	Reception Door

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (9 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	1	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (17 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	3.9	-	1.6	0.65
Standard value	0.91*	2.6	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- New DHW Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Lobby 1	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1N	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 1S	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 1S	-	-	-	-	-	-	-	0.3	-	-	N/A
Lobby 2	-	-	-	-	-	-	-	0.3	-	-	N/A
Lobby 3	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int GrS	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per GrS	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 5	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 6	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Int 7	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 5	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 6	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 7	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 8	-	-	-	-	-	-	-	0.3	-	-	N/A
Office_Per 9	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Warehouse Unit 1	95	-	-	34676
Staircase 1	-	90	-	176
Toilets 1	-	90	-	89
Toilets 2	-	90	-	150
Toilets 3	-	90	-	78
Toilets 4	-	90	-	139
Lobby 1	-	90	22	188
Office_Int 1N	95	-	-	522
Office_Per 1N	95	-	-	453
Corridor 1	-	90	-	43
Corridor 2	-	90	-	37
Plant Room 1	90	-	-	98
Staircase 2	-	90	-	179
Corridor 3	-	90	-	37
Toilets 5	-	90	-	78
Toilets 6	-	90	-	139
Office_Int 1S	95	-	-	517
Office_Per 1S	95	-	-	410
Lobby 2	-	90	-	67
Lobby 3	-	90	-	61
Store 1	90	-	-	6
Office_Int GrS	95	-	-	521

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Office_Per GrS	95	-	-	395
Lobby 4	-	90	-	61
Store 2	90	-	-	6
Store 3	90	-	-	6
Office_Int 5	95	-	-	522
Office_Int 6	95	-	-	517
Office_Int 7	95	-	-	521
Office_Per 5	95	-	-	374
Office_Per 6	95	-	-	453
Office_Per 7	95	-	-	410
Office_Per 8	95	-	-	395
Office_Per 9	95	-	-	374

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?
Warehouse Unit 1	YES (+12%)	NO
Lobby 1	YES (+175%)	NO
Office_Int 1N	NO (-93%)	NO
Office_Per 1N	NO (-21%)	NO
Office_Int 1S	NO (-94%)	NO
Office_Per 1S	NO (-24%)	NO
Lobby 2	YES (+147%)	NO
Lobby 3	YES (+114%)	NO
Office_Int GrS	NO (-94%)	NO
Office_Per GrS	NO (-22%)	NO
Office_Int 5	NO (-93%)	NO
Office_Int 6	NO (-94%)	NO
Office_Int 7	NO (-94%)	NO
Office_Per 5	NO (-21%)	NO
Office_Per 6	NO (-21%)	NO
Office_Per 7	NO (-24%)	NO
Office_Per 8	NO (-22%)	NO
Office_Per 9	NO (-21%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	8919	8919
External area [m^2]	20705	20705
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	5
Average conductance [W/K]	7007	6856
Average U-value [W/m^2K]	0.34	0.33
Alpha value* [%]	1.5	1.5

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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/m^2]

	Actual	Notional
Heating	13.41	26.02
Cooling	1.75	1.39
Auxiliary	2.24	1.91
Lighting	21.55	32.75
Hot water	4.87	4.85
Equipment*	43.08	43.08
TOTAL**	**43.82**	**66.92**

* 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^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	71.06	103.54
Primary energy* [kWh/m^2]	98.74	145.57
Total emissions [kg/m^2]	16.9	24.9

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	40.8	0	13.2	0	16.4	0.86	0	0.95	0
	Notional	53.1	0	18	0	21.4	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	95.8	0	30.9	0	1.1	0.86	0	0.95	0
	Notional	71.3	0	24.2	0	1.2	0.82	0	----	----
[ST] Flued forced-convection air heaters, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	48.6	0	14.7	0	0	0.92	0	0.92	0
	Notional	95.2	0	30.8	0	0	0.86	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	21.5	201.3	6.9	15	16.7	0.86	3.73	0.95	3.9
	Notional	19.1	154.9	6.5	12	13.1	0.82	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	Glazing
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	1.5	Reception Door

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

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 4 - Green Scheme

As designed

Date: Tue Mar 28 12:33:27 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	24.3
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	24.3
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	13.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	External Wall
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.64	1.7	Rooflight
Personnel doors	2.2	2.2	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	1.5	VD_GF
High usage entrance doors	3.5	1.5	1.5	Reception Door

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets (9 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1.58	-	-	0.3	-
Standard value	0.86	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- Staircase

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Warehouse Unit 1

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	1	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

4- Offices (17 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.83	5.69	-	1.5	0.65
Standard value	2.5*	2.6	N/A	1.5^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

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

1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Warehouse Unit 1	95	-	-	34676
Staircase 1	-	90	-	176
Toilets 1	-	90	-	89
Toilets 2	-	90	-	150
Toilets 3	-	90	-	78

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Toilets 4	-	90	-	139
Lobby 1	-	90	22	188
Office_Int 1N	95	-	-	522
Office_Per 1N	95	-	-	453
Corridor 1	-	90	-	43
Corridor 2	-	90	-	37
Plant Room 1	90	-	-	98
Staircase 2	-	90	-	179
Corridor 3	-	90	-	37
Toilets 5	-	90	-	78
Toilets 6	-	90	-	139
Office_Int 1S	95	-	-	517
Office_Per 1S	95	-	-	410
Lobby 2	-	90	-	67
Lobby 3	-	90	-	61
Store 1	90	-	-	6
Office_Int GrS	95	-	-	521
Office_Per GrS	95	-	-	395
Lobby 4	-	90	-	61
Store 2	90	-	-	6
Store 3	90	-	-	6
Office_Int 5	95	-	-	522
Office_Int 6	95	-	-	517
Office_Int 7	95	-	-	521
Office_Per 5	95	-	-	374
Office_Per 6	95	-	-	453
Office_Per 7	95	-	-	410
Office_Per 8	95	-	-	395
Office_Per 9	95	-	-	374

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?
Warehouse Unit 1	YES (+12%)	NO
Lobby 1	YES (+175%)	NO
Office_Int 1N	NO (-93%)	NO
Office_Per 1N	NO (-21%)	NO
Office_Int 1S	NO (-94%)	NO
Office_Per 1S	NO (-24%)	NO
Lobby 2	YES (+147%)	NO
Lobby 3	YES (+114%)	NO
Office_Int GrS	NO (-94%)	NO
Office_Per GrS	NO (-22%)	NO
Office_Int 5	NO (-93%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Office_Int 6	NO (-94%)	NO
Office_Int 7	NO (-94%)	NO
Office_Per 5	NO (-21%)	NO
Office_Per 6	NO (-21%)	NO
Office_Per 7	NO (-24%)	NO
Office_Per 8	NO (-22%)	NO
Office_Per 9	NO (-21%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	8919	8919
External area [m^2]	20705	20705
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	5
Average conductance [W/K]	7007	6856
Average U-value [W/m^2K]	0.34	0.33
Alpha value* [%]	1.5	1.5

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**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/m^2]

	Actual	Notional
Heating	12.68	25.46
Cooling	1.2	1.39
Auxiliary	1.04	0.84
Lighting	21.55	32.75
Hot water	4.87	4.85
Equipment*	43.08	43.08
TOTAL**	**41.33**	**65.3**

* 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^2]

	Actual	Notional
Photovoltaic systems	4.64	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	71.06	103.54
Primary energy* [kWh/m^2]	92.89	142.21
Total emissions [kg/m^2]	13.5	24.3

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	40.8	0	7.8	0	16.7	1.46	0	1.58	0
	Notional	53.1	0	12.3	0	21.8	1.2	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	95.8	0	30.9	0	1.1	0.86	0	0.95	0
	Notional	71.3	0	24.2	0	1.2	0.82	0	----	----
[ST] Flued forced-convection air heaters, [HS] Direct gas firing, [HFT] Natural Gas, [CFT] Electricity										
	Actual	48.6	0	14.7	0	0	0.92	0	0.92	0
	Notional	95.2	0	30.8	0	0	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	21.5	201.3	1.3	10.3	6.3	4.62	5.44	4.83	5.69
	Notional	19.1	154.9	2.2	12	3.9	2.43	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	External Wall
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.5	Glazing
Personnel doors	1.5	2.2	D_GF
Vehicle access & similar large doors	1.5	1.5	VD_GF
High usage entrance doors	1.5	1.5	Reception Door

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

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

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