



Littlehampton Leisure Centre

For

Arun District Council

Energy Strategy



Caveat

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Glossary

ADL2013	Approved Document L 2013 Edition
ASHP	Air Source Heat Pump
BER	Building Emission Rate
BREEAM	Building Research Establishment Environmental Assessment Methodology
BRUKL	Building Regulations United Kingdom Part L
CHP	Combined Heat and Power
DCLG	Department for Communities and Local Government
DHW	Domestic Hot Water
EPC	Energy Performance Certificate
FiT	Feed in Tariff
GAHP	Gas Absorption Heat Pump
GSHP	Ground Source heat Pump
IES	Integrated Environmental Systems
LTHW	Low Temperature Hot Water
LZC	Low and zero carbon technologies
PV	Photovoltaic
SBEM	Simplified Building Energy Model
TER	Target Emission Rate



1 Executive Summary

This report outlines the proposed energy strategy for the proposed development of a new Leisure Centre in Littlehampton, West Sussex. The proposed building is planned to consist of new leisure centre including an 8 lane 25m pool, a community pool, sports hall, studios, gym, changing areas, reception/café area and ancillary administration and plant areas.

The proposed energy strategy has been developed in line with the following energy hierarchy:

<i>"Be Lean"</i>	Reduce the building's energy requirements by incorporating passive design measures and reduce the building's energy consumption through the use of energy efficient mechanical and electrical engineering systems.
<i>"Be Clean"</i>	Reduce the building's carbon dioxide emissions through the efficient supply of heat and electricity.
<i>"Be Green"</i>	Reduce the building's carbon dioxide emissions through the use of renewable technologies.

This hierarchy of a passive first and energy efficient design is well proven and a useful format to demonstrate how passive, energy efficient and renewable/low carbon technologies are incorporated within the design.

The baseline energy benchmarks for the energy strategy are based on the Target Emissions Ratings (TERs) for Building Regulations Part L 2013 using IES VE 2015 thermal modelling software. The energy figures calculated within this report are based on national calculation methods for Part L compliance only and should not be used for any other purpose.

VZDV is not aware of any existing or proposed local district energy networks in the area hence this has not been considered further.

As part of the *"Be Lean"* stage a range of passive and active energy efficiency measures the following technologies are to be employed within the development which achieves compliance with the Part L 2013 baseline scheme and will provide a reduction of around 1.6% in CO₂ emissions over the baseline scheme.

As part of the *"Be Clean"* stage a number of Low and Zero Carbon (LZC) technologies have been considered. The most appropriate technology in this instance includes a gas-fired combined heat and power (CHP) unit. The CHP will provide all year round baseload heat and electricity. This would provide a reduction of around 22% in CO₂ emissions over the *"Be Lean"* case.

As part of the *"Be Green"* stage a number of low/zero carbon and renewable technologies have been appraised in terms of technical, physical and financial feasibility for use on the project. Each technology was considered as an alternative option operating in conjunction with CHP. Roof mounted photovoltaics technology was considered to be the most favourable for the development. This would provide a reduction of 1.1% in CO₂ emissions over the *"Be Clean"* case.

If all of the above technologies were implemented the overall predicted reduction in CO₂ emissions from the Baseline development model would be 24% which would equate to an annual saving of approximately 94 tonnes of CO₂. However due to budget constraints provision only for the CHP and PV will be made and these technologies may be implemented at a future date.



Figure 1-1 below sets out how the proposed energy efficiency measures and LZC systems reduce CO₂ emissions in line with the proposed energy hierarchy.

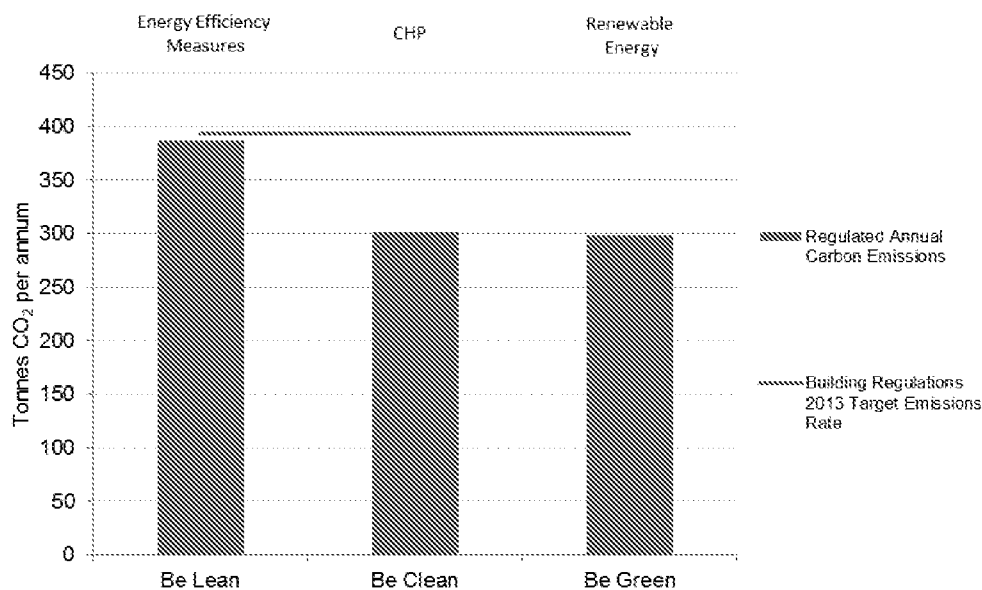


Figure 1-1 | The Energy Hierarchy

Table 1 below shows the CO₂ emissions breakdown and Table 2 shows the percentage breakdown at each stage of the energy hierarchy.

	Carbon Dioxide Emissions (tonnes CO ₂ per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L Compliant Development	393	133
After energy demand reduction "Be Lean"	387	133
After CHP "Be Clean"	302	133
After renewable energy "Be Green"	299	133

Table 1 | Carbon Emissions Breakdown

	Carbon Dioxide Emissions	
	Tonnes of CO ₂ per annum	%
Savings from energy demand reduction	6	1.6%
Savings from CHP	85	22%
Savings from renewable energy	3	1.1%
Total cumulative savings	94	24%

Table 2 | Regulated CO₂ Emissions Savings



2 Introduction

The energy assessment for Littlehampton Leisure Centre has taken a three-stage approach to reducing the building's carbon dioxide emissions in line with the following energy hierarchy:

<i>"Be Lean"</i>	Reduce the building's energy requirements by incorporating passive design measures and reduce the building's energy consumption through the use of energy efficient mechanical and electrical engineering systems.
<i>"Be Clean"</i>	Reduce the building's carbon dioxide emissions through the efficient supply of heat and electricity.
<i>"Be Green"</i>	Reduce the building's carbon dioxide emissions through the use of renewable technologies.

The energy assessment comprised the following stages:

1. Estimating a target for total regulated and unregulated annual energy consumption and CO₂ emissions of the proposed development. The estimates are based primarily on Part L approved software modelling results.
2. Estimating savings in regulated annual energy consumption and CO₂ emissions of the proposed development through the incorporation of passive and active energy efficiency measures. The estimates are based primarily on Part L approved software modelling results.
3. Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of energy networks including CHP.
4. Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of renewable technologies.



3 Baseline Energy Demand Assessment

ADL2013 has been used to define the baseline carbon footprint of the development. A building taken as compliant with ADL2013 is taken as the baseline on which this report will discuss carbon reductions using renewable technologies.

VZDV uses IES VE 2015 using DSM methodology to assess the building. The IES VE Compliance software has been approved by the Department for Communities and Local Government (DCLG) for use as a Dynamic Simulation Model (DSM) software package. As part of its approval process, the IES software had to demonstrate that it satisfies all of the tests and other requirements defined within sections 2 and 3 of the document "CIBSE TM33:2006, CIBSE standard tests for the assessment of building services design software".

The baseline energy benchmarks for the energy strategy are based on the Target Emissions Ratings (TERs) for Building Regulations Part L 2013 using IES VE 2015 thermal modelling software. The energy figures calculated within this report are based on national calculation methods for Part L compliance only and should not be used for any other purpose. Note that in accordance with Part L the energy figures within this report exclude unregulated electricity.

3.1 Baseline Energy Demand Results

The Target Emission Rate (TER) is defined in accordance with ADL2013 and is used as the baseline for the leisure centre, as detailed in Table 3.

Regulated Energy Balance	Energy		CO ₂ Emissions	
	kWh/yr	kWh/yr/m ²	kgCO ₂ /yr	kgCO ₂ /yr/m ²
LTHW Heating Energy	187,420	47.86	40,483	10.34
ASHP Heating Energy	21,799	5.57	11031	2.82
Chiller Energy	3,256	0.83	1648	0.42
Lighting Energy	65,520	16.73	33,155	8.47
Pump / Fan Energy	24,611	6.28	12,454	3.18
DHW Energy	1,363,121	348.09	294,434	75.19
Total	1,665,727	425.36	393,204	100.4

Table 3 | Baseline Energy and Carbon Emissions ADL2013



4 Energy Efficient Design Measures “Be Lean”

4.1 Passive Measures

The energy hierarchy approach has been to adopt a fabric first approach whereby the thermal envelope of the building is enhanced to improve the overall energy efficiency of the building. The passive design measures adopted include:

- Limiting the heat loss through walls, floors, roof, windows, doors
- Avoiding thermal bridging
- Ensuring adequate thermal mass
- Night cooling
- Shading in summer
- Reducing air permeability
- Building orientation to maximize thermal gain where needed
- Enhance the thermal envelope, particularly the pool and pool hall
- Balance between daylighting and thermal gain
- Optimum building fabric parameters in terms of cost/ u value

The thermal envelope enhancements are summarised elementally in the following table:

	Part L2A (2013) Minimum Performance	Proposed Building Performance	Proposed Pool Hall Performance
Construction Element	U-value (W/m ² K)	U-value (W/m ² K)	U-value (W/m ² K)
Ground Floor	0.25	0.20	0.20
External Wall	0.35	0.20	0.20
Roof	0.25	0.16	0.14
Windows	2.20	1.60	1.40
Rooflights	2.20	1.60	1.40
Doors	2.20	2.20	2.20
Air tightness (m ³ /hm ² @ 50Pa)	10	5	3

Table 4 | Targeted Building Fabric Thermal Performance

The pool halls are high in energy use being maintained at circa 30°C all year round hence these areas have been identified as areas with improved thermal envelope characteristics.

The artificial lighting is a significant proportion of the overall building energy and carbon emissions. Avoiding the need to use lighting by utilising the available daylight is an important factor in reducing carbon emissions. Windows are used to provide natural daylight into the building. The following glazing parameters have been used to strike a good balance between thermal gain and light transmittance:

	Commercial Windows
Frame factor	10%
G-value (BS EN 410)	0.41
Visible light transmittance	0.67

Table 5 | Targeted Glazing Performance



4.2 Active Measures

The mechanical and electrical services are critical to reducing energy consumption. The following active energy saving products and techniques should be integrated into the base design to achieve reductions in CO₂ emissions:

- Dimming controls linked to daylight sensors
- Local light switching
- Movement and absence sensors for lighting control
- Low energy lighting
- Low specific fan power
- Metering for energy management
- Rigorous commissioning
- Heating controls to optimize plant efficiency
- Controls set up to dynamically adjust heating, ventilation, cooling, hot water generation to reduce carbon emissions and maximise energy efficiency
- Variable speed drives and control for optimisation
- Energy efficient heat recuperation from extract air
- Integrating cost effective pool covers
- Automatically incorporating free cooling
- Optimising pool water treatment and turnover to suit bather demand
- Natural ventilation where appropriate
- Air source heat pumps

4.3 Overheating and Cooling

Unnecessary overheating and cooling has been considered to reduce potential overheating and reliance on air conditioning systems. Below is a summary of the steps taken:

1. Minimise internal heat generation through energy efficient design.
 - Heat generation will be minimised through the specification of energy efficient ventilation systems, insulation on pipework and low energy lighting.
2. Reduce the amount of heat entering the building in summer through orientation, shading, albedo, fenestration, blinds, insulation and green roofs and walls.
 - The amount of heat entering the building will be reduced by:
 - Energy efficient facades with appropriate proportions of glazing;
 - External shading;
 - A glazing shading coefficient carefully selected to minimise solar gain in the summer, but also to maximise solar gain in winter.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
 - Within certain areas there is a need to conceal services, which reduces the possibility of incorporating exposed internal thermal mass.
 - Ceiling heights in the building have been maximised within the constraints of the overall building heights and massing
4. Passive Ventilation
 - This has been used in the sports hall, circulation spaces, gym & studios
5. Mechanical Ventilation
 - The proposed ventilation strategy is a combination of natural ventilation and mechanical ventilation with heat recovery (MVHR).
6. Active Cooling Systems
 - The building makes use of mechanical cooling by means of renewable air source heat pumps in specific areas where temperature control is essential such as the gym and studios.



New building baseline model in accordance with ADL2013 after applying the active and passive energy efficient means:

Regulated Energy Balance	Energy		CO ₂ Emissions	
	kWh/yr	kWh/yr/m ²	kgCO ₂ /yr	kgCO ₂ /yr/m ²
LTHW Heating Energy	136,780	34.93	29,544	7.54
ASHP Heating Energy	15,719	4.01	7,954	2.03
Chiller Energy	3,406	0.87	1,724	0.44
Lighting Energy	68,033	17.37	34,427	8.79
Pump / Fan Energy	51,991	13.28	26,309	6.72
DHW Energy	1,328,253	339.19	286,903	73.26
Total	1,604,182	409.65	386,860	98.8

Table 6 | Baseline Energy and Carbon Emissions ADL2013 after Energy Efficient Measures

The difference in CO₂ emissions for the various categories is due to the different system and efficiencies between the notional building used for TER and the actual building used for BER. This follows the 'whole building emissions' approach adopted by building regulations, which gives designers flexibility on how to meet the overall target.

The improvement from the TER using the energy efficient means is 1.6%.

Figure 4-1 below shows that the Regulated Carbon Dioxide Emissions of the Energy Efficient Scheme which achieves compliance with Building Regulations.

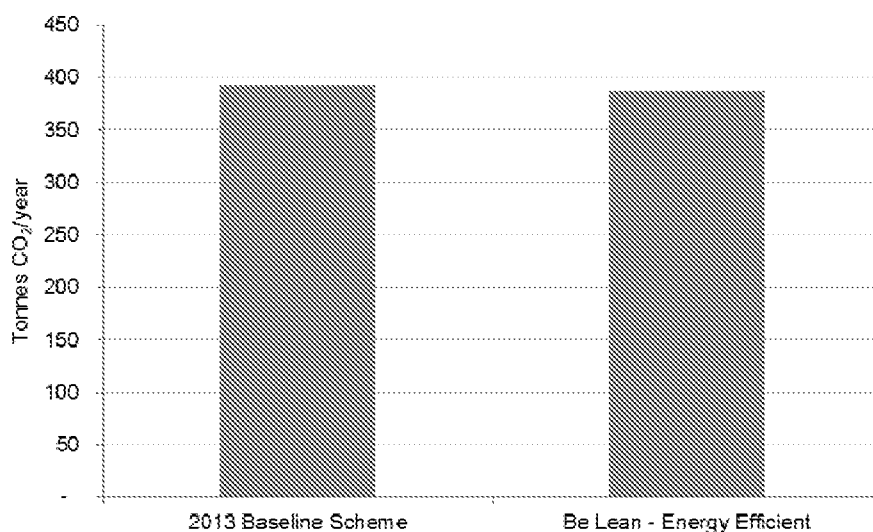


Figure 4-1 | Regulated Carbon Dioxide Emissions



5 Combined Heat and Power and District Heating “Be Clean”

This section addresses the *Be Clean* stage of the energy hierarchy.

5.1 Area Wide Heat Networks

The first step in selecting energy systems is to consider a connection to an existing heating or cooling network. VZDV is not aware of any existing or proposed local district energy networks in the area hence this has not been considered further.

5.2 Site Wide Heat Networks

The next step in the decentralised energy strategy is to consider site wide heat networks. VZDV is not aware of any existing or proposed local district energy networks in the area hence this has not been considered further.

5.3 Local Gas-fired Combined Heat and Power (CHP)

CHP uses a gas-fired reciprocating engine or turbine, connected to a generator to simultaneously generate both heat and power (electricity). Useable heat is generated by recovering the heat from the engine that, in a conventional generator, is rejected to atmosphere. In order to optimise the performance of the CHP engine it is important to provide consistent heating and electrical loads. For this reason, such a system would be supplemented by a gas fired boiler system and public electrical supply.

To ensure that CHP is financially viable it is essential that the unit is selected to meet the base heat load and that this load is maintained over a large proportion of the day (a figure of 14 – 17 hours per day is often quoted subject to the load profiles and gas and electricity prices) to ensure that the additional costs (maintenance) associated with running a CHP unit can be recovered.

This need to run the CHP plant, as far as possible continuously makes the building load profile of prime importance when reviewing the viability of such solutions and in particular the summer time heat load profile. CHP systems only make financial sense to operate when the waste heat associated with generating the electricity is usefully used. To enable the CHP plant to run continuously when it is operating, a thermal store is often used so that excess CHP capacity can be used to generate hot water for use at a later time.

In order to analyse the performance of CHP systems, monthly load profiles have been produced from the total estimated energy consumption figures of the energy efficient development, see Figure 5-2.

Table 7 shows the CHP details that are proposed.

Fuel Type	Natural Gas
Thermal efficiency (gross)	50.5%
Electrical efficiency (gross)	31.0%
Heat to Power Ratio	1.63
Estimated Running Hours	17 hours/day

Table 7 | CHP Details



Figure 5-2 below shows the CHP contribution to the heating and hot water load on a monthly basis.

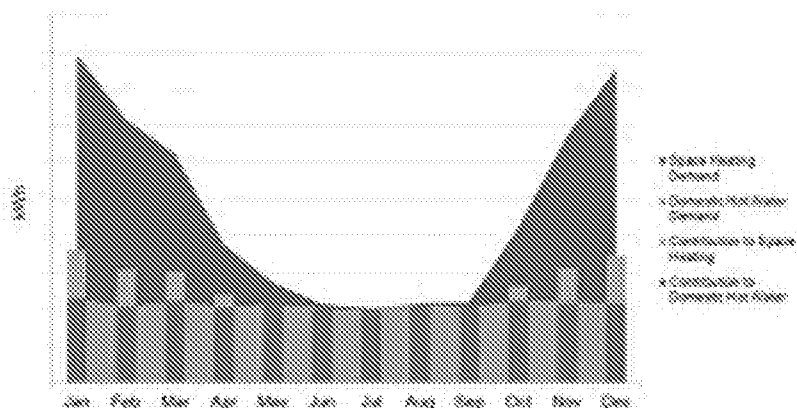


Figure 5-1 | Monthly load profiles

It is envisaged that all the electricity produced by the CHP unit will be used on site.

Figure 5-2 below shows the regulated Carbon Dioxide emissions after the *Be Clean* stage is approximately 22% lower taking into account the contribution of CHP. Emissions are compared against the baseline and *Be Lean* schemes.

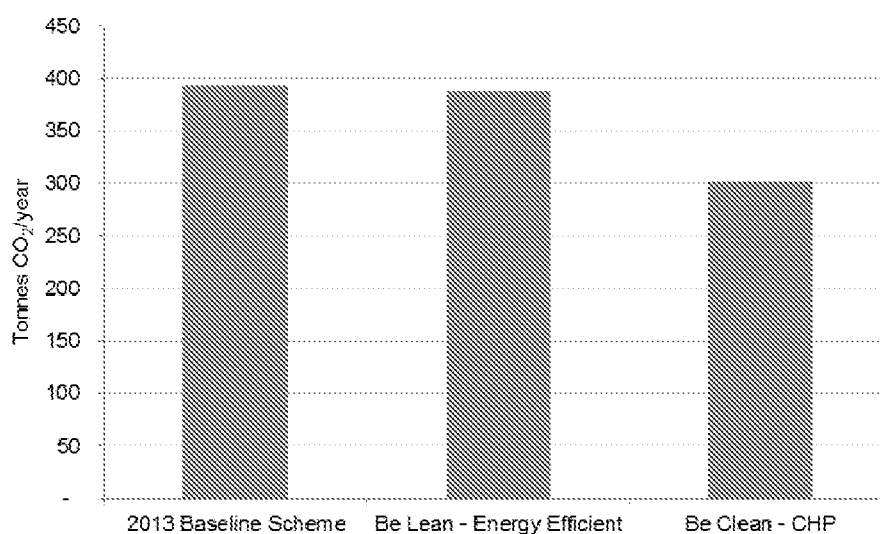


Figure 5-2 | Regulated Carbon Dioxide Emissions



6 Renewable Energy “Be Green”

This section addresses the *Be Green* stage of the energy hierarchy. A number of renewable technologies have been appraised in terms of technical, physical and financial feasibility, as potential renewable systems for use on the project. Each technology was considered as an alternative option operating in conjunction with CHP

The following low and zero carbon technologies were considered and compared for this particular development:

- Gas fired combined heat and power (CHP)
- Wind turbines
- Solar thermal heating
- Photovoltaic panels
- Biomass boiler
- Liquid biomass CHP
- Air source heat pumps
- Ground source heat pumps
- Gas absorption heat pumps

These are summarised in the following table:

	Financially Viable	Comments
Gas fired CHP	8 - 12 years	Generates both heat & electricity giving CO ₂ savings. Performance limited by small DHW load and reduced operating hours
Wind Turbines	20 – 25 years	Visual impact, noise, planning issues, relative small carbon benefit
Solar Thermal Panels	15 – 20 years	This technology conflicts with the CHP and generates most of its heat when demand is lowest
Photovoltaic Panels (PV)	< 10 years	Good CO ₂ reduction, reasonable payback, limited by available roof area
Biomass	> 20 years	Practical issues for delivery, operation, maintenance and air quality
Liquid biomass CHP	No payback	Practical issues for sourcing fuel, delivery, operation, maintenance and air quality; depending on fuel source as to whether it achieves renewable status
Air source heat pumps	> 20 years	This technology is not readily compatible with CHP due to the nature of the low grade heat it produces; this technology has been used in areas where cooling is required to provide space heating and cooling
Ground Source Heat Pumps (GSHP)	> 30 years	Low grade heat limits design flexibility. Also environmental and cost issues associated with ground works.
Gas Absorption Heat Pumps (GAHP)	> 20 years	Low grade heat limits design flexibility. Relatively small capacity of machines means multiple machines required for larger buildings, with associated cost and space implications.

Table 8 | Summary of Considered Renewable Technologies



Although all LZC technologies contribute towards CO₂ reduction, some are more suitable than others and the list of LZC technologies that can make a significant contribution has been narrowed down to:

- I. Combined Heat & Power (CHP)
- II. Photovoltaic (PV)

The extent of PV is 100m² of roof area (achieving 6,180 kWh/annum) providing approximately 1.1% saving in Carbon Dioxide emissions from that at “*Be Clean*” stage. Refer to architects roof plan for typical location and arrangement of PV.

PV uptake in the UK has been considerable in recent years and although the government’s Feed in Tariffs (FiT) has reduced considerably it is still one of the more commercially viable options for carbon reduction.

Incorporating CHP and PV technology:

Regulated Energy Balance	Energy		CO ₂ Emissions	
	kWh/yr	kWh/yr/m ²	kgCO ₂ /yr	kgCO ₂ /yr/m ²
PV Generated Electricity	-6,180	-1.58	-3,207	-0.82
CHP Generated Electricity	-373,533	-95.39	-193,864	-49.5
LTHW Heating Energy	182,803	46.68	39,485	10.08
ASHP Heating Energy	15,719	4.01	7,954	2.03
Chiller Energy	3,406	0.87	1,724	0.44
Lighting Energy	68,033	17.37	34,427	8.79
Pump / Fan Energy	51,991	13.28	26,309	6.72
DHW Energy	1,786,721	456.26	385,932	98.55
Total	1,728,960	441.51	298,759	76.3

Table 9 | Baseline Energy and Carbon Emissions ADL2013 after Energy Efficient Means, CHP and PV as Renewable Technology

Figure 6-1 shows the estimated development regulated Carbon Dioxide emissions after the “*Be Green*” stage is approximately 1.2% lower than that at *Be Clean* Stage. Emissions are compared against the baseline, *Be Lean* and *Be Clean* scheme.

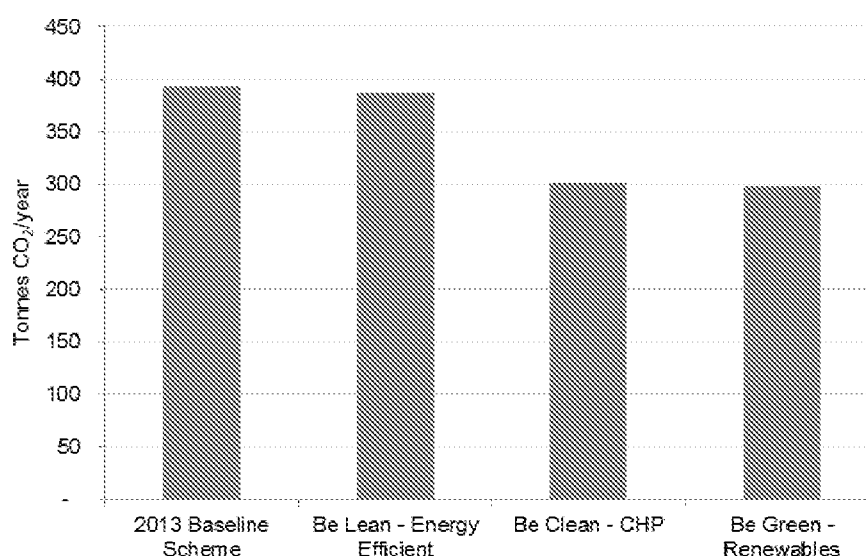


Figure 6-1 | Regulated Carbon Dioxide Emissions



7 Conclusions

The proposed energy strategy for the building includes energy efficient measures (passive and active) to minimise the carbon footprint, and these measures alone show an Approved Document L (ADL) 2013 compliant building (*Be Lean*). This will provide a reduction of around 1.6% in CO₂ emissions over the baseline scheme.

A local base unit gas-fired CHP shows a possible further improvement of 22% from the *Be Clean* stage.

A number of renewable technologies have been appraised in terms of technical, physical and financial feasibility, as potential renewable systems for use on the project. Each technology was considered as an alternative option operating in conjunction with CHP. Roof mounted photovoltaics technology was considered to be the most favourable for the development, this shows a possible further improvement of 1.1% from the *Be Green* stage.

If all of the above technologies were implemented the cumulative regulated Carbon Dioxide emissions reductions from *Be Lean*, *Be Clean* and *Be Green* would be approximately 24% on average lower than a Part L 2013 compliant development.

Table 10 below shows the CO₂ emissions breakdown and Table 11 shows the percentage breakdown at each stage of the hierarchy.

However due to budget constraints provision only for the CHP and PV will be made and these technologies may be implemented at a future date.

	Carbon Dioxide Emissions (tonnes CO ₂ per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L Compliant Development	393	133
After energy demand reduction <i>"Be Lean"</i>	387	133
After CHP <i>"Be Clean"</i>	302	133
After renewable energy <i>"Be Green"</i>	299	133

Table 10 | Carbon Emissions Breakdown

	Carbon Dioxide Emissions	
	Tonnes of CO ₂ per annum	%
Savings from energy demand reduction	6	1.6%
Savings from CHP	85	22%
Savings from renewable energy	3	1.1%
Total cumulative savings	94	24%

Table 11 | Regulated CO₂ Emissions Savings



Figure 7-1 below sets out how the proposed energy efficiency measures and LZC systems reduce regulated CO₂ emissions:

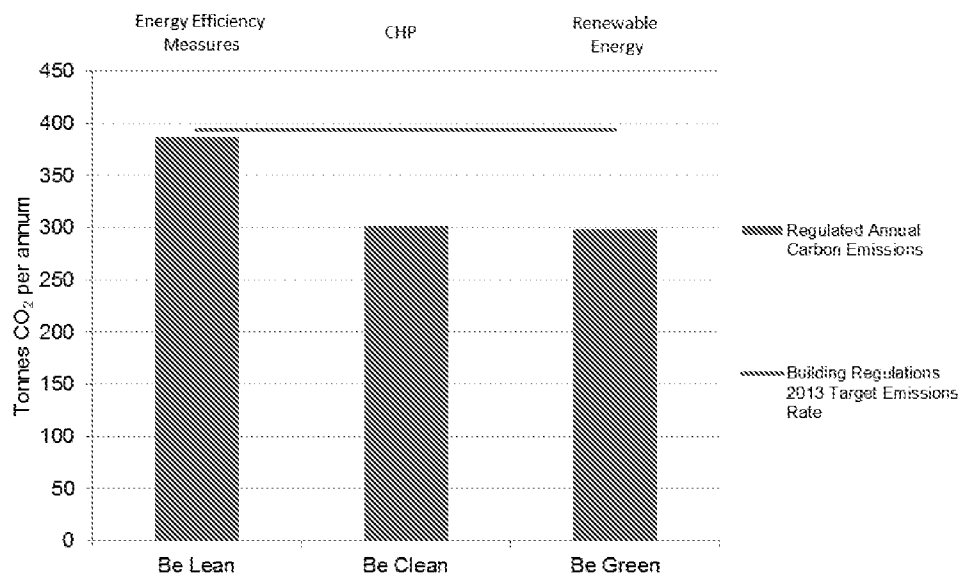


Figure 7-1 | The Energy Hierarchy



8 Appendix A – BRUKL Report – *Be Lean*

Project name

Littlehampton Leisure Centre (Be Lean)

As designed

Date: Thu Feb 09 10:42:24 2017

Administrative information

Building Details

Address: Littlehampton Leisure Centre, City, Postcode

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.6

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.6

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

Certifier details

Name: Harjit Singh Thind

Telephone number: 01727 731560

Address: VZDV, 6a Parkway, Valley Road, Porters Wood,
St Albans, AL3 6PACriterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	100.4
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	100.4
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	98.8
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	U _{Limit}	U _{Calc}	U _{Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	00000006:Surf[10]
Floor	0.25	0.2	0.2	00000013:Surf[0]
Roof	0.25	0.15	0.16	01000010:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.55	1.6	00000006:Surf[0]
Personnel doors	2.2	2.2	2.2	0000000B:Surf[0]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

U_{Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{Calc} = Calculated area-weighted average U-values [W/(m²K)]U_{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	5

Building services

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

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

1- Air Based Heating + AHU02 & 03 (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.12	1.8	0.73
Standard value	0.91	N/A	N/A	1.5 [*]	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] 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.					

2- Radiators + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.3	0	-
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- VRF + Mech Vent (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.26	0	0	0.73
Standard value	2.5 [*]	3.2	N/A	N/A	0.65
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.					

4- Air Curtain + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.1	0	-
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					NO

5- Radiators + Mech Vent (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.3	0	0.73
Standard value	0.91 [*]	N/A	N/A	N/A	0.65
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.					

6- Air Based Heating + AHU01 (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.16	1.8	0.65
Standard value	0.91	N/A	N/A	1.5 [*]	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] 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.					

7- UFH + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.5	0	-
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 0.88. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

8- VRF + Windcatchers

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.26	0	0	-
Standard value	2.5*	3.2	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 all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
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	ID of system type	SFP [W/(l/s)]										HR efficiency	
		A	B	C	D	E	F	G	H	I		Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
00_Duty Office		-	1.1	0.5	-	-	-	-	-	-	-	-	N/A
00_IT		-	1.1	0.5	-	-	-	-	-	-	-	-	N/A
00_Lobby - WC		-	-	-	1.8	-	-	-	-	-	-	-	N/A
00_Manager Office		-	1.1	0.5	-	-	-	-	-	-	-	-	N/A
00_Multi-Purpose Room		-	1.1	0.5	-	-	-	-	-	-	-	-	N/A
00_Reception/Servery		-	-	-	1.8	-	-	-	-	-	-	-	N/A
00_WC		-	-	-	1.8	-	-	-	-	-	-	-	N/A
00_WC		-	-	-	1.8	-	-	-	-	-	-	-	N/A
00_WC		-	-	-	1.8	-	-	-	-	-	-	-	N/A
01_Acc Change		-	-	-	1.8	-	-	-	-	-	-	-	N/A
01_Acc WC		-	-	-	1.8	-	-	-	-	-	-	-	N/A
01_Admin		-	1.1	0.5	-	-	-	-	-	-	-	-	N/A
01_Lobby		-	-	-	1.8	-	-	-	-	-	-	-	N/A
01_Staff Rest Room		-	1.1	0.5	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
00_Acc Change		-	114	-	18
00_Acc Shower		-	143	-	12
00_Cafe		-	111	-	150
00_Change 1 - Dry		76	-	-	190
00_Change 2 - Dry		76	-	-	192
00_Changing Place		-	89	-	35
00_Chem Store 1		-	60	-	227
00_Chem Store 2		-	60	-	142
00_Circulation 2		-	72	-	205
00_Ci Store		-	60	-	144
00_Duty Office		141	-	-	78
00_Entrance Lobby		-	90	-	37
00_Escape Circulation		-	159	-	34
00_First Aid		144	-	-	66
00_Foyer		-	66	-	161
00_Gas Intake		60	-	-	30
00_Informal Viewing		82	-	-	349
00_IT		260	-	-	32
00_Kitchen		-	146	-	148
00_Learner Pool		-	63	-	1712
00_Lobby - Plant		-	194	-	8
00_Lobby - WC		-	141	-	12
00_LV Intake Room		60	-	-	102
00_Manager Office		171	-	-	44
00_Multi-Purpose Room		-	109	-	126
00_Plant		60	-	-	673
00_Pool Hall		-	71	-	4276
00_Pool Store 1		-	60	-	384
00_Pool Store 2		-	60	-	622
00_Reception/Servery		-	64	60	181
00_Sports Hall		-	110	-	2982
00_Sports Hall - Change 1		78	-	-	234
00_Sports Hall - Change 2		78	-	-	261
00_Sports Hall - Lobby 1		-	154	-	11
00_Sports Hall - Lobby 2		-	150	-	11
00_Sports Hall - Showers 2		-	110	-	18
00_Sports Hall - Showers 2		-	110	-	17
00_Sports Hall - WC 1		-	67	-	89
00_Sports Hall - WC 2		-	68	-	93
00_Sports Hall Store 1		-	60	-	667
00_Sports Hall Store 2		-	60	-	589
00_Stair & Circulation 1		-	67	-	275

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name	Standard value	Luminaire	Lamp	Display lamp	
		80	60	22	
00_Stair 2		-	115	-	30
00_Stair 3		-	102	-	39
00_Store - Kitchen		-	60	-	141
00_Store - Vending		-	60	-	120
00_WC		-	79	-	53
00_WC		-	69	-	182
00_WC		-	105	-	32
00_WC		-	61	-	209
00_WC		-	105	-	35
00_WC		-	91	-	43
00_Wet Change		-	62	-	597
00_Wet Change		-	106	-	21
01_Acc Change		-	96	-	19
01_Acc WC		-	71	-	47
01_Admin		97	-	-	227
01_Circulation 2		-	77	-	189
01_Circulation 3		-	89	-	68
01_Circulation 4		-	136	-	22
01_F Change		70	-	-	510
01_F Showers		-	79	-	53
01_F WC		-	64	-	140
01_Gym		-	89	-	1472
01_Lobby		-	118	-	15
01_Lobby - Plant		-	194	-	8
01_M Change		69	-	-	499
01_M Showers		-	74	-	59
01_M WC		-	62	-	142
01_Plant		60	-	-	902
01_Spin Studio		-	108	-	151
01_Staff Rest Room		114	-	-	110
01_Stair		-	194	-	15
01_Stair & Circulation 1		-	74	-	167
01_Stair 2		-	172	-	31
01_Stair 3		-	157	-	38
01_Store		-	60	-	120
01_Studio 1		-	105	-	344
01_Studio 2		-	104	-	396
01_Studio Store 1		-	60	-	155
01_Studio Store 2		-	60	-	435
LG_Balance Tank - Learner Pool		60	-	-	107
LG_Balance Tank - Main Pool		60	-	-	175
LG_Plant Circulation		-	74	-	27

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?
00_Cafe	NO (-46.8%)	NO
00_Change 1 - Dry	N/A	N/A
00_Change 2 - Dry	N/A	N/A
00_Duty Office	NO (-76.8%)	NO
00_First Aid	N/A	N/A
00_Informal Viewing	NO (-52.5%)	NO
00_IT	N/A	N/A
00_Learner Pool	NO (-79.8%)	NO
00_Manager Office	NO (-72.2%)	NO
00_Multi-Purpose Room	NO (-8.5%)	YES
00_Pool Hall	YES (+62.7%)	NO
00_Reception/Servery	NO (-82.5%)	NO
00_Sports Hall	N/A	N/A
00_Sports Hall - Change 1	N/A	N/A
00_Sports Hall - Change 2	N/A	N/A
01_Admin	NO (-49.8%)	NO
01_F Change	N/A	N/A
01_Gym	NO (-6.1%)	NO
01_M Change	N/A	N/A
01_Spin Studio	N/A	N/A
01_Staff Rest Room	NO (-57.9%)	NO
01_Studio 1	N/A	N/A
01_Studio 2	NO (-25.2%)	YES

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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	3916	3916
External area [m ²]	9789.3	9789.3
Weather	SOU	SOU
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2936.26	3270.74
Average U-value [W/m ² K]	0.3	0.33
Alpha value* [%]	9.23	10

* 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
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C3 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
100	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	38.94	53.43
Cooling	0.87	0.83
Auxiliary	13.28	6.28
Lighting	17.37	16.73
Hot water	339.18	348.09
Equipment*	65.27	65.27
TOTAL**	409.64	425.36

* 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 & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	180.42	211.14
Primary energy* [kWh/m ²]	573.56	587.73
Total emissions [kg/m ²]	98.8	100.4

* 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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	921.8	0	276.2	0	64.6	0.93	0	0.95	0
Notional	52.4	0	16.9	0	1.5	0.86	0	-----	-----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	35.2	0	11	0	1.5	0.89	0	0.95	0
Notional	1165.5	0	375.5	0	31.5	0.86	0	-----	-----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	40.1	151.9	2.8	10.7	22.4	3.92	3.96	4	5.3
Notional	46.7	150	5.1	11.7	21.3	2.56	3.79	-----	-----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	66.6	0	21.4	0	1.7	0.89	0	0.95	0
Notional	77.5	0	25	0	1.7	0.86	0	-----	-----
[ST] Other local room heater - fanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	290.9	0	101	0	0	0.8	0	1	0
Notional	218	0	70.3	0	0	0.86	0	-----	-----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	252.3	40.3	17.9	2.8	0	3.92	3.96	4	5.3
Notional	253.1	33.9	27.6	2.5	0	2.56	3.79	-----	-----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	16.9	0	5.3	0	11	0.89	0	0.95	0
Notional	27.5	0	8.9	0	4.7	0.86	0	-----	-----
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	13.4	0	4	0	9.9	0.93	0	0.95	0
Notional	20.2	0	6.5	0	6.4	0.86	0	-----	-----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	-----	-----

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 _{typ}	U _{min}	Surface where the minimum value occurs*
Wall	0.23	0.2	00000006:Surf[10]
Floor	0.2	0.2	00000013:Surf[0]
Roof	0.15	0.14	00000033:Surf[1]
Windows, roof windows, and rooflights	1.5	1.4	0100001E:Surf[0]
Personnel doors	1.5	2.2	0000000B:Surf[0]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{typ} = Typical individual element U-values [W/(m ² K)]		U _{min} = Minimum individual element U-values [W/(m ² K)]	
* 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	5



9 Appendix A – BRUKL Report – *Be Clean*

Project name

Littlehampton Leisure Centre (Be Clean)

As designed

Date: Thu Feb 09 10:32:24 2017

Administrative information

Building Details

Address: Littlehampton Leisure Centre, City, Postcode

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.6

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.6

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

Certifier details

Name: Harjit Singh Thind

Telephone number: 01727 731560

Address: VZDV, 6a Parkway, Valley Road, Porters Wood,
St Albans, AL3 6PACriterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	100.4
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	100.4
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	77.1
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 _{Limit}	U _{Calc}	U _{Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	00000006:Surf[10]
Floor	0.25	0.2	0.2	00000013:Surf[0]
Roof	0.25	0.15	0.16	01000010:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.55	1.6	00000006:Surf[0]
Personnel doors	2.2	2.2	2.2	0000000B:Surf[0]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

U_{Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{Calc} = Calculated area-weighted average U-values [W/(m²K)]U_{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	5

Building services

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

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

1- Air Based Heating + AHU02 & 03 (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.12	1.8	0.73
Standard value	0.91	N/A	N/A	1.5 [*]	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] 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.					

2- Radiators + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.3	0	-
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- VRF + Mech Vent (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.26	0	0	0.73
Standard value	2.5 [*]	3.2	N/A	N/A	0.65
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.					

4- Air Curtain + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.1	0	-
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					NO

5- Radiators + Mech Vent (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.3	0	0.73
Standard value	0.91 [*]	N/A	N/A	N/A	0.65
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.					

6- Air Based Heating + AHU01 (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.16	1.8	0.65
Standard value	0.91	N/A	N/A	1.5 [*]	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] 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.					

7- UFH + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.5	0	-
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 0.88. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

8- VRF + Windcatchers

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.26	0	0	-
Standard value	2.5*	3.2	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 all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

"No HWS in project, or hot water is provided by HVAC system"

1- CHECK2-CHP

	CHPQA quality index	CHP electrical efficiency
This building	105	0.31
Standard value	105	0.2

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	ID of system type	SFP [W/(l/s)]									HR efficiency	
		A	B	C	D	E	F	G	H	I	Zone	Standard
Standard value		0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
00_Duty Office		-	1.1	0.5	-	-	-	-	-	-	-	N/A
00_IT		-	1.1	0.5	-	-	-	-	-	-	-	N/A
00_Lobby - WC		-	-	-	1.8	-	-	-	-	-	-	N/A
00_Manager Office		-	1.1	0.5	-	-	-	-	-	-	-	N/A
00_Multi-Purpose Room		-	1.1	0.5	-	-	-	-	-	-	-	N/A
00_Reception/Servery		-	-	-	1.8	-	-	-	-	-	-	N/A
00_WC		-	-	-	1.8	-	-	-	-	-	-	N/A
00_WC		-	-	-	1.8	-	-	-	-	-	-	N/A
00_WC		-	-	-	1.8	-	-	-	-	-	-	N/A
01_Acc Change		-	-	-	1.8	-	-	-	-	-	-	N/A
01_Acc WC		-	-	-	1.8	-	-	-	-	-	-	N/A

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
01_Admin	-	-	1.1	0.5	-	-	-	-	-	-	-	N/A
01_Lobby	-	-	-	-	1.8	-	-	-	-	-	-	N/A
01_Staff Rest Room	-	-	1.1	0.5	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
00_Acc Change	-	-	114	-	18
00_Acc Shower	-	-	143	-	12
00_Cafe	-	-	111	-	150
00_Change 1 - Dry	-	76	-	-	190
00_Change 2 - Dry	-	76	-	-	192
00_Changing Place	-	-	89	-	35
00_Chem Store 1	-	-	60	-	227
00_Chem Store 2	-	-	60	-	142
00_Circulation 2	-	-	72	-	205
00_Ci Store	-	-	60	-	144
00_Duty Office	-	141	-	-	78
00_Entrance Lobby	-	-	90	-	37
00_Escape Circulation	-	-	159	-	34
00_First Aid	-	144	-	-	66
00_Foyer	-	-	66	-	161
00_Gas Intake	-	60	-	-	30
00_Informal Viewing	-	82	-	-	349
00_IT	-	260	-	-	32
00_Kitchen	-	-	146	-	148
00_Learner Pool	-	-	63	-	1712
00_Lobby - Plant	-	-	194	-	8
00_Lobby - WC	-	-	141	-	12
00_LV Intake Room	-	60	-	-	102
00_Manager Office	-	171	-	-	44
00_Multi-Purpose Room	-	-	109	-	126
00_Plant	-	60	-	-	673
00_Pool Hall	-	-	71	-	4276
00_Pool Store 1	-	-	60	-	384
00_Pool Store 2	-	-	60	-	622
00_Reception/Servery	-	-	64	60	181
00_Sports Hall	-	-	110	-	2982
00_Sports Hall - Change 1	-	78	-	-	234
00_Sports Hall - Change 2	-	78	-	-	281
00_Sports Hall - Lobby 1	-	-	154	-	11
00_Sports Hall - Lobby 2	-	-	150	-	11
00_Sports Hall - Showers 2	-	-	110	-	18

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name	Standard value	Luminaire	Lamp	Display lamp	
00_Sports Hall - Showers 2	-	-	110	-	17
00_Sports Hall - WC 1	-	-	67	-	89
00_Sports Hall - WC 2	-	-	66	-	93
00_Sports Hall Store 1	-	-	60	-	667
00_Sports Hall Store 2	-	-	60	-	589
00_Stair & Circulation 1	-	-	67	-	275
00_Stair 2	-	-	115	-	30
00_Stair 3	-	-	102	-	39
00_Store - Kitchen	-	-	60	-	141
00_Store - Vending	-	-	60	-	120
00_WC	-	-	79	-	53
00_WC	-	-	69	-	182
00_WC	-	-	105	-	32
00_WC	-	-	61	-	209
00_WC	-	-	105	-	35
00_WC	-	-	91	-	43
00_Wet Change	-	-	62	-	597
00_Wet Change	-	-	106	-	21
01_Acc Change	-	-	96	-	19
01_Acc WC	-	-	71	-	47
01_Admin	97	-	-	-	227
01_Circulation 2	-	-	77	-	169
01_Circulation 3	-	-	89	-	68
01_Circulation 4	-	-	136	-	22
01_F Change	70	-	-	-	510
01_F Showers	-	-	79	-	53
01_F WC	-	-	64	-	140
01_Gym	-	-	89	-	1472
01_Lobby	-	-	118	-	15
01_Lobby - Plant	-	-	194	-	8
01_M Change	69	-	-	-	499
01_M Showers	-	-	74	-	59
01_M WC	-	-	62	-	142
01_Plant	60	-	-	-	902
01_Spin Studio	-	-	108	-	151
01_Staff Rest Room	114	-	-	-	110
01_Stair	-	-	194	-	15
01_Stair & Circulation 1	-	-	74	-	167
01_Stair 2	-	-	172	-	31
01_Stair 3	-	-	157	-	38
01_Store	-	-	60	-	120
01_Studio 1	-	-	105	-	344
01_Studio 2	-	-	104	-	396

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	80	60	22	
01_Studio Store 1		-	60	-	155
01_Studio Store 2		-	60	-	435
LG_Balance Tank - Learner Pool		60	-	-	107
LG_Balance Tank - Main Pool		60	-	-	175
LG_Plant Circulation		-	74	-	27

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?
00_Cafe	NO (-46.6%)	NO
00_Change 1 - Dry	N/A	N/A
00_Change 2 - Dry	N/A	N/A
00_Duty Office	NO (-76.8%)	NO
00_First Aid	N/A	N/A
00_Informal Viewing	NO (-52.5%)	NO
00_IT	N/A	N/A
00_Learner Pool	NO (-79.8%)	NO
00_Manager Office	NO (-72.2%)	NO
00_Multi-Purpose Room	NO (-6.5%)	YES
00_Pool Hall	YES (+62.7%)	NO
00_Reception/Servery	NO (-62.5%)	NO
00_Sports Hall	N/A	N/A
00_Sports Hall - Change 1	N/A	N/A
00_Sports Hall - Change 2	N/A	N/A
01_Admin	NO (-48.6%)	NO
01_F Change	N/A	N/A
01_Gym	NO (-0.1%)	NO
01_M Change	N/A	N/A
01_Spin Studio	N/A	N/A
01_Staff Rest Room	NO (-57.9%)	NO
01_Studio 1	N/A	N/A
01_Studio 2	NO (-25.2%)	YES

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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	3916	3916
External area [m ²]	9789.3	9789.3
Weather	SOU	SOU
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2936.26	3270.74
Average U-value [W/m ² K]	0.3	0.33
Alpha value* [%]	9.23	10

* 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
B8 Storage or Distribution
C1 Hotels
C2 Residential Inst.: Hospitals and Care Homes
C3 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
100 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	50.69	53.43
Cooling	0.87	0.83
Auxiliary	13.28	6.28
Lighting	17.37	16.73
Hot water	456.25	348.09
Equipment*	65.27	65.27
TOTAL**	443.07	425.36

* 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	95.39	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	180.42	211.14
Primary energy* [kWh/m ²]	437.9	587.73
Total emissions [kg/m ²]	77.1	100.4

* 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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	921.8	0	157.3	0	64.6	0.93	0	0.95	0
Notional	52.4	0	16.9	0	1.5	0.86	0	-----	-----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	35.2	0	6.3	0	1.5	0.89	0	0.95	0
Notional	1165.5	0	375.5	0	31.5	0.86	0	-----	-----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	40.1	151.9	2.8	10.7	22.4	3.92	3.96	4	5.3
Notional	46.7	159	5.1	11.7	21.3	2.56	3.79	-----	-----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	66.6	0	12.1	0	1.7	0.89	0	0.95	0
Notional	77.5	0	25	0	1.7	0.86	0	-----	-----
[ST] Other local room heater - fanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	290.9	0	101	0	0	0.8	0	1	0
Notional	218	0	70.3	0	0	0.86	0	-----	-----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	252.3	40.3	17.9	2.8	0	3.92	3.96	4	5.3
Notional	253.1	33.9	27.6	2.5	0	2.56	3.79	-----	-----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	16.9	0	3.3	0	11	0.89	0	0.95	0
Notional	27.5	0	8.9	0	4.7	0.86	0	-----	-----
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	13.4	0	2.4	0	9.9	0.93	0	0.95	0
Notional	20.2	0	6.5	0	6.4	0.86	0	-----	-----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	-----	-----

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 _{typ}	U _{min}	Surface where the minimum value occurs*
Wall	0.23	0.2	00000006:Surf[10]
Floor	0.2	0.2	00000013:Surf[0]
Roof	0.15	0.14	00000033:Surf[1]
Windows, roof windows, and rooflights	1.5	1.4	0100001E:Surf[0]
Personnel doors	1.5	2.2	0000000B:Surf[0]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{typ} = Typical individual element U-values [W/(m ² K)]			U _{min} = Minimum individual element U-values [W/(m ² K)]
* 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	5



10 Appendix A – BRUKL Report – *Be Green*

Project name

Littlehampton Leisure Centre (Be Green)

As designed

Date: Thu Feb 09 10:37:51 2017

Administrative information

Building Details

Address: Littlehampton Leisure Centre, City, Postcode

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.6

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.6

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

Certifier details

Name: Harjit Singh Thind

Telephone number: 01727 731560

Address: VZDV, 6a Parkway, Valley Road, Porters Wood,
St Albans, AL3 6PACriterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	100.4
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	100.4
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	76.3
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 _{Limit}	U _{Calc}	U _{Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	00000006:Surf[10]
Floor	0.25	0.2	0.2	00000013:Surf[0]
Roof	0.25	0.15	0.16	01000010:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.55	1.6	00000006:Surf[0]
Personnel doors	2.2	2.2	2.2	0000000B:Surf[0]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

U_{Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{Calc} = Calculated area-weighted average U-values [W/(m²K)]U_{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	5

Building services

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

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

1- Air Based Heating + AHU02 & 03 (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.12	1.8	0.73
Standard value	0.91	N/A	N/A	1.5 [*]	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] 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.					

2- Radiators + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.3	0	-
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- VRF + Mech Vent (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.26	0	0	0.73
Standard value	2.5 [*]	3.2	N/A	N/A	0.65
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.					

4- Air Curtain + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.1	0	-
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					NO

5- Radiators + Mech Vent (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.3	0	0.73
Standard value	0.91 [*]	N/A	N/A	N/A	0.65
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.					

6- Air Based Heating + AHU01 (HR)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.16	1.8	0.65
Standard value	0.91	N/A	N/A	1.5 [*]	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] 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.					

7- UFH + Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.5	0	-
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 0.88. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

8- VRF + Windcatchers

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.26	0	0	-
Standard value	2.5*	3.2	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 all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

"No HWS in project, or hot water is provided by HVAC system"

1- CHECK2-CHP

	CHPQA quality index	CHP electrical efficiency
This building	105	0.31
Standard value	105	0.2

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	
00_Duty Office	-	1.1	0.5	-	-	-	-	-	-	-	N/A	
00_IT	-	1.1	0.5	-	-	-	-	-	-	-	N/A	
00_Lobby - WC	-	-	-	1.8	-	-	-	-	-	-	N/A	
00_Manager Office	-	1.1	0.5	-	-	-	-	-	-	-	N/A	
00_Multi-Purpose Room	-	1.1	0.5	-	-	-	-	-	-	-	N/A	
00_Reception/Servery	-	-	-	1.8	-	-	-	-	-	-	N/A	
00_WC	-	-	-	1.8	-	-	-	-	-	-	N/A	
00_WC	-	-	-	1.8	-	-	-	-	-	-	N/A	
00_WC	-	-	-	1.8	-	-	-	-	-	-	N/A	
01_Acc Change	-	-	-	1.8	-	-	-	-	-	-	N/A	
01_Acc WC	-	-	-	1.8	-	-	-	-	-	-	N/A	

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
01_Admin	-	-	1.1	0.5	-	-	-	-	-	-	-	N/A
01_Lobby	-	-	-	-	1.8	-	-	-	-	-	-	N/A
01_Staff Rest Room	-	-	1.1	0.5	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
00_Acc Change	-	-	114	-	18
00_Acc Shower	-	-	143	-	12
00_Cafe	-	-	111	-	150
00_Change 1 - Dry	-	76	-	-	190
00_Change 2 - Dry	-	76	-	-	192
00_Changing Place	-	-	89	-	35
00_Chem Store 1	-	-	60	-	227
00_Chem Store 2	-	-	60	-	142
00_Circulation 2	-	-	72	-	205
00_Ci Store	-	-	60	-	144
00_Duty Office	-	141	-	-	78
00_Entrance Lobby	-	-	90	-	37
00_Escape Circulation	-	-	159	-	34
00_First Aid	-	144	-	-	66
00_Foyer	-	-	66	-	161
00_Gas Intake	-	60	-	-	30
00_Informal Viewing	-	82	-	-	349
00_IT	-	260	-	-	32
00_Kitchen	-	-	146	-	148
00_Learner Pool	-	-	63	-	1712
00_Lobby - Plant	-	-	194	-	8
00_Lobby - WC	-	-	141	-	12
00_LV Intake Room	-	60	-	-	102
00_Manager Office	-	171	-	-	44
00_Multi-Purpose Room	-	-	109	-	126
00_Plant	-	60	-	-	673
00_Pool Hall	-	-	71	-	4276
00_Pool Store 1	-	-	60	-	384
00_Pool Store 2	-	-	60	-	622
00_Reception/Servery	-	-	64	60	181
00_Sports Hall	-	-	110	-	2982
00_Sports Hall - Change 1	-	78	-	-	234
00_Sports Hall - Change 2	-	78	-	-	281
00_Sports Hall - Lobby 1	-	-	154	-	11
00_Sports Hall - Lobby 2	-	-	150	-	11
00_Sports Hall - Showers 2	-	-	110	-	18

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name	Standard value	Luminaire	Lamp	Display lamp	
00_Sports Hall - Showers 2	-	-	110	-	17
00_Sports Hall - WC 1	-	-	67	-	89
00_Sports Hall - WC 2	-	-	66	-	93
00_Sports Hall Store 1	-	-	60	-	667
00_Sports Hall Store 2	-	-	60	-	589
00_Stair & Circulation 1	-	-	67	-	275
00_Stair 2	-	-	115	-	30
00_Stair 3	-	-	102	-	39
00_Store - Kitchen	-	-	60	-	141
00_Store - Vending	-	-	60	-	120
00_WC	-	-	79	-	53
00_WC	-	-	69	-	182
00_WC	-	-	105	-	32
00_WC	-	-	61	-	209
00_WC	-	-	105	-	35
00_WC	-	-	91	-	43
00_Wet Change	-	-	62	-	597
00_Wet Change	-	-	106	-	21
01_Acc Change	-	-	96	-	19
01_Acc WC	-	-	71	-	47
01_Admin	97	-	-	-	227
01_Circulation 2	-	-	77	-	169
01_Circulation 3	-	-	89	-	68
01_Circulation 4	-	-	136	-	22
01_F Change	70	-	-	-	510
01_F Showers	-	-	79	-	53
01_F WC	-	-	64	-	140
01_Gym	-	-	89	-	1472
01_Lobby	-	-	118	-	15
01_Lobby - Plant	-	-	194	-	8
01_M Change	69	-	-	-	499
01_M Showers	-	-	74	-	59
01_M WC	-	-	62	-	142
01_Plant	60	-	-	-	902
01_Spin Studio	-	-	108	-	151
01_Staff Rest Room	114	-	-	-	110
01_Stair	-	-	194	-	15
01_Stair & Circulation 1	-	-	74	-	167
01_Stair 2	-	-	172	-	31
01_Stair 3	-	-	157	-	38
01_Store	-	-	60	-	120
01_Studio 1	-	-	105	-	344
01_Studio 2	-	-	104	-	396

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	80	60	22	
01_Studio Store 1		-	60	-	155
01_Studio Store 2		-	60	-	435
LG_Balance Tank - Learner Pool		60	-	-	107
LG_Balance Tank - Main Pool		60	-	-	175
LG_Plant Circulation		-	74	-	27

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?
00_Cafe	NO (-46.6%)	NO
00_Change 1 - Dry	N/A	N/A
00_Change 2 - Dry	N/A	N/A
00_Duty Office	NO (-76.8%)	NO
00_First Aid	N/A	N/A
00_Informal Viewing	NO (-52.5%)	NO
00_IT	N/A	N/A
00_Learner Pool	NO (-79.8%)	NO
00_Manager Office	NO (-72.2%)	NO
00_Multi-Purpose Room	NO (-6.5%)	YES
00_Pool Hall	YES (+62.7%)	NO
00_Reception/Servery	NO (-62.5%)	NO
00_Sports Hall	N/A	N/A
00_Sports Hall - Change 1	N/A	N/A
00_Sports Hall - Change 2	N/A	N/A
01_Admin	NO (-48.6%)	NO
01_F Change	N/A	N/A
01_Gym	NO (-0.1%)	NO
01_M Change	N/A	N/A
01_Spin Studio	N/A	N/A
01_Staff Rest Room	NO (-57.9%)	NO
01_Studio 1	N/A	N/A
01_Studio 2	NO (-25.2%)	YES

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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	3916	3916
External area [m ²]	9789.3	9789.3
Weather	SOU	SOU
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2936.26	3270.74
Average U-value [W/m ² K]	0.3	0.33
Alpha value* [%]	9.23	10

* 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
 B8 Storage or Distribution
 C1 Hotels
 C2 Residential Inst.: Hospitals and Care Homes
 C3 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
100 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	50.69	53.43
Cooling	0.87	0.83
Auxiliary	13.28	6.28
Lighting	17.37	16.73
Hot water	456.25	348.09
Equipment*	65.27	65.27
TOTAL**	443.07	425.36

* Energy used by equipment does not count towards the total for calculating emissions.

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	1.58	0
Wind turbines	0	0
CHP generators	95.39	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	180.42	211.14
Primary energy* [kWh/m ²]	437.9	587.73
Total emissions [kg/m ²]	76.3	100.4

* 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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	921.8	0	157.3	0	64.6	0.93	0	0.95	0
Notional	52.4	0	16.9	0	1.5	0.86	0	-----	-----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	35.2	0	6.3	0	1.5	0.89	0	0.95	0
Notional	1165.5	0	375.5	0	31.5	0.86	0	-----	-----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	40.1	151.9	2.8	10.7	22.4	3.92	3.96	4	5.3
Notional	46.7	150	5.1	11.7	21.3	2.56	3.79	-----	-----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	66.6	0	12.1	0	1.7	0.89	0	0.95	0
Notional	77.5	0	25	0	1.7	0.86	0	-----	-----
[ST] Other local room heater - fanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	290.9	0	101	0	0	0.8	0	1	0
Notional	218	0	70.3	0	0	0.86	0	-----	-----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	252.3	40.3	17.9	2.8	0	3.92	3.96	4	5.3
Notional	253.1	33.9	27.6	2.5	0	2.56	3.79	-----	-----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	16.9	0	3.3	0	11	0.89	0	0.95	0
Notional	27.5	0	8.9	0	4.7	0.86	0	-----	-----
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	13.4	0	2.4	0	9.9	0.93	0	0.95	0
Notional	20.2	0	6.5	0	6.4	0.86	0	-----	-----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	-----	-----

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 _{typ}	U _{min}	Surface where the minimum value occurs*
Wall	0.23	0.2	00000006:Surf[10]
Floor	0.2	0.2	00000013:Surf[0]
Roof	0.15	0.14	00000033:Surf[1]
Windows, roof windows, and rooflights	1.5	1.4	0100001E:Surf[0]
Personnel doors	1.5	2.2	0000000B:Surf[0]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{typ} = Typical individual element U-values [W/(m ² K)]			U _{min} = Minimum individual element U-values [W/(m ² K)]
* 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	5