climate
INTEGRATED SOLUTIONS

LONDON BOROUGH OF RICHMOND UPON THAMES

Climate Change – Local Plan Net Zero Carbon evidence base

Prepared by: CIS
Prepared for: London Borough of Richmond upon Thames

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V1.7

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1. Executive Summary

1.1. Following instruction from the London Borough of Richmond, CIS's first objective was to gather information on the typologies for review for both residential and commercial property types. These were discussed and agreed with much of the detailed assumptions on construction type, glazing, orientation etc left to the modelling team to develop. We have collated a schedule of assumptions for both residential and commercial properties which can be viewed within this report and alongside the modelling outcomes and recommendations.

1.2. The report is broken into 2 sections, one for residential and one for commercial property typologies.

1.3. It is worth noting that with current software to SAP and Building Regulation Standards, there have been some delays in full functionality of the software being available. However, all the results have been delivered via the software to keep standardisation of findings with other users of these packages. Whilst this is a frustrating factor for all organisations, we have looked at alternative processes to best deliver the correct results to the latest standards.

1.4. There is a need to consider what regulations are currently in place for change of use developments as they would be required to be built to current building regulation standards. It is worth noting that only new elements to the building or upgraded sections of existing buildings need to meet with the SAP calculation requirements. These buildings will need to apply actual targets in submissions and applicants will need to keep in mind that there is no TER required for domestic change of use and no carbon offset charges.

1.5. The TER and DER do not apply for domestic change of use and no carbon offset charges are applied.

1.6. We would note at this time that only upgraded or new sections of buildings undergoing change of use will be required to achieve the intended new Local Plan standards (Regulation 18 Version).

Residential Typologies Conclusion

1.7. The proposed energy targets are demanding but do not exceed the best developments being brought forward in London, and they will drive up the standards of lower performing developments. These new targets will require upskilling of contractors and designers to deliver the higher standards but that is to be expected if build quality is to improve. From a technical and commercial standpoint these standards should not preclude projects being either technically or commercially viable see Whole Plan Viability Assessment (WPVA).

Non-Residential Typologies Conclusion

1.8. The revised standards under the draft Local Plan (Regulation 18 Version) for non-residential development are demanding but achievable for new build and will drive up standards of construction and provide improved U-values. It is important to state at this time that the mitigation of potential overheating and the requirement for overheating report for all typologies should proactively mitigate potential issues at the design stage. Different typologies will have lesser or greater difficulty in achieving the revised targets. In particular the CoU Sports based building typologies with a high hot water demand will

need careful consideration at the design stage, but it is believed these can achieve the revised targets.

BREEAM Conclusion

1.9. On reviewing the, draft Local Plan (Regulation 18 Version) BREEAM standards Policy 6 Sustainable Construction Standards, it is considered that the move to 'Outstanding' means that the majority of developments should be able to achieve the standard but there may be a number, such as some smaller developments, which may struggle to exceed BREEAM Excellent. This can be due to either local building factors or a lack of early credits being achieved. This sometimes is simply due to technical standards being unachievable on the site. On smaller developments the additional costs of specialist consultants e.g., an ecologist, may not be commercially viable and yet may be required to achieve the desired number of credits to achieve the new standard. This should be considered at each review stage so that suitable guidance in this situation can be provided for planning officers. Assessing this impact in more detail would be a significant undertaking and a project in itself.

Methodology

1.10. It has been important from the original scoping of the project that there is continuity between the Whole Plan Viability Assessment , and the work being carried out by CIS.

1.11. A reference report within the Whole Plan Viability Assessment regarding cost uplift was from a project in Cornwall. It has been noted by CIS that inflation rates for material particularly around renewables e.g., heat pumps and solar PV have risen between 20-30% in the past few months due to demand and supply chain issues. On top of that the uplift in build costs of 5% applied within the Whole Plan Viability Assessment to increase 'Sustainable Construction standards' and promote zero carbon development seems broadly in line with this report's assumptions.

1.12. Typically, the cost of labour will exceed the cost of material and as such the complexity of the buildings, number of rooms and ceiling heights etc will mean that the cost per meter squared will vary greatly. As an example, market guidance for standard IWI insulation is between £40-£50 per sqm but will be dependent on building age, type complexity etc.

1.13. The second element of our methodology was to assess what was technically feasible for applicants to consider, but to ensure we had considered whether they were realistically commercially viable. In terms of financially appropriate measures to achieve the draft revised local plan a fabric first approach should be adopted to ensure the efficiency of buildings are of the highest achievable standard taking account of commercial and technical viability.

1.14. In terms of renewables with the accelerating move towards electric heating solutions i.e., heat pumps, along with the proven efficiency and relative inexpensiveness of solar PV we would recommend maximising the amount of solar PV on developments subject to design and shading factors etc. The return-on-investment calculations for this technology mean that solar PV should be considered financially appropriate in the vast majority of applications.

1.15. One consideration with Solar PV specification is the relative fixed cost of an element of the works including scaffolding, lifting of materials etc. These are proportionately more expensive on smaller schemes however typically solar should be in the region of £1,500-£2,000 per kWp for roof mounted solar, of which approximately 40% might be labour.

1.16. Please note this is guidance only, in current market conditions costs of materials have made all renewables costs quite volatile at this time.

2. Scope

2.1. The appointed consultant will produce a single evidence-based document that will demonstrate whether the policy targets and requirements Richmond Council has set out in the pre-publication Local Plan (Regulation 18 Version) are achievable and deliverable for applicants, and whether there could potentially be policy areas with even more stringent and ambitious requirements. In addition, the appointed consultant will suggest any amendments to existing Regulation 18 policies if needed.

3. Local Plan Observations

3.1. Following our meeting with project stakeholders CIS was requested to review the draft Local Plan (Regulation 18 Version) for any amendments that may be needed following the issue of our draft report. We would draw attention to the following points:

3.2. Page 144/341 mentions Part L in terminology, as such it was considered appropriate to then reference other regulations as well, please see a bit more detail of what they are below.

- Part L of the Building Regulations sets the limiting values for all building fabrics, the conservation of fuel and energy.
- Part F applies to the ventilation requirements and standard required within buildings.
- Part O requires the calculation and minimisation of overheating within commercial and residential buildings. TM52 and TM59 overheating analysis for domestic and non-domestic properties requires detailed dynamic simulation thermal modelling (DSM).

3.3. With the reference to Part L, CIS recommend including Part O – overheating TM52 (residential) TM59(non-domestic) – this is becoming increasingly important and common place, particularly on London developments. As such you may wish to consider these being requested in the new Local Plan (Regulation 18 Version) for future planning applications to mitigate overheating. The issue of overheating, in both new build and change of use developments, is going to become an increasingly important factor for residential properties and in terms of potential energy costs from mitigation of overheating. Whilst TM52 & TM59 maybe considered onerous, they will ensure the buildings are futureproofed against potential overheating. Requiring overheating assessments to be carried out by applicants may be considered a suitable solution for the draft Local Plan (Regulation 18 Version) to ensure applicants consider this issue at the design stage. It may be considered appropriate to require an Overheating Assessment for ALL developments whilst more detailed thermal modelling assessments are required on the larger developments.

3.4. Part F – ventilation in building. There is significant emphasis now being placed on this aspect of buildings as well as it being a Health and Safety Executive requirement. Consider referencing in the draft policy and potentially looking for inclusion in planning applications and reference in Energy Statements. Part F should be considered the most cost-effective way to ensure a healthy building environment for both residential and non-residential properties. Policy should be carefully considered at the design stage for new build and major change of use renovations.

3.5. Energy metering, sub metering and M&T Section 16.18 (page 150/341) are mentioned and intended for inclusion. Considering the energy hierarchy requirements for "Be Seen" reporting we consider it appropriate to require applicants to provide evidence of building performance to inform future industry-wide benchmarks or performance ratings for major building typologies based on in-use performance.

3.6. Creation of building logbooks in accordance with CIBSE TM31 – this would be helpful to applicants and for the Council's own portfolio (and all others working on the building). TM31 is a standard format to demonstrate compliance with Part L and will support the

3.7. delivery of Local Plan (Regulation 18 Version) Policy 4 Minimising Greenhouse gas emissions and promoting energy efficiency (Strategic Policy)

3.8. BREEAM - It would be extremely unlikely that in some circumstances smaller units would be able to achieve BREEAM 'Outstanding' or 'Excellent' and in very limited cases may only be able to achieve BREEAM 'Very Good'. The applicant will need to show detailed information for consideration of any reduction of the BREEAM requirement below 'Outstanding'. This requirement may be more suitable for larger buildings of 500sqm+. In terms of shell and core or core only, it can't be achieved under BREEAM – not enough information would be available to have the necessary credits built up (it would also be relevant to consider what happens to the developer who may 'inherit' a shell only development). There may be benefit in developing a system to monitor what happens to the building once it's let, this could be picked up as part of the "Be Seen" element of the London Plan Energy Hierarchy. Within this consideration it is also important to note that the requirement for the final BREEAM rating need also to be applied to the shell and core or core only developer and not just the final developer because by the time the final fit out has taken place many of the necessary credits to achieve the required BREEAM rating are no longer available.

3.9. Otherwise, we noted an extensive array of legislative requirements are covered in the current draft Regulation 18 Plan.

4. Domestic Typologies

4.1. In order to fully understand the different typologies for the domestic properties, we have outlined below the assumptions made in developing those responses.

4.2. Following consultation with the team at The London Borough of Richmond upon Thames and other members of the Richmond Council team the following domestic typologies were agreed:

Agreed Typologies
1-4 Residential Best Practice New Build
1-4 Residential Best Practice Conservation Area
1-4 Residential Best Practice Change of Use
1-4 Residential Best Practice Change of Use in Conservation Areas
Upper Floor High Street Conservation Area Change of Use

5. Assumptions Domestic

General Assumptions for 1-4 Residential

- First floor flat with 2 flats above.
- Corner flat with 2 sides (one long and one short) exposed, one party side (long) and one (short) to unheated but enclosed corridor.
- Average shading
- 43m2 floor space (average flat size according to office of national statistics). 14m2 living room.
- 5m x 8.6m rectangle
- 33m2 of internal partitions (plasterboard on timber)
- 2.4 ceiling height
- 3 times 1.5m2 windows two south one west. 70% of window opening area is glazing.
- Corridor acting as draft lobby.

1-4 Residential Best Practice New Build

5.1. The specification for this typology is intended to be achievable but still challenging. Our strategy has been based on a fabric first approach. See below the specifications for this typology:

- Wall u-value 0.14 (passipedia recommends 0.1 to 0.15) Whilst we understand these properties will not be seeking Passivhaus standards these are typical standard that can be achieved for this type of property.
- Window U-0.8 (whole window value) (best rating achievable on the Green Building Store is 0.68)
- Door U-0.7 (best rating achievable on the Green Building Store is 0.67)
- 100% draft proofing (assumes all windows and doors have current good standard seals throughout the property)
- +Assumes whole property incorporates mechanical ventilation heat recovery (MVHR) (the SAP model requires the input of an actual model in SAP's database, so we have selected one with a moderate specification: (Zehnder's GomfoAir350 a 2009 model with flow rate 21 SFP 0.71 and efficiency 88)
- Generic air source heat pump from SAPs internal database
- Time and temperature zone controls
- Water use <= 125 litres/person /day
- Water source from mains
- Bath and Shower with pump connected to main system, flow rate 8l/min (assumes to be mains fed shower)
- Linear thermal bridging y-0.051 (Based on a typical property construction and design using the "off the shelf" approved details. As an aside, in the short term these may not be achievable by small developers as the approved details are being withdrawn and the skills to calculate custom details will be in very high demand until industry bodies sort out pre-calculated details)
- No significant point thermal bridging
- 4 PV panels (43m2 ceiling area divided by 4 for the 4 other stories = 10.75. each 400w panel and fitting is about 2m so theoretically 5 could fit but reducing to 4 to allow for other roof uses.)
- Each PV panel assumed to have 400w output (equals 1.6kwp) (e.g., www.sunshinesolar.co.uk)
- PV 30^0 horizontal southwest facing (assuming most but not all 4 storey blocks have flat roof allowing southerly orientation)
- PV part of multiple Dwelling set up with diverter, export capable meter and connected to dwelling meter
- 10 hours off peak electric tariff with smart meter.
- Air tightness 3.0 (current good industry best practice)

SAP Rating	95 A	**CO2 Emmission**	0.02 t/yr	**DER**	0.62 kgCO2/yr/m2	**TER**	12.58 kgCO2/yr/m2
%DER<TER	95.07%	**Compliance**	See BREL	**DPER**	17.46 kWh/m2/yr	**TPER**	66.82 kWh/m2/yr
DPER<TPER	73.87%	**DFEE**	12.15 kWh/m2/yr	**TFEE**	19.99 kWh/m2/yr	**DFEE<TFEE**	39.2%

Above achieves (the key metric Richmond mostly referred to as "% DER<TER.

5.2. The above measures CIS consider are technically feasible for new build properties of this type. To achieve these standards the specification is of a higher end glazing solution (triple glazed). The wall U-values would require a good quality of installation and materials but should be the expectation as these are perhaps the best value way of improving U-values and improving energy cost with a fabric first approach.

1-4 Residential Best Practice Conservation Area

5.3. The specification for this typology is intended to be achievable but still challenging. Our strategy has been based on a fabric first approach, while also reflecting the limitations imposed by a conservation area.

5.4. As "1-4 residential best practice new build" above except:

- 3 instead of 4 PV panels (assuming extra restriction on visible locations)
- glazing U-0.94 (oak finish PVCuf sash window on green building store)
- Wall U-value 0.15 (assuming restrictions to exterior surface finishes only cause minor impact)

SAP Rating	93 A	**CO2 Emmission**	0.06 t/yr	**DER**	1.48 kgCO2/yr/m2	**TER**	12.58 kgCO2/yr/m2
%DER<TER	88.24%	**Compliance**	See BREL	**DPER**	22.61 kWh/m2/yr	**TPER**	66.82 kWh/m2/yr
DPER<TPER	66.16%	**DFEE**	13.43 kWh/m2/yr	**TFEE**	19.99 kWh/m2/yr	**DFEE<TFEE**	32.78%

1-4 Residential Best Practice Change of Use

5.5. The specification for this typology is intended to be achievable but still challenging. Our strategy has been based on a fabric first approach, while this also reflects the limitations imposed by a conservation area. The specification puts forward takes account of the potential difficulties in alterations to existing buildings and a likely reduction in performance because of the existing building fabric.

5.6. As "1-4 residential best practice" above except:

- Glazing U-0.85 (worst allowed by EnerPHit (~Passivhaus for refits) standard))
- Wall U-0.35 (highest value allowed by EnerPHit standard for internal insulation in a cool-temperate climate) note these are a set of highly ambitious standards
- Thermal bridging 0.15 standard practice assumes thermal bridging of 0.15 Y value, this is against a background of 0.11 being achieved in highly efficient buildings
- It is assumed there is no point bridging (e.g., Canopy mountings and badly planed electric cables)
- Standard Tariff (please note currently within SAP off-peak supply makes the result slightly worse in this case)
- Air tightness 0.4m3/ (h.m2) (midpoint between default and new build good practice)
- 3 rather than 4 PV panels (assuming some pre-existing obstacles/shadows on roof)

5.7. This typology and specification were tested in Design SAP 10 software to produce the results below, further details of the SAP methodology are included in appendix 2.

5.8. Note that most of the figures below relate to Part L requirements which do not apply to change of us and refits and are provided for completeness only to allow comparison to the newbuild models.

SAP Rating	92 A	**CO2 Emmission**	0.07 t/yr	**DER**	2.13 kgCO2/yr/m2	**TER**	12.58 kgCO2/yr/m2
%DER<TER	83.07%	**Compliance**	See BREL	**DPER**	29.06 kWh/m2/yr	**TPER**	66.82 kWh/m2/yr
DPER<TPER	56.51%	**DFEE**	25.69 kWh/m2/yr	**TFEE**	19.99 kWh/m2/yr	**DFEE<TFEE**	-28.54%

5.9. The above measure CIS considers are technically feasible for properties of this type and age. To achieve these standards the specification is of a higher end glazing solution (triple glazed). The wall U-values would require a good quality of installation and materials but should be the expectation as these are perhaps the best value way of improving U-values and improving energy cost with a fabric first approach. It is recognised that within a conservation area the choice of windows would be more limited, and it is assumed EWI measures would be required to improve the U values.

1-4 Residential Best Practice Change of Use in Conservation Areas

5.10. The specification for this typology is intended to be achievable but still challenging. Our strategy has been based on a fabric first approach. The outline below reflects the layout and orientation of this typology, also notes the limitations of change of use developments and the fact the typology is within a conservation area.

5.11. As "1-4 residential best practice change of use" above except:

- Glazing U-0.94 (oak, sash window style from green building store)
- Wall U-0.4 (assuming minor impact of limits on external finishes)
- 2 PV panels (assuming limits due to both visibility and existing roof features)
- This typology was tested throughout methodology and produced the results shown below. Note however that most of the requirements do not apply to change of use projects and are included for information only.

5.12. This typology and specification were tested in a Design SAP 10 software to produce the results below, further details of the SAP methodology are included in appendix 2.

5.13. Note that most of the figures below relate to Part L requirements which do not apply to refits and are provided for completeness only to allow comparison to the newbuild models. Where point bridging is mentioned: (e.g., Canopy mountings and badly planed electric cables)

SAP Rating	89 B	**CO2 Emmission**	0.12 t/yr	**DER**	3.11 kgCO2/yr/m2	**TER**	12.58 kgCO2/yr/m2
%DER<TER	75.28%	**Compliance**	See BREL	**DPER**	36.46 kWh/m2/yr	**TPER**	66.82 kWh/m2/yr
DPER<TPER	45.44%	**DFEE**	28.21 kWh/m2/yr	**TFEE**	19.99 kWh/m2/yr	**DFEE<TFEE**	-41.15%

5.14. The above measures CIS consider are technically feasible for new build properties of this type. To achieve these standards the specification is of a higher end glazing solution (triple glazed). The wall U-values would require a good quality of installation and materials but should be the expectation as these are perhaps the best value way of improving U-values and improving energy cost with a fabric first approach. It is recognised that within a conservation area the choice of windows would be more limited, and it is assumed EWI measures would be required to improve the U values.

Upper Floor High Street Conservation Area Change of Use

5.15. The specification for this typology is intended to be achievable but still challenging. Our strategy has been based on a fabric first approach. The outline below reflects the layout and orientation of this typology, also notes the limitations of change of use developments and the fact the typology is within a conservation area.

5.16. As 1-4 residential best practice change of use in conservation areas:

Above except:

- 2 long external walls 2 short party walls, small wall with door to stairwell which is not part of the dwelling.
- 4 instead of 3 windows. 2 south 2 north facing
- 43m2 of exposed roof u-0.12 (enerPHit requirement level for external insulation)
- 5m2 of semi exposed floor to unheated corridor or such. (Floor to shop counts as no heat loss) u- 0.35 (enerPHit requirement for internal insulation)
- PV orientated West (assuming pitched roof, some of which will point East/West (East and West orientation give similar results within modelling software)
- This results in the below. Note however that most of the requirements do not apply to change of use projects and are included for info only.

5.17. This typology and specification were tested in Design SAP 10 software to produce the results below, further details of the SAP methodology are included in appendix 2.

5.18. Note that most of the figures below relate to Part L requirements which do not apply to refits and are provided for completeness only to allow comparison to the newbuild models. Where point bridging is mentioned: (e.g., Canopy mountings and badly planed electric cables)

SAP Rating	86 B	**CO2 Emmission**	0.15 t/yr	**DER**	4.1 kgCO2/yr/m2	**TER**	14.22 kgCO2/yr/m2
%DER<TER	71.17%	**Compliance**	See BREL	**DPER**	47.91 kWh/m2/yr	**TPER**	75.52 kWh/m2/yr
DPER<TPER	36.56%	**DFEE**	45.71 kWh/m2/yr	**TFEE**	28.35 kWh/m2/yr	**DFEE<TFEE**	-61.21%

5.19. The above measures CIS consider are technically feasible for new build properties of this type. To achieve these standards the specification is of a higher end glazing solution (triple glazed). The wall U-values would require a good quality of installation and materials but should be the expectation as these are perhaps the best value way of improving U-values and improving energy cost with a fabric first approach. It is recognised that within a conservation area the choice of windows would be more limited, and it is assumed EWI measures would be required to improve the U values.

Table of Results

5.20. Please note the table below outlines each of the residential typologies showing the financial contribution required at the current £95 per tonne rate and at the suggested £300 per tonne rate. Key to note are the significant carbon reduction improvements with the new Local Plan (Regulation 18 Version) minimum standard compared with the London Plan requirements.

	Carbon reduction % over part L	New Local Plan minimum Carbon reduction % over part L	CO2 t/y	offset at £95/tonne	offset at £300/tonne
1-4 Residential Best Practice New Build	95.07%	60%	0.02	£57	£180
1-4 Residential Best Practice Conservation Area	88.24%	60%	0.06	£171	£540
1-4 Residential Best Practice Change of Use	83.07%	35%	0.07	£200	£630
1-4 Residential Best Practice Change of Use in Conservation Areas	75.28%	35%	0.12	£342	£1080
Upper Floor High Street Conservation Area Change of Use	71.17%	35%	0.15	£427.5	£1350

6. Commercial Typologies

6.1. In order to fully understand the different typologies for the commercial properties, we have outlined below the assumptions which have been made for each typology.

6.2. We have noted below the typologies agreed and criteria we have considered when modelling these building types. An approved SBEM software was used to generate BRUKL Part L performance documents, details of this methodology is provided in appendix 2.

6.3. The software used; Design Builder is used around the world and is the leading thermal modelling software. Design Builder is a GUI interface to the National Calculation Methodology (NCM) tool approved by the UK Government to undertake such calculations with detailed accuracy. The calculation tool is used by all undertaking such calculations to provide a uniformed or standardised approach to the output results.

Agreed Typologies

Type	Commercial	Build
1	500m2 Nursery	New Build
2	500m2 Commercial	New Build
3	Sports	New Build
4	500m2 Nursery	Change of Use
5	500m2 Commercial	Change of Use
6	Sports	Change of Use

Building Design Criteria – 2021 Design Perimeters

Table 4.1 Limiting U-values for new or replacement elements in new and existing buildings and air permeability in new buildings

Element type	Maximum U-value[1] W/(m²·K) or air permeability
Roof (flat roof)[2]	0.18
Roof (pitched roof)[2]	0.16
Wall[2][3]	0.26
Floor[4][5]	0.18
Swimming pool basin[6]	0.25
Windows in buildings similar to dwellings[7][8]	1.6 or Window Energy Rating[9] Band B
All other windows,[8][10][11] roof windows, curtain walling	1.6
Rooflights[12][13]	2.2
Pedestrian doors (including glazed doors)[14]	1.6
Vehicle access and similar large doors	1.3
High-usage entrance doors	3.0
Roof ventilators (including smoke vents)	3.0
Air permeability (for new buildings)	8.0m³/(h·m²) @ 50Pa

Table 6.1 Minimum heat generator seasonal efficiency for boiler systems in new buildings[1]

Fuel type	System	Boiler seasonal efficiency (gross calorific value)
Natural gas	Single-boiler ≤2MW output	93%
	Single-boiler >2MW output	88%
	Multiple-boiler	88% for any individual boiler 93% for overall multi-boiler system

NOTE:

1. Seasonal efficiencies should be calculated in line with paragraphs 6.3 to 6.6.

Table 6.2 Minimum heat generator seasonal efficiency for boiler systems in existing buildings[1][2]

Fuel type	System	Boiler seasonal efficiency (gross calorific value)
Natural gas	Single-boiler ≤400kW output	91%
	Single-boiler 401kW–2MW output	88%
	Single-boiler >2MW output	84%
	Multiple-boiler	84% for any individual boiler 91% for overall multi-boiler system
LPG	Single-boiler ≤2MW output	93%
	Single-boiler >2MW output	88%
	Multiple-boiler	88% for any individual boiler 93% for overall multi-boiler system
Oil	Single-boiler	93%
	Multiple-boiler	88% for any individual boiler 93% for overall multi-boiler system

NOTES:

1. Seasonal efficiencies should be calculated in line with paragraphs 6.3 to 6.6.
2. Non-condensing boilers should be fitted with a flue condensing kit where feasible and where the boiler is likely to be able to operate in condensing mode (e.g. variable temperature circuits).

Table 6.5 Minimum thermal efficiencies for domestic hot water (DHW) systems

DHW system type	Fuel type	Heat generator seasonal efficiency (gross calorific value)	Product standard
Direct-fired: new and existing buildings	Natural gas	91%[1]	**BS EN 15502-2** or **BS EN 89** or **BS EN 26** as appropriate
	LPG	92%[1]	
Indirect-fired: new and existing buildings	Natural gas	91% (boiler efficiency)	Use equations (as appropriate) in paragraphs 6.3 to 6.6. If primary return temperature ≤55°C, use equation 6.1 ($0.81\eta_{30\%} + 0.19\eta_{100\%}$) to calculate boiler seasonal efficiency. If primary return temperature >55°C, use boiler full load efficiency ($1.0\eta_{100\%}$) at 80/60°C flow/return temperatures. If boiler seasonal efficiency values are obtained as net values, the factors in SAP 10 Table E4 should be used to convert them to gross values.
	LPG	91% (boiler efficiency)	
	Oil	91% (boiler efficiency)	
Electrically-heated: new and existing buildings		100% assumed	

NOTE:

1. In exceptional circumstances, where a condensing boiler cannot feasibly be fitted in an existing building (for example, where there is insufficient space for a replacement flue system), a boiler with the following minimum seasonal efficiency may be used:
   a. 80% for natural gas
   b. 79% for LPG.

Building design criteria - Design Perimeters for Change of Use

Table 4.1 Limiting U-values for new or replacement elements in new and existing buildings and air permeability in new buildings

Element type	Maximum U-value[1] W/(m²·K) or air permeability
Roof (flat roof)[2]	0.18
Roof (pitched roof)[2]	0.16
Wall[2][3]	0.26
Floor[4][5]	0.18
Swimming pool basin[6]	0.25
Windows in buildings similar to dwellings[7][8]	1.6 or Window Energy Rating[9] Band B
All other windows,[8][10][11] roof windows, curtain walling	1.6
Rooflights[12][13]	2.2
Pedestrian doors (including glazed doors)[14]	1.6
Vehicle access and similar large doors	1.3
High-usage entrance doors	3.0
Roof ventilators (including smoke vents)	3.0
Air permeability (for new buildings)	8.0m³/(h·m²) @ 50Pa

500m2 Nursery New Build

6.4. This typology has been prepared to meet the following specifications:

- Built to current 2021 building regulations UK using a standard brick and block construction with insulated floors and ceilings. Windows, doors, and all associated build fabric meet the minimum thermal properties required by Part L without exceeding them beyond budgetary concerns.
- Building services are split type air conditioning systems, (celling cassettes and wall mounted indoor units) installed throughout with Lossnay type cross flow heat exchangers providing heat recovery ventilation.
- Hot water provision is localised to staff areas / WC's and provided by modern under-sink, 15L electric storage units.
- Lighting is modern LED with occupancy sensors and photoelectric options for daylight sensing where required.
- A 15kWp PV array has been installed.

6.5. The results detailed in the report show the building passes the required building regulations with energy consumption predicted to 45.24kWh/m2/yr with overall yearly emissions calculated to be in the region of just 3.53kgCO2/m2/yr. These specifications are considered reasonable and the results achievable for non-residential developments of this and similar types of development in Richmond in line with draft Local Plan (Regulation 18 Version) Policies.

Construction Data Used

Fabrics	Specification
External Walls (W/m2K)	0.26
External Wall Type	Brick & Block Cavity
Internal Walls (W/m2k)	0.48
Internal Wall Type	Solid 100mm Block
Pitched Roof (W/m2k)	0.16
P&T Roof Construction	Tiled
Flat Roof (W/m2K)	0.18
Flat Roof Construction	Timber & Felt
Windows (w/m2k)	1.6
Light Transmission	0.8
Total Solar Transmission	0.72
Frame Type	UPVC
Shading	Internal Blinds
Personnel Doors (W/m2k)	1.6
Air Permeability (m3/hr/m2)	8
Internal Floor Area (m2)	501.61
Total Number of Floors	2

Installed Building Services

HVAC	
System Type	Daikin ASHP
Heating (CoP)	3.6
Cooling (ESEER)	3.6

Hot Water Provision	
System Type	Local Storage
Fuel Type	Electric
Storage Volume (l)	Ariston 15-30L

Cooling (EER)	3.98
Heat Recovery	Yes (75% Efficient)
Ventilation	None
Local Extract Exhaust	WCs / Kitchen Areas

Secondary Circulation	None

Lighting	
Lamp Type	LED
Occupancy Sensing	Yes
Daylight Sensing	No
Controls	Auto On/Off + Manual
Parasitic Drain	0.1w/m2
Lighting Design	No
Power Density (W/m2)	7.5
Illuminance	NCM Standard for activity

Renewables	
PV	None
Solar	None
Wind	None
GSHP	None

500m2 Nursery Change of Use

6.6. This typology has been prepared to meet the following specifications:

- Base model is a 1970/80's former residential unit with typical fabrics and regulations used for that age and style including uninsulated cavity walls, floors, ceiling and roof. Single glazed, wood framed windows, tungsten and T8 lighting, 65% efficient boiler with 125L storage tank for heating and hot water.
- The refurbishment is back to a shell and core with insulated cavities, internal lightweight partitions, and roof elements. The ground floor remains the same. Windows have been upgraded to modern 4-
- 16-4 UPVC windows with Low E Argon filled glass as per the external doors.
- Building services have been fully replaced with split type air conditioning systems, (celling cassettes and wall mounted indoor units) as would be expected of a fully occupied conditioned space requiring comfort cooling and heating. Lossnay type cross flow heat exchangers providing heat recovery ventilation.
- Hot water provision is localised to staff areas / WC's and provided by modern under-sink, 15L electric storage units.
- Lighting has been replaced with modern LED systems and all associated building service controls have been upgraded as expected with modern systems.
- A 15kWp PV array has been installed.

6.7. The results are detailed in the report and clearly show the vast improvements achievable with basic improvements as expected of a Part L compliant modern building.

6.8. The requirements of the refurbishment that meets the 2021 building regulations to obtain the required results are a minimum standard expected.

6.9. Energy consumption is reduced from 113.32kWh/m2/yr to just 34.06kWh/m2/yr with overall emissions down from 21.18kgCO2/m2/yr to just 1.9kg's proving a significant reducing in both areas by meeting and easily exceeding the current minimum refurbishment requirements to Part L standards. These specifications are considered reasonable and the results achievable for non-residential developments of this and similar types of development in Richmond in line with draft Local Plan (Regulation 18 Version) Policies.

Construction Data Used

Fabrics	Baseline	Upgrade
External Walls (W/m2K)	1.00	0.26
External Wall Type	Brick & Block Cavity	Brick & Block Cavity
Internal Walls (W/m2k)	1.14	0.48
Internal Wall Type	Uninsulated Timber	Solid 100mm Block
Pitched Roof (W/m2k)	3.85	0.16
P&T Roof Construction	Tiled - Uninsulated	Tiled - Insulated
Flat Roof (W/m2K)	2.80	0.18
Flat Roof Construction	Timber & Felt Uninsulated	Timber & Felt
Ground Floor	0.58	0.18
GF Construction	Solid Uninsulated	Solid - Insulated
Internal Floor	1.40	1.00

Internal Construction	Timber Uninsulated	Solid - Insulated
Windows (w/m2k)	3.63	1.60
Light Transmission	-	0.80
Total Solar Transmission	-	0.72
Frame Type	Wooden	UPVC
Shading	none	Internal Blinds
Shading Transmission Factor	1.00	0.75
Personnel Doors (W/m2k)	4.80	1.60
Air Permeability (m3/hr/m2)	25.00	8.00
Internal Floor Area (m2)	501.61	501.61
Total Number of Floors	2.00	2.00

HVAC	**Baseline**	**Upgrade**
System Type	LTHW Gas	ASHP
Heating (CoP)	0.65	4.00
Cooling (ESEER)	-	6.13
Cooling (EER)	-	3.98
Heat Recovery	-	0.70
Ventilation	None	
Local Extract Exhaust	WCs / Kitchen Areas	
Exhaust SFP (W/l-s)	1.50	0.30

Hot Water Provision	**Baseline**	**Upgrade**
System Type	From LTHW System	From ASHP / AWHP
Fuel Type	Gas	Electric
Storage Volume (l)	125L	100L
Secondary Circulation	None	None

Lighting	**Baseline**	**Upgrade**
Lamp Type	T8	LED
Occupancy Sensing	No	Yes
Daylight Sensing	No	Yes
Controls	Manual	Yes
Parasitic Drain	-	0.1w/m
Lighting Design	No	
Controls		
Central Time	Yes	Yes
Optimum Start/Stop	No	Yes
Local Time Control	No	Yes
Local Temperature Control	No	Yes
Weather Compensation	No	Yes

Renewables		
PV	None	Yes (15.0kWp)
ASHP	None	Yes
Solar DHW	None	No

Wind	None	No
GSHP	None	No

Nursery CoU - Output Results Pre-Full Refurbishment

6.10. These show the estimated performance of the existing building before refurbishment. The BRUKL output automatically compares this against the target for newbuilds, so it is expected to fail in almost every regard. It is included only for the post-renovation calculation to be compared against.

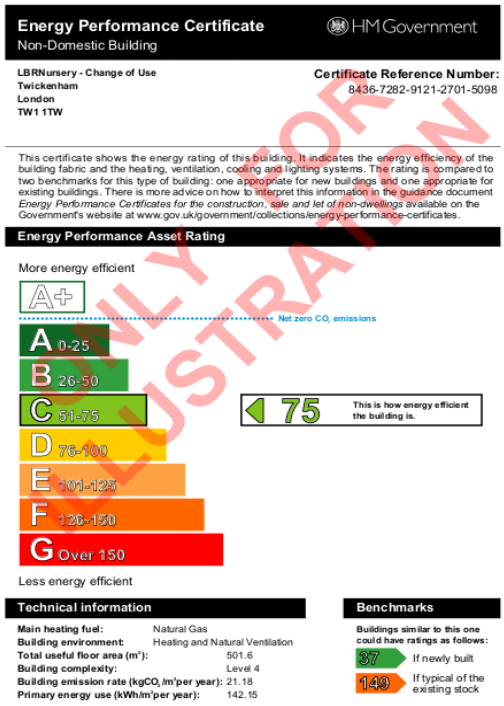
Data	Results	Units
Calculated CO2 Emission Rate from Notional building	10.4	kg.CO2/m2.yr
Building CO2 Emission Rate (BER)	21.18	kg.CO2/m2.yr
Target CO2 Emission Rate (TER)	10.44	kg.CO2/m2.yr
Emissions Compliant?	FAIL	
Building Primary Energy Rate (BPER)	142.15	kWh/m2.yr
Target Primary Energy Rate (TPER)	57.17	kWh/m2.yr
Primary Energy Compliant?	FAIL	

Performance Summary	
Area (m2)	501.61
Weather	LON
Foundation Area	167.2

kWh/m2	Actual	Notional
Heating	49.32	25.06
Cooling	0	0
Auxiliary	7.94	4.53
Lighting	29.32	5.21
Hot Water	26.74	26.40
TOTAL	113.32	61.18

kWh/m2	Actual	Notional
Grid Electricity Consumption	37.27	13.19
Other High Carbon Fuel	76.06	47.99
Low Carbon Fuel Consumption	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	0
Solar Hot Water	0



Official

Data	Results	Units	Band
Target Emission Rate (TER)	10.4	kg.CO2/m2.yr	B
Stock Average	41.9	kg.CO2/m2.yr	F
Reference Building	14.1	kg.CO2/m2.yr	B-C
Building Emission Rate (BER)	21.18	kg.CO2/m2.yr	C
Building Energy Consumption	113.32	kWh/m2.yr	-
Rating	75		C

Performance Summary	
Area (m2)	501.61
Weather	LON

kWh/m2	Actual	Notional	Reference
Heating	49.32	25.06	33.75
Cooling	0	0	8.90
Auxiliary	7.94	4.53	3.76
Lighting	29.32	5.21	21.34
Hot Water	26.74	26.40	31.86
TOTAL	113.32	61.18	99.62

% of CO2	Actual
Heating	75
Cooling	0
Auxiliary	5
Lighting	19
Hot Water	0
CHP	0

kWh/m2	Actual	Notional	Reference
Grid Electricity Consumption	37.27	13.19	34.00
Other High Carbon Fuel	76.06	47.99	65.61
Low Carbon Fuel Consumption	0.00	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	0
Solar Hot Water	0

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

LBRNursery - CoU-Baseline

As designed

Date: Thu Sep 15 10:04:16 2022

Administrative information

Building Details

Address: LBRNursery - Change of Use, Twickenham, London, TW1 1TW

Certifier details

Name: Steve Williams

Telephone number: 01202 067043

Address: 30 Wentworth Close Bournemouth, Dorset, BH5 2DZ

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.c.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.1.2

BRUKL compliance module version: v6.1.c.0

Foundation area [m^2]: 167.2

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	10.44	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	21.18	
Target primary energy rate (TPER), $kWh/m^2.annum$	57.17	
Building primary energy rate (BPER), $kWh/m^2.annum$	142.15	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Building Global Parameters

	Actual	Notional
Floor area [m^2]	501.6	501.6
External area [m^2]	731.5	731.5
Weather	LON	LON
Infiltration [$m^3/hr/m^2$@ 50Pa]	25	3
Average conductance [W/K]	538.23	221.79
Average U-value [W/m^2K]	0.74	0.3
Alpha value* [%]	9.86	25.63

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	49.32	25.06
Cooling	0	0
Auxiliary	7.94	4.53
Lighting	29.32	5.21
Hot water	26.74	26.4
Equipment*	24.5	24.5
TOTAL**	**113.32**	**61.18**

* Energy used by equipment does not count towards the total for consumption or 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	11.12
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*11.12*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	206.31	137.45
Primary energy [kWh/m^2]	142.15	57.17
Total emissions [kg/m^2]	21.18	10.44

Nursery CoU - Output Results Post Full Refurbishment

6.11. The inputs discussed above were entered into the SBEM software with the results below. Note, due to how the BRUKL output documents work the notional values generated (and the TER + TPER results which are derived from them) are based on the notional newbuild building which changes of use would not be expected to meet. Instead, these "actual" results (and BER + BPER which are derived from them) should be compared against the pre-refurbishment BRUKL output provided above. Of most relevance to draft Local Plan (Regulation 18 Version) Policy 4 the Building Emission Rate of 1.9 is 91.03% lower than the pre-refurbishment Building Emission Rate of 21.18.

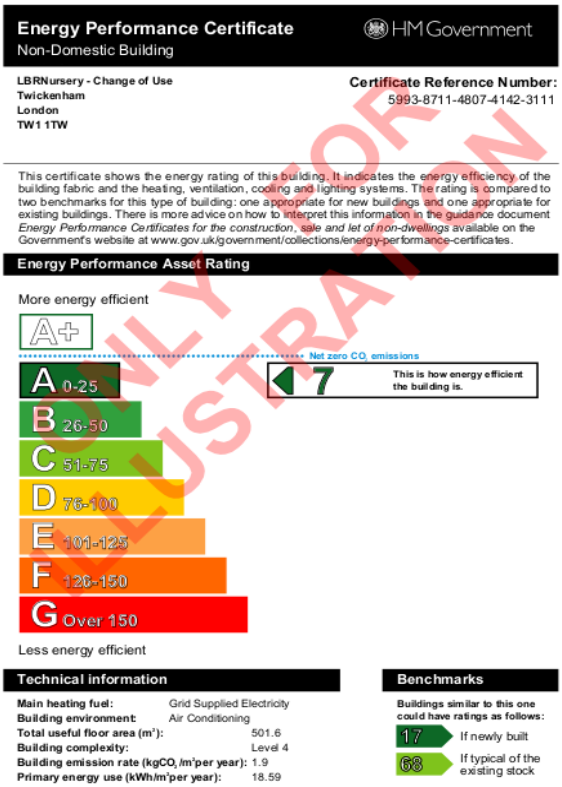
Data	Results	Units
Calculated CO2 Emission Rate from Notional building	4.8	kg.CO2/m2.yr
Building CO2 Emission Rate (BER)	1.90	kg.CO2/m2.yr
Target CO2 Emission Rate (TER)	4.79	kg.CO2/m2.yr
Emissions Compliant?	PASS	
Building Primary Energy Rate (BPER)	18.59	kWh/m2.yr
Target Primary Energy Rate (TPER)	51.97	kWh/m2.yr
Primary Energy Compliant?	PASS	

Performance Summary	
Area (m2)	501.61
Weather	LON
Foundation Area	167.2

kWh/m2	Actual	Notional
Heating	1.33	1.82
Cooling	5.99	4.04
Auxiliary	9.04	15.40
Lighting	13.61	5.21
Hot Water	4.09	8.67
TOTAL	34.06	35.13

kWh/m2	Actual	Notional
Grid Electricity Consumption	34.06	35.13
Other High Carbon Fuel	0.00	0.00
Low Carbon Fuel Consumption	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	22.57
Solar Hot Water	0



Official

Data	Results	Units	Band
Target Emission Rate (TER)	4.8	kg.CO2/m2.yr	A
Stock Average	19.2	kg.CO2/m2.yr	C
Reference Building	14.1	kg.CO2/m2.yr	B-C
Building Emission Rate (BER)	1.90	kg.CO2/m2.yr	A
Building Energy Consumption	34.06	kWh/m2.yr	-
Rating	7		**A**

Performance Summary	
Area (m2)	501.61
Weather	LON

kWh/m2	Actual	Notional	Reference
Heating	1.33	1.82	33.75
Cooling	5.99	4.04	8.90
Auxiliary	9.04	15.40	3.76
Lighting	13.61	5.21	21.34
Hot Water	4.09	8.67	31.86
TOTAL	34.06	35.13	99.62

% of CO2	Actual
Heating	17
Cooling	16
Auxiliary	27
Lighting	40
Hot Water	0
CHP	0

kWh/m2	Actual	Notional	Reference
Grid Electricity Consumption	34.06	35.13	34.00
Other High Carbon Fuel	0.00	0.00	65.61
Low Carbon Fuel Consumption	0.00	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	22.57
Solar Hot Water	0

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

LBRNursery-CoU-Refurbished

As designed

Date: Thu Sep 15 09:47:23 2022

Administrative information

Building Details

Address: LBRNursery - Change of Use, Twickenham, London, TW1 1TW

Certifier details

Name: Steve Williams

Telephone number: 01202 067043

Address: 30 Wentworth Close Bournemouth, Dorset, BH5 2DZ

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.c.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.1.2

BRUKL compliance module version: v6.1.c.0

Foundation area [m²]: 167.2

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.79	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	1.9	
Target primary energy rate (TPER), $kWh/m^2.annum$	51.97	
Building primary energy rate (BPER), $kWh/m^2.annum$	18.59	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

Building Global Parameters

	Actual	Notional
Floor area [m^2]	501.6	501.6
External area [m^2]	731.5	731.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	8	3
Average conductance [W/K]	200.88	221.79
Average U-value [W/m^2K]	0.27	0.3
Alpha value* [%]	26.41	25.63

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	1.33	1.82
Cooling	5.99	4.04
Auxiliary	9.04	15.4
Lighting	13.61	5.21
Hot water	4.09	8.67
Equipment*	24.5	24.5
TOTAL**	**34.06**	**35.13**

* Energy used by equipment does not count towards the total for consumption or 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	22.57	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*22.57*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	108.95	81.29
Primary energy [kWh/m^2]	18.59	51.97
Total emissions [kg/m^2]	1.9	4.79

Sports New Build

6.12. This typology has been prepared to meet the following specifications:

- Built to current 2021 building regulation UK using a standard brick and block construction with insulated floors and roof. Windows, doors, and all associated build fabric meet the minimum thermal properties required by Part L without exceeding them beyond budgetary concerns.
- Modern, high efficiency building services have been installed to meet the hot water demands of such a utility block. All on demand services with no storage vessel to ensure zero standing losses from hot water.
- Lossnay type cross flow heat exchangers providing heat recovery ventilation, extraction and fresh air as expected.
- Lighting is modern LED with occupancy sensors and photoelectric options for daylight sensing where required.
- A 15kWp PV array has been installed.

6.13. The results detailed in the report show the building passes the required building regulations with energy consumption predicted to be 526.96kWh/m2/yr with overall yearly emissions calculated to be in the region of just 70.3kgCO2/m2/yr. These specifications are considered reasonable and the results achievable for non-residential developments of this and similar types of development in Richmond in line with draft Local Plan (Regulation 18 Version) Policies.

Construction Data Used

Fabrics	Specification
External Walls (W/m2K)	0.26
External Wall Type	Brick & Block Cavity
Internal Walls (W/m2k)	0.48
Internal Wall Type	Solid 100mm Block
Pitched Roof (W/m2k)	0.16
P&T Roof Construction	Tiled
Flat Roof (W/m2K)	0.18
Flat Roof Construction	Timber & Felt
Windows (w/m2k)	1.6
Light Transmission	0.8
Total Solar Transmission	0.72
Frame Type	UPVC
Shading	Internal Blinds
Personnel Doors (W/m2k)	1.6
Air Permeability (m3/hr/m2)	8
Internal Floor Area (m2)	501.61
Total Number of Floors	2

Installed Building Services

HVAC	
System Type	Daikin ASHP
Heating (CoP)	4
Cooling (ESEER)	6.15

Hot Water Provision	
System Type	By Air to Water HP
Fuel Type	Electric
Storage Volume (l)	500L

Cooling (EER)	3.98
Heat Recovery	Yes (75% Efficient)
Ventilation	Yes
Local Extract Exhaust	Yes
Emitters	Floor
Pump	-

Secondary Circulation	None

Lighting	
Lamp Type	LED
Occupancy Sensing	Yes
Daylight Sensing	No
Controls	Auto On/Off + Manual
Parasitic Drain	0.1w/m2
Lighting Design	No
Power Density (W/m2)	3.5
Illuminance	NCM Standard for activity

Renewables	
PV	15
Solar	None
Wind	None
GSHP	None

Sports Change of Use

6.14. This typology has been prepared to meet the following specifications:

- Base model is a 1960/1970 standalone, single story utility block typically found at public sports grounds. Built with sold walls, uninsulated concrete floor, timber framed ceiling and roof with an uninsulated, timber roof with tile cladding. Glazing is 4mm single glazed metal framed units. Long and narrow with frosted glass sited high within the walls for privacy purposes.
- Lighting is T8 throughout with hot water provision by an older style 65% efficient boilers, a 500L buffer store.
- The typology assumes that as part of the refurbishment this building has been taken back to a shell and core and the external walls insulated. It is likely the internal heavy, solid partitions walls would remain the same but any new partitioning via internal restructuring would be Part L compliant.
- Glazing is upgraded to 4-12-4 metal framed with the roof insulation improved to meet minimum Part L standards.
- Building services have been replaced with modern, high efficiency on demand water heaters with no storage vessel to ensure zero standing losses from hot water.
- Lossnay type cross flow heat exchangers provide heat recovery ventilation, extraction and fresh air to minimise condensate.
- Lighting has been replaced with modern LED systems and all associated building service controls have been upgraded as expected with modern systems.
- A 15kWp PV array has been installed.

6.15. The results are detailed in the report and clearly show the vast improvements achievable with basic improvements as expected of a Part L compliant modern building.

6.16. The requirements of the refurbishment to obtain the results are a minimum standard expectation of the current building regulations.

6.17. Energy consumption is reduced from 826.36kWh/m2/yr to just 150.25kWh/m2/yr with overall emissions down from 150.99kgCO2/m2/yr to just 13.98kg's, a vast reduction shown in meeting or easily exceeding the current minimum refurbishment requirements. These specifications are considered reasonable and the results achievable for non-residential developments of this and similar types of development in Richmond in line with draft Local Plan (Regulation 18 Version) Policies.

Construction Data Used

Fabrics	Baseline	Upgrade
External Walls (W/m2K)	1.00	0.26
External Wall Type	Brick & Block Cavity	Brick & Block Cavity
Internal Walls (W/m2k)	1.14	0.48
Internal Wall Type	Solid 100mm Block	Solid 100mm Block
Pitched Roof (W/m2k)	3.85	0.16
P&T Roof Construction	Tiled - Uninsulated	Tiled - Insulated
Flat Roof (W/m2K)	2.80	0.18
Flat Roof Construction	Timber & Felt Uninsulated	Timber & Felt
Ground Floor	0.58	0.58
GF Construction	Solid Uninsulated	Solid - Uninsulated
Internal Floor	None	None
Internal Construction	-	-
Windows (w/m2k)	3.63	1.60
Light Transmission	-	0.80
Total Solar Transmission	-	0.72
Frame Type	Wooden	UPVC
Shading	none	None
Shading Transmission Factor	1.00	0.75
Personnel Doors (W/m2k)	4.80	1.60
Air Permeability (m3/hr/m2)	25.00	8.00
Internal Floor Area (m2)	501.61	501.61
Total Number of Floors	1.00	1.00

HVAC	Baseline	Upgrade
System Type	LTHW Gas	ASHP
Heating (CoP)	0.65	4.00
Cooling (ESEER)	-	6.13
Cooling (EER)	-	3.98
Heat Recovery	-	0.70
Ventilation	None	MHRV
Local Extract Exhaust	None	MHRV
Exhaust SFP (W/l-s)	-	0.40

Hot Water Provision	Baseline	Upgrade
System Type	From LTHW System	From ASHP / AWHP
Fuel Type	Gas	Electric
Storage Volume (l)	500.00	500.00
Secondary Circulation	None	None

Lighting	Baseline	Upgrade
Lamp Type	T8	LED
Occupancy Sensing	No	Yes
Daylight Sensing	No	Yes
Controls	Manual	Yes
Parasitic Drain	-	0.1w/m
Lighting Design	No	No
Controls		
Central Time	Yes	Yes
Optimum Start/Stop	No	Yes
Local Time Control	No	Yes
Local Temperature Control	No	Yes
Weather Compensation	No	Yes

Renewables		
PV	None	Yes (15.0kWp)
ASHP	None	Yes
Solar DHW	None	No
Wind	None	No
GSHP	None	No

Sports CoU - Output Results Pre-Full Refurbishment

6.18. These show the estimated performance of the existing building before refurbishment. The BRUKL output automatically compares this against the target for newbuilds, so it is expected to fail in almost every regard. It is included only for the post-renovation calculation to be compared.

Data	Results	Units
Calculated CO2 Emission Rate from Notional building	76.5	kg.CO2/m2.yr
Building CO2 Emission Rate (BER)	150.99	kg.CO2/m2.yr
Target CO2 Emission Rate (TER)	76.49	kg.CO2/m2.yr
Emissions Compliant?	FAIL	
Building Primary Energy Rate (BPER)	826.36	kWh/m2.yr
Target Primary Energy Rate (TPER)	391.62	kWh/m2.yr
Primary Energy Compliant?	FAIL	

Performance Summary	
Area (m2)	501.61
Weather	LON
Foundation Area	501.61

kWh/m2	Actual	Notional
Heating	117.03	36.03
Cooling	0	0
Auxiliary	2.40	3.30
Lighting	19.44	4.96
Hot Water	587.49	343.99
TOTAL	726.36	388.28

kWh/m2	Actual	Notional
Grid Electricity Consumption	21.84	10.14
Other High Carbon Fuel	704.52	378.14
Low Carbon Fuel Consumption	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	0
Solar Hot Water	0

Official

Data	Results	Units	Band
Target Emission Rate (TER)	76.5	kg.CO2/m2.yr	B
Stock Average	306.7	kg.CO2/m2.yr	F
Reference Building	121.6	kg.CO2/m2.yr	B-C
Building Emission Rate (BER)	150.99	kg.CO2/m2.yr	C
Building Energy Consumption	726.36	kWh/m2.yr	-
Rating	62		C

Performance Summary	
Area (m2)	501.61
Weather	LON

kWh/m2	Actual	Notional	Reference
Heating	117.03	36.03	55.63
Cooling	0	0	12.59
Auxiliary	2.40	3.30	2.44
Lighting	19.44	4.96	17.01
Hot Water	587.49	343.99	681.19
TOTAL	726.36	388.28	768.86

% of CO2	Actual
Heating	98
Cooling	0
Auxiliary	0.220803
Lighting	2
Hot Water	0
CHP	0

kWh/m2	Actual	Notional	Reference
Grid Electricity Consumption	21.84	10.14	32.04
Other High Carbon Fuel	704.52	378.14	736.82
Low Carbon Fuel Consumption	0.00	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	0
Solar Hot Water	0

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

LBRSports-CoU-Baseline

As built

Date: Fri Sep 16 12:25:51 2022

Administrative information

Building Details

Address: LBRSports - CoU-Baseline, Twickenham, London, TW1 1TW

Certification tool

Calculation engine: SBEM
Calculation engine version: v6.1.c.0
Interface to calculation engine: DesignBuilder SBEM
Interface to calculation engine version: v7.1.2
BRUKL compliance module version: v6.1.c.0

Certifier details

Name: Steve Williams
Telephone number: 01202 067043
Address: 30 Wentworth Close Bournemouth, Dorset, BH5 2DZ

Foundation area [m²]: 501.61

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	76.49	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	150.99	
Target primary energy rate (TPER), kWh/m^2annum	391.62	
Building primary energy rate (BPER), kWh/m^2annum	826.36	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Building Global Parameters

	Actual	Notional
Floor area [m^2]	501.6	501.6
External area [m^2]	731.4	731.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	25	3
Average conductance [W/K]	690.76	137.13
Average U-value [W/m^2K]	0.94	0.19
Alpha value* [%]	7.22	17.24

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	117.03	36.03
Cooling	0	0
Auxiliary	2.4	3.3
Lighting	19.44	4.96
Hot water	587.49	343.99
Equipment*	17.82	17.82
TOTAL**	**726.36**	**388.28**

* Energy used by equipment does not count towards the total for consumption or 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	33.37
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*33.37*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	339.99	140.31
Primary energy [kWh/m^2]	826.36	391.62
Total emissions [kg/m^2]	150.99	76.49

Sports CoU - Output Results Post Full Refurbishment

6.19. The Inputs discussed above were entered into the SBEM software with the results below. Note due to how the BRUKL output documents work the notional values generated (and the TER + TPER results which are derived from them) are based on the notional newbuild building which changes of use would not be expected to meet. Instead, these "actual" results (and BER + BPER which are derived from them) should be compared against the pre-refurbishment BRUKL output provided above. Of most relevance to draft Local Plan (Regulation 18 Version) Policy 4 the Building Emission Rate of 2.10 is **98.5%** lower than the pre-refurbishment Building Emission Rate of 150.99.

6.20. Whilst modelling the CoU Sports building, the improvement factors are on the regulations currently applied to the buildings. So, if we look at new builds, we are trying to achieve the target 50% improvement factor on a new build that's actually a lot harder than achieving a higher % on a building that is built to 1990 regs or before as there is a lot more opportunity to improve building efficiency compared to the older units being brought up to current spec.

Data	Results	Units
Calculated CO2 Emission Rate from Notional building	5.5	kg.CO2/m2.yr
Building CO2 Emission Rate (BER)	2.10	kg.CO2/m2.yr
Target CO2 Emission Rate (TER)	5.54	kg.CO2/m2.yr
Emissions Compliant?	PASS	
Building Primary Energy Rate (BPER)	20.37	kWh/m2.yr
Target Primary Energy Rate (TPER)	60.07	kWh/m2.yr
Primary Energy Compliant?	PASS	

Performance Summary	
Area (m2)	501.61
Weather	LON
Foundation Area	501.61

kWh/m2	Actual	Notional
Heating	8.14	2.67
Cooling	4.77	2.16
Auxiliary	5.97	20.61
Lighting	8.29	5.18
Hot Water	7.82	10.01
TOTAL	34.99	40.62

kWh/m2	Actual	Notional
Grid Electricity Consumption	34.99	40.62
Other High Carbon Fuel	0.00	0.00
Low Carbon Fuel Consumption	0.00	0.00

kWh/m2	Actual	Notional
Grid Electricity Displaced by Renewables	22.48	0
Solar Hot Water	0	-

Data	Results	Units	Band
Target Emission Rate (TER)	5.5	kg.CO2/m2.yr	A
Stock Average	22.2	kg.CO2/m2.yr	C
Reference Building	20.2	kg.CO2/m2.yr	B-C
Building Emission Rate (BER)	2.10	kg.CO2/m2.yr	A
Building Energy Consumption	34.99	kWh/m2.yr	-
Rating	5		A

Performance Summary	
Area (m2)	501.61
Weather	LON

kWh/m2	Actual	Notional	Reference
Heating	8.14	2.67	62.83
Cooling	4.77	2.16	13.59
Auxiliary	5.97	20.61	14.79
Lighting	8.29	5.18	17.63
Hot Water	7.82	10.01	33.59
TOTAL	34.99	40.62	142.43

% of CO2	Actual
Heating	48
Cooling	12
Auxiliary	17
Lighting	23
Hot Water	0
CHP	0

Energy Performance Certificate
Non-Domestic Building

HM Government

LBRSports - CoU-Upgraded
Twickenham
London
TW1 1TW

Certificate Reference Number:
9453-1689-5334-6694-7082

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government's website at www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Asset Rating

More energy efficient

A+
A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

Net zero CO_2 emissions

5 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	Grid Supplied Electricity
Building environment:	Air Conditioning
Total useful floor area (m^2):	501.6
Building complexity:	Level 4
Building emission rate ($kgCO_2/m^2$ per year):	2.1
Primary energy use (kWh/m^2 per year):	20.37

Benchmarks

Buildings similar to this one could have ratings as follows:

14 If newly built
66 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in the Energy Performance of Buildings Regulations 2012 as amended.

Assessment Software: DesignBuilder SBEM v7.1.3 using calculation engine SBEM v6.1.e.0
Property Reference:
Assessor Name: Steve Williams
Assessor Number:
Accreditation Scheme: Elmhurst Energy Systems
Assessor Qualifications: NOS8
Employer/Trading Name: Williams Energy
Employer/Trading Address:
Issue Date:
Valid Until:
Related Party Disclosure:

Recommendations for improving the energy performance of the building are contained in the associated Recommendation Report.

About this document and the data in it

Opportunity to benefit from a Green Deal on this property

500m2 Commercial New Build

6.21. This typology has been prepared to meet the following specifications:

- Built to current 2021 building regulation UK using a standard brick and block construction with insulated floors and ceilings. Windows, doors, and all associated build fabric meet the minimum thermal properties required by Part L without exceeding them beyond budgetary concerns.
- Building services are as per the refurbishment project with split type air conditioning systems, (celling cassettes and wall mounted indoor units) installed throughout with Lossnay type cross flow heat exchangers providing heat recovery ventilation.
- Hot water provision is localised to staff areas / WC's and provided by modern under-sink, 15L electric storage units.
- Lighting is modern LED with occupancy sensors and photoelectric options for daylight sensing where required.
- A 15kWp PV array has been installed.

6.22. The results detailed in the report show the building passes the required building regulations with energy consumption predicted to be 45.24kWh/m2/yr with overall yearly emissions calculated to be in the region of just 6.17kgCO2/m2/yr. These specifications are considered reasonable and the results achievable for non-residential developments of this and similar types of development in Richmond in line with draft Local Plan (Regulation 18 Version) Policies.

Construction Data Used

Fabrics	New Build Data Set
External Walls (W/m2K)	0.26
External Wall Type	Brick & Block Cavity
Internal Walls (W/m2k)	0.48
Internal Wall Type	Uninsulated Timber
Pitched Roof (W/m2k)	0.16
P&T Roof Construction	Tiled - Uninsulated
Flat Roof (W/m2K)	0.18
Flat Roof Construction	Slab
Ground Floor	0.02
GF Construction	Slab
Internal Floor	1.00
Internal Construction	Slab
Windows (w/m2k)	1.80
Light Transmission	0.80
Total Solar Transmission	0.72
Frame Type	Metal
Shading	Solar Reflective Glass
Personnel Doors (W/m2k)	1.80
Air Permeability (m3/hr/m2)	8.00
Internal Floor Area (m2)	501.61
Total Number of Floors	1.00

Installed Building Services

HVAC	
System Type	ASHP
Heating (CoP)	4.00
Cooling (ESEER)	6.13
Cooling (EER)	3.98
Heat Recovery	0.75
Ventilation	None
Local Extract Exhaust	WCs / Kitchen Areas
Emitters	Ceiling Cassette

Hot Water Provision	
System Type	Local Electric
Fuel Type	Electric
Storage Volume (l)	125L
Secondary Circulation	None

Lighting	
Lamp Type	LED
Occupancy Sensing	Yes
Daylight Sensing	No
Controls	Auto + Manual
Parasitic Drain	0.3we/m2
Lighting Design	Yes
Power Density (W/m2)	3.50
Illuminance	NCM Standard for activity

Renewables	
PV	15kWp
Solar DHW	None
Wind	None
GSHP	None

500m2 Commercial Change of Use

6.23. This typology has been prepared to meet the following specifications:

- Base model is a 1970/80's high street unit with typical fabrics and regulations used for that age and style including uninsulated cavity walls, floors, ceiling, and roof. Single glazed, wood framed windows, tungsten and T8 lighting, 65% efficient boiler with 125L storage tank for heating and hot water.
- The refurbishment is back to a shell and core with insulated cavities, internal lightweight partitions, and roof elements. The ground floor remains the same. Windows have been upgraded to modern 6mm metal display with reflective glass and all external doors upgraded.
- Building services have been fully replaced with split type air conditioning systems, (celling cassettes and wall mounted indoor units) as would be expected of a conditioned retail unit. Lossnay type cross flow heat exchangers providing heat recovery ventilation.
- Hot water provision is localised to staff areas / WC's and provided by modern under-sink, 15L electric storage units.
- Lighting has been replaced with modern LED systems and all associated building service controls have been upgraded as expected with modern systems.
- A 15kWp PV array has been installed.

6.24. The results are detailed in the report and clearly show the vast improvements achievable with basic improvements as expected of a Part L compliant modern building.

6.25. The requirements of the refurbishment to obtain the results are a minimum standard expectation of the current building regulations.

6.26. Energy consumption is reduced from 179.3kWh/m2/yr to just 44.41kWh/m2/yr with overall emissions down from 25kgCO2/m2/yr to just 4.17kg's proving a significant reducing in both areas by meeting or easily exceeding the current minimum refurbishment. These specifications are considered reasonable and the results achievable for non-residential developments of this and similar types of development in Richmond in line with draft Local Plan (Regulation 18 Version) Policies.

Construction Data Used

Fabrics	Baseline	Upgrade
External Walls (W/m2K)	1.00	0.26
External Wall Type	Brick & Block Cavity	Brick & Block Cavity
Internal Walls (W/m2k)	1.14	0.48
Internal Wall Type	Solid 100mm Block	Solid 100mm Block
Pitched Roof (W/m2k)	3.85	0.16
P&T Roof Construction	Tiled - Uninsulated	Tiled - Insulated
Flat Roof (W/m2K)	2.80	0.18
Flat Roof Construction	Timber & Felt Uninsulated	Timber & Felt
Ground Floor	0.58	0.58
GF Construction	Solid Uninsulated	Solid - Uninsulated
Internal Floor	None	None
Internal Construction	-	-
Windows (w/m2k)	3.63	1.60
Light Transmission	-	0.80
Total Solar Transmission	-	0.72

Frame Type	Wooden	UPVC
Shading	none	None
Shading Transmission Factor	1.00	0.75
Personnel Doors (W/m2k)	4.80	1.60
Air Permeability (m3/hr/m2)	25.00	8.00
Internal Floor Area (m2)	501.61	501.61
Total Number of Floors	1.00	1.00

HVAC	Baseline	Upgrade
System Type	LTHW Gas	ASHP
Heating (CoP)	0.65	4.00
Cooling (ESEER)	-	6.13
Cooling (EER)	-	3.98
Heat Recovery	-	0.70
Ventilation	None	MHRV
Local Extract Exhaust	None	MHRV
Exhaust SFP (W/l-s)	-	0.40

Hot Water Provision	Baseline	Upgrade
System Type	From LTHW System	Ariston Type Local
Fuel Type	Gas	Electric
Storage Volume (l)	500.00	15.00
Secondary Circulation	None	None

Lighting	Baseline	Upgrade
Lamp Type	T8	LED
Occupancy Sensing	No	Yes
Daylight Sensing	No	Yes
Controls	Manual	Yes
Parasitic Drain	-	0.1w/m
Lighting Design	No	No
Controls		
Central Time	Yes	Yes
Optimum Start/Stop	No	Yes
Local Time Control	No	Yes
Local Temperature Control	No	Yes
Weather Compensation	No	Yes

Renewables		
PV	None	Yes (15.0kWp)
ASHP	None	Yes
Solar DHW	None	No
Wind	None	No
GSHP	None	No

Commercial CoU - Output Results Pre-Full Refurbishment

6.27. These show the estimated performance of the existing building before refurbishment. The BRUKL output automatically compares this against the target for newbuilds, so it is expected to fail in almost every regard. It is included only for the post-renovation calculation to be compared against.

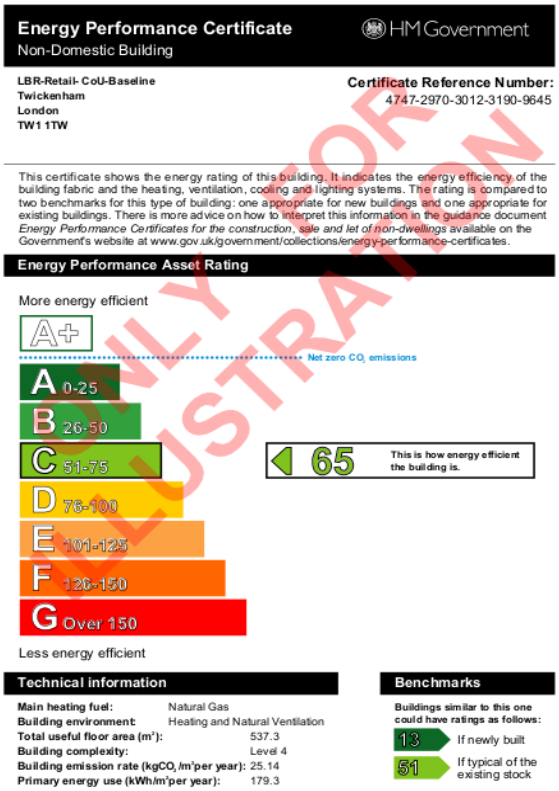
Data	Results	Units
Calculated CO2 Emission Rate from Notional building	4.9	kg.CO2/m2.yr
Building CO2 Emission Rate (BER)	25.14	kg.CO2/m2.yr
Target CO2 Emission Rate (TER)	4.90	kg.CO2/m2.yr
Emissions Compliant?	FAIL	
Building Primary Energy Rate (BPER)	179.30	kWh/m2.yr
Target Primary Energy Rate (TPER)	13.30	kWh/m2.yr
Primary Energy Compliant?	FAIL	

Performance Summary	
Area (m2)	537.3
Weather	LON
Foundation Area	537.3

kWh/m2	Actual	Notional
Heating	52.63	16.55
Cooling	0	0
Auxiliary	2.34	2.70
Lighting	55.50	13.17
Hot Water	28.90	17.54
TOTAL	139.37	49.96

kWh/m2	Actual	Notional
Grid Electricity Consumption	57.84	17.52
Other High Carbon Fuel	81.52	32.44
Low Carbon Fuel Consumption	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	0
Solar Hot Water	0



Official

Data	Results	Units	Band
Target Emission Rate (TER)	4.9	kg.CO2/m2.yr	A
Stock Average	19.7	kg.CO2/m2.yr	C
Reference Building	19.4	kg.CO2/m2.yr	B-C
Building Emission Rate (BER)	25.14	kg.CO2/m2.yr	C
Building Energy Consumption	139.37	kWh/m2.yr	-
Rating	65		C

Performance Summary	
Area (m2)	537.3
Weather	LON

kWh/m2	Actual	Notional	Reference
Heating	52.63	16.55	23.60
Cooling	0	0	31.64
Auxiliary	2.34	2.70	2.38
Lighting	55.50	13.17	72.02
Hot Water	28.90	17.54	28.04
TOTAL	139.37	49.96	157.68

% of CO2	Actual
Heating	68
Cooling	0
Auxiliary	1
Lighting	31
Hot Water	0
CHP	0

kWh/m2	Actual	Notional	Reference
Grid Electricity Consumption	57.84	17.52	106.04
Other High Carbon Fuel	81.52	32.44	51.64
Low Carbon Fuel Consumption	0.00	0.00	0.00

kWh/m2	Actual
Grid Electricity Displaced by Renewables	0
Solar Hot Water	0

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

LBRRetail-CoU-Baseline

As built

Date: Fri Sep 16 13:24:44 2022

Administrative information

Building Details

Address: LBR-Retail- CoU-Baseline, Twickenham, London, TW1 1TW

Certifier details

Name: Steve Williams

Telephone number: 01202 067043

Address: 30 Wentworth Close Bournemouth, Dorset, BH5 2DZ

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.c.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.1.2

BRUKL compliance module version: v6.1.c.0

Foundation area [m²]: 537.3

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), kgCO_2/m².annum	4.9	
Building CO_2 emission rate (BER), kgCO_2/m².annum	25.14	
Target primary energy rate (TPER), kWh/m².annum	13.3	
Building primary energy rate (BPER), kWh/m².annum	179.3	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Building Global Parameters

	Actual	Notional
Floor area [m²]	537.3	537.3
External area [m²]	770.9	770.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	25	3
Average conductance [W/K]	695.88	235.15
Average U-value [W/m²K]	0.9	0.31
Alpha value* [%]	7.27	21.77

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	52.63	16.55
Cooling	0	0
Auxiliary	2.34	2.7
Lighting	55.5	13.17
Hot water	28.9	17.54
Equipment*	24.4	24.4
TOTAL**	**139.37**	**49.96**

* Energy used by equipment does not count towards the total for consumption or 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	33.37
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*33.37*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	338.61	146.88
Primary energy [kWh/m²]	179.3	13.3
Total emissions [kg/m²]	25.14	4.9

Commercial CoU - Output Results Post Full Refurbishment

6.28. The inputs discussed above were entered into the SBWM software with the results below. Note, due to how the BRUKL output documents work the notional values generated (and the Ttype. ToER results which are derived from them) are based on the notional newbuild building which changes of use would not be expected to meet. Instead, these "actual" results (and BER + BPER which are derived from them) should be compared against the pre-refurbishment BRUKL output provided above. Of most relevance to draft Local Plan (Regulation 18 Version) Policy 4 the Building Emission Rate of 4.17 is 83% lower than the pre-refurbishment Building Emission Rate of 25.14.

6.29. The building was previously modelled under the new draft policy targets and was a narrow pass the recent introduction of the revised target means that this building is now a fail.

Data	Results	Units
Calculated CO2 Emission Rate from Notional building	4.6	kg.CO2/m2.yr
Building CO2 Emission Rate (BER)	2.28	kg.CO2/m2.yr
Target CO2 Emission Rate (TER)	4.64	kg.CO2/m2.yr
Emissions Compliant?	PASS	
Building Primary Energy Rate (BPER)	24.19	kWh/m2.yr
Target Primary Energy Rate (TPER)	50.61	kWh/m2.yr
Primary Energy Compliant?	PASS	

Performance Summary	
Area (m2)	537.3
Weather	LON
Foundation Area	537.3

kWh/m2	Actual	Notional
Heating	0.25	1.87
Cooling	13.33	5.97
Auxiliary	2.12	10.82
Lighting	18.69	13.62
Hot Water	2.27	2.06
TOTAL	36.66	34.33

kWh/m2	Actual	Notional
Grid Electricity Consumption	36.66	34.33
Other High Carbon Fuel	0.00	0.00
Low Carbon Fuel Consumption	0.00	0.00

kWh/m2	Actual	Notional
Grid Electricity Displaced by Renewables	20.99	0
Solar Hot Water	0	-

Data	Results	Units	Band
Target Emission Rate (TER)	6	kg.CO2/m2.yr	A
Stock Average	24	kg.CO2/m2.yr	C
Reference Building	19.4	kg.CO2/m2.yr	B-C
Building Emission Rate (BER)	4.17	kg.CO2/m2.yr	A
Building Energy Consumption	49.92	kWh/m2.yr	-
Rating	11		A

Performance Summary	
Area (m2)	537.3
Weather	LON

kWh/m2	Actual	Notional	Reference
Heating	0.60	1.66	23.60
Cooling	11.12	6.14	31.64
Auxiliary	4.48	10.75	2.38
Lighting	20.71	13.17	72.02
Hot Water	13.01	12.62	28.04
TOTAL	49.92	44.33	157.68

% of CO2	Actual
Heating	1
Cooling	21
Auxiliary	9
Lighting	42
Hot Water	27
CHP	0

kWh/m2	Actual
Grid Electricity Displaced by Renewables	20.99
Solar Hot Water	0

Official

Energy Performance Certificate
Non-Domestic Building

HM Government

LBR-Retail- CoU-Upgraded
Twickenham
London
TW1 1TW

Certificate Reference Number:
0005-7174-6366-6743-0636

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government's website at www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

11 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	Grid Supplied Electricity
Building environment:	Air Conditioning
Total useful floor area (m^2):	537.3
Building complexity:	Level 4
Building emission rate ($kgCO_2/m^2$per year):	4.17
Primary energy use (kWh/m^2per year):	44.41

Benchmarks

Buildings similar to this one could have ratings as follows:

15 If newly built
62 If typical of the existing stock

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

LBRRetail-CoU-Upgraded

As designed

Date: Fri Sep 16 13:33:11 2022

Administrative information

Building Details

Address: LBR-Retail- CoU-Baseline, Twickenham, London, TW1 1TW

Certification tool

Calculation engine: SBEM
Calculation engine version: v6.1.c.0
Interface to calculation engine: DesignBuilder SBEM
Interface to calculation engine version: v7.1.2
BRUKL compliance module version: v6.1.c.0

Certifier details

Name: Steve Williams
Telephone number: 01202 067043
Address: 30 Wentworth Close Bournemouth, Dorset, BH5 2DZ

Foundation area [m^2]: 537.3

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2$annum	5.98	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	4.17	
Target primary energy rate (TPER), kWh/m^2annum	65.34	
Building primary energy rate (BPER), kWh/m^2annum	44.41	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

Building Global Parameters

	Actual	Notional
Floor area [m^2]	537.3	537.3
External area [m^2]	770.9	770.9
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	8	3
Average conductance [W/K]	205	235.15
Average U-value [W/m^2K]	0.27	0.31
Alpha value* [%]	24.69	21.77

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	0.6	1.66
Cooling	11.12	6.14
Auxiliary	4.48	10.75
Lighting	20.71	13.17
Hot water	13.01	12.62
Equipment*	24.4	24.4
TOTAL **	**49.92**	**44.33**

* Energy used by equipment does not count towards the total for consumption or 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	20.99	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*20.99*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	176.66	113.01
Primary energy [kWh/m^2]	44.41	65.34
Total emissions [kg/m^2]	4.17	5.98

Commercial Summary

6.30. CIS has modelled the 6no typologies agreed below, 4no new build and 2no change of use. Our report summarises the assumptions made on the base case buildings modelling and identifying the steps taken to improve the building performance improving the Building Emission Rates (BER) and reducing the Building Primary Energy Rate (BPER).

Type	Commercial	Build
1	500m2 Nursery	New Build
2	500m2 Commercial	New Build
3	Sports	New Build
4	500m2 Nursery	Change of Use
5	500m2 Commercial	Change of Use
6	Sports	Change of Use

6.31. On the change of use typologies, we have shown a baseline using Part L targets for the assumed age of property (1980's) and after refurbishment applying the identified build and building services upgrades.

6.32. We have also considered how the building performs to the revised targets in the draft Local Plan (Regulation 18 version) and we have commented on the technical feasibility of delivering the measures and the commercial viability for developers. In addition, we have considered if the measures as outlined exceed the minimum 60% improvement over Part L required under under Policy 4 (table 16.1) of the draft Local Plan (Regulation 18 Version).

6.33. As an approach changes to certain areas of fabric upgrade in commercial modelling software lifting them from standard values to higher performing levels are difficult to integrate and have knock on impacts. For example, they can lead to increased risk of overheating or air quality issues leading to specification of MVHR systems. Whilst this can be done at this point, we have looked at other more identifiable measures to achieve good performance levels and to show what impact they may have on the total emissions reduction.

6.34. Post construction it is also difficult to see if the fabric measures in the building have been installed as planned. Assessing the fabric specification installed complies is hard to assess and rely on quality workmanship to avoid issues such as thermal bridging. We have focused on other forms of upgrade to achieve a significant portion of the improvements. These include adoption of full LED lighting, Solar PV for each typology and ASHP's. We have stated the size of solar array prescribed for domestic and commercial buildings, in the case of the commercial buildings this could be significantly greater and gives leeway for further improvement. The season COP stated for the ASHP's is in accordance with the specified unit's performance.

6.35. A you will see from the data provided each of the typologies exceeds the minimum 50% on site reduction whilst requiring identifiable measures that can be calculated under the 'be seen' energy hierarchy required under the London Plan.

Datum Model

Typology	calc notional building	BER CO2 rate	TER CO2 rate	%	Pass or fail
500m2 Nursery CoU	41.9	21.18	10.4		FAIL
500m2 Nursery new build					
Sports CoU	306.7	150.99	76.49		FAIL
Sports New Build					
500m2 comm/retail CoU	19.7	25.14	4.9		FAIL
500m2 comm/retail new build					

Refurbed

calc notional building	BER CO2 rate	TER CO2 rate	% Improvement	Pass or fail
19.2	1.9	4.8	60.42	PASS
6.5	1.8	6.54	72.48	PASS
5.5	2.1	5.54	0.38	PASS
5.4	0.79	5.43	85.45	PASS
4.6	2.28	4.64	50.86	FAIL
3.9	1.17	3.94	70.30	PASS

For new build these are not industry baseline values, these are derived from current LBR policy requirements. The CoU do reflect assumed construction on each typology.

Pass or fail for refurbished buildings based on draft local policy changes.

For more information, please contact Climate Integrated Solutions Ltd

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7. Appendix 1 - Acronyms

Acronym	Description
SAP	Standard Assessment Procedure: the government approved methodology for calculating carbon emissions for homes
BRUKL	Building Regulation UK Part L report: The government approved methodology for calculating carbon emissions for homes
SBEM	Simplified Building Energy Model: a approved methodology often used to generate the BRUKL report
DER	Dwelling Emission Rate & BEM – Building Emission Rate: the dwelling/buildings in use carbon emission in In KG of CO_2 per year per $m^{2.}$ The % by which this is lower than the TER is the key indicator used in most policy requirements
TER	Target Emission Rate: the maximum emission rate allowed by building regulations. Refurbishment/change of use projects have no fixed target. In KG of CO_2 per year per m^2
DFEE	Dwelling Fabric Energy Efficiency & BFEE – Building Fabric Energy Efficiency. The calculated emissions after notional services are applied thus producing a measure of the building fabric quality
TFEE	Target Fabric Energy Efficiency. The maximum DFEE or BEFF allowed by Part L
DPER	Dwelling Primary Energy rate: the kWh/m2/year predicted to be used by the dwelling after transmission losses
HSE	Health and Safety Executive
M&T	Metering and Technology
BREEAM	Building Research Establishment Environmental Assessment Method: A holistic assessment method covering dozens of considerations to give an overall sustainability rating
U Value or e.g. U-0.8	how many wats of heat is lost though each m^2 of a building element per degree difference in temperature between inside and outside
EWI	External Wall Insulation, IWI Internal Wall insulation.
CoP	Coefficient of Performance
ESEER	European seasonal energy efficiency ratio
EER	Energy Efficiency Ratio
CoU	Change of Use
DHW	District Hot Water
GSHP	Ground Source Heat Pump
ASHP	Air Source Heat Pump
BER	Building Emission Rates
BPER	Building Primary Energy Rate

8. Appendix 2 - Assessment procedures

“The Standard Assessment Procedure (SAP) is the methodology used by the government to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of dwelling energy performances that are needed to underpin energy and environmental policy initiatives.

The government is committed to increasing the accuracy of SAP. The most recent update of the SAP 10.2 specification (published 15 December 2021) is available on the BRE website. The next version of SAP 10 (10.2) was to come into force with the updated Part L Building regulations in Summer 2022, but is now expected to be finalised in January 2023 and will incorporate various changes to the methodology, including updated:

- fuel prices
- CO2 emissions
- primary energy factors

For existing buildings, a simplified version of SAP called Reduced Data SAP (RdSAP) is used to assess the energy performance. An RdSAP assessment will use a set of assumptions about the building based on conventions and requirements at the time the building was constructed. Government is working on an RdSAP update which we expect to publish in Spring 2022.

SAP works by assessing how much energy a dwelling will consume when delivering a defined level of comfort and service provision. The assessment is based on standardised assumptions for occupancy and behaviour. This enables a like-for-like comparison of dwelling performance. Related factors, such as fuel costs and emissions of carbon dioxide (CO2), can be determined from the assessment.

SAP quantifies a dwelling’s performance in terms of: energy use per unit floor area, a fuel-cost-based energy efficiency rating (the SAP Rating) and emissions of CO2 (the Environmental Impact Rating). These indicators of performance are based on estimates of annual energy consumption for the provision of space heating, domestic hot water, lighting, and ventilation. Other SAP outputs include estimate of appliance energy use, the potential for overheating in summer and the resultant cooling load.” Standard Assessment Procedure - GOV.UK (www.gov.uk)

The SAP software will produce both full SAP outputs and the Domestic EPC (Energy Performance Certificate)

SBEM and BRUKL

“SBEM Calculations are used to demonstrate the compliance of new build commercial properties as required by Part L2 of the Building Regulations (and regional variants). As well as being a mandatory requirement for new build commercial properties, some extensions and conversions may also require an SBEM calculation.

SBEM uses the National Calculation Method (NCM) to calculate the proposed buildings annual energy use and can also identify ways to save money. The following information is often required to provide a full calculation:

- The types of heating
- The types of lighting
- The ventilation and air conditioning that will be used
- The building construction plans
- The use of any renewable energy sources (solar PV, wind turbines and ground/air-source heating etc).

It also takes into account the U-Values of the building fabric/thermal elements (roofs, walls, windows), and once constructed, the air tightness of the building.

Overall, an SBEM Calculation provides a clear picture of the energy performance and carbon emissions of your proposed building. An obvious indication of the proposed building energy usage is shown through the Energy Performance Asset Rating which is located on the Non-Domestic Energy Performance Certificate (EPC) generated by the SBEM Calculation. “ SBEM Calculations for new builds | What is SBEM? (elmhurstenergyconsultancy.co.uk)

The SBEM software will then produce both a BRUKL (Building Regulations UK Part L) compliance report and a non-domestic EPC (Energy Performance Certificate)