



Llangatwg Community High School

Low Zero Carbon (LZC Study)

26CC07-TBA-10-XX-T-ME0002

Prepared for Neath Port Talbot Council
February 2025

High-performing partnership
Higher performing buildings

WA0347 Llangatwg Community High School



PROJECT
Llangatwg Community High School

PROJECT NO
WA0347

REPORT
LZC Study – RIBA Work Stage 2

PREPARED FOR
Neath Port Talbot Council

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1.0 Introduction

This report investigates the feasibility of a number of low and zero carbon (LZC) technologies which could be used to support the evolving energy strategy for the proposed replacement Llangatwg Community High School in Aberdulais, Neath.

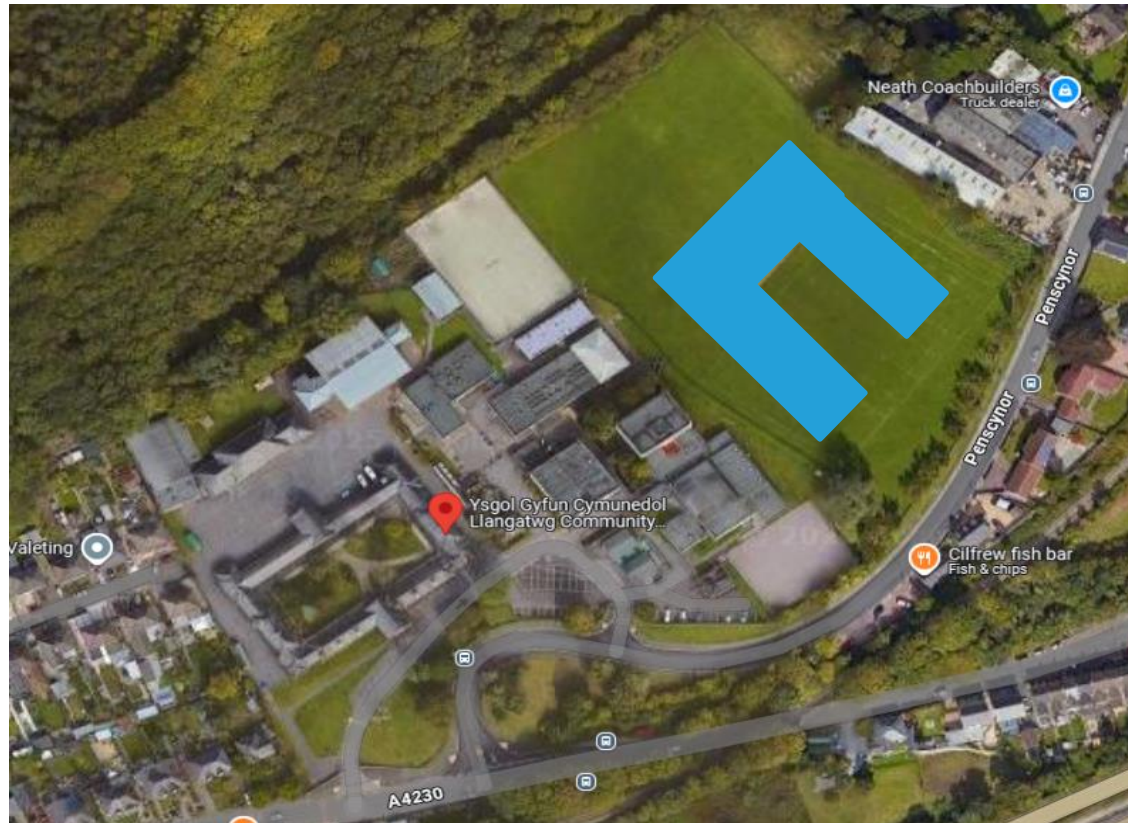


Fig. 1 Location of proposed building on the school site

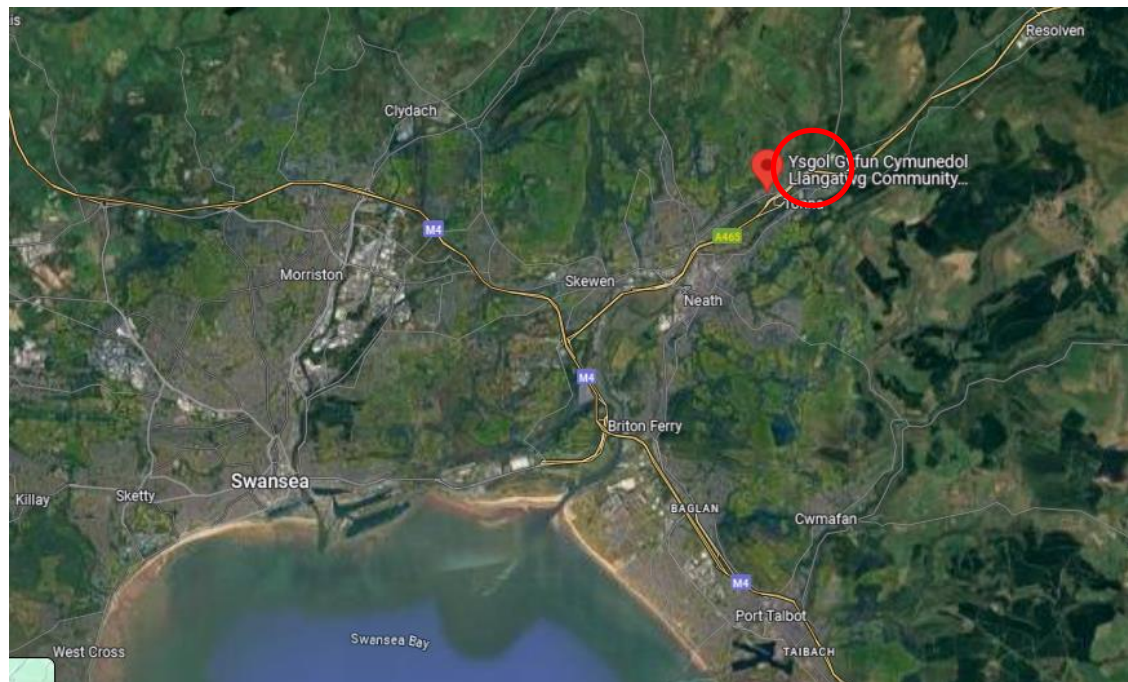


Fig. 2 Site location relative to Swansea Bay

This report has been structured in compliance with the BREEAM New construction V6.1 Ene04 credit: 'Low and zero carbon feasibility study' and 'passive design' and has been undertaken at RIBA Work Stage 2. In accordance with these standards the following is reported:

- + A baseline energy strategy for the buildings – including its energy consumption, CO₂ emissions and an outline estimation of cost
- + An overall assessment on the appropriateness of LZC technologies for the site
- + Explanations for excluding several technologies are given in Appendix A
- + Feasibility of exporting heat/electricity from the system
- + For the technologies that are feasible the following is reported::
 - + The energy demand of the development (see note below)
 - + The annual energy provided by the LZC energy source
 - + The expected carbon reductions from the LZC energy source
 - + Site constraints
 - + Noise impact
 - + Payback
 - + Whole life cost impact of potential specification in terms of carbon emissions
 - + Any planning considerations
 - + Any available grants/income schemes
 - + Reasons for excluding other technologies

To satisfy the requirements of the BREEAM Ene 04 credit, it is recommended that the LZC technology specified for the building should provide a 'meaningful' reduction in regulated CO₂ emissions. As a guide it is recommended that the specified LZC provides a minimum contribution of 5% of overall regulated CO₂ emissions for the building. This guidance will be taken into consideration when reporting on potential technologies assessed for this development.

Further investigation is recommended by the project team during the detailed design to assess the most practical way to accommodate the energy strategy chosen for the building, and in coordination with the designers and manufacturers, estimate the exact performance of the chosen system(s) in detail.

It is also recommended that a further detailed review of the anticipated thermal and electrical load profiles for the building is undertaken to confirm appropriate sizing and viability of LZC technology at this site.

The energy performance of the building was calculated using the Apache module of IES Virtual Environment 2023 in Compliance (Part L) mode.

1.1 Policy drivers

The Welsh Government is committed to net zero carbon (NZC) by 2030 and promotes a range of low and zero carbon (LZC) technologies to achieve this.

For the educational sector, the Welsh Government published the Sustainable Communities for Learning guidance in January 2022, which mandates Net Zero Carbon (NZC) in operation for all new schools.

1.2 Objectives

The report evaluates the suitability of LZC technologies to provide value to the development in terms of meaningful energy or CO₂ savings and economic viability. The review considers both the technical capacity of the technology, as well as existing site constraints and demand patterns of the building which may preclude the technology from operating at the site.

- + The following technologies were included for review:
- + Ground source heat pump
- + Mini hydro
- + Photovoltaic array

Technologies deemed to be unsuitable for the site are briefly described in Appendix B with justifications as to why they were excluded from further consideration.

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Appropriate sources have been referenced throughout this document to provide an outline estimation of costs associated with Particular energy technologies, and to draw overall comparisons between strategies. However, as the costs provided are estimates, and are not directly linked to any product or manufacturer, they should not be used to gauge an accurate reflection of actual costs likely to be incurred but can be used to enable comparisons to be made.

2.0 Methodology

2.1 Basecase Part L compliance

In accordance with BREEAM Knowledge Base clarification note¹ KBCN0297, the BER of the base case building must be smaller than the target value, TER.

The base case building with an air source heat pump but without LZCs would meet those requirements. Therefore, the Part L Actual building of the base case was used as the basis against which energy and CO₂ savings were calculated.

2.2 Carbon factors

The carbon factors used in the calculations are taken from the common values used in Table 12 of SAP10.2 and Part L Wales 2022, including Part L's value for grid displaced electricity provided by PV.

Electricity	0.136
Grid displaced electricity from PV	0.145

Table 1: Carbon factors

2.3 Fuel tariffs

The energy cost savings, simple paybacks and life cycle costs were calculated using the DESNZ prices of fuels purchased by non-domestic consumers including CCL (Climate Change Levy). These are regularly updated (quarterly) and the 3rd quarter 2024 costs were used at time of the publication².

	Consumer type	Tariff in £/kWh
Electricity	Small (below 500 MWh)	0.265

Table 2: Fuel Tariffs

2.4 Incentive schemes

Smart export guarantee (SEG)

As of April 2019, FiTs (Feed in Tariffs) and export tariffs are no longer available. The scheme was replaced in January 2020 with the Smart Export Guarantee (SEG), under which utilities are obliged to offer a tariff to eligible producers of renewable electricity³ (up to 5MW capacity).

All generators who wish to receive payment for the electricity which they export back to the National Grid would need to apply to a SEG licensee (an electricity supplier which offers a SEG tariff). However, as there are no specifically published tariffs, SEG payments are not taken into consideration in this report but assumed in the PV section where PV supplied “self-consumption” in the building does not exceed generation.

Boiler upgrade scheme (BUS)

The RHI (Renewable Heating Incentive) is closed to new applicants, and the Boiler Upgrade Scheme⁴ is now available to promote low carbon sources of space heating.

The Boiler Upgrade Scheme (BUS) provides grants for both domestic and small (sub 45kWth capacity) non-domestic properties to replace existing fossil fuel heating with more efficient, low carbon heating systems including ASHPs. However, as this grant aid is designed for existing properties (and thus existing heating systems) it is not applicable to a new build scheme. In addition, this project would be ineligible due to being beyond the heating system capacity limit of the grant's eligibility criteria.

¹ BRE- Modelling Basecase for LZC technology available at [Modelling basecase for Low/Zero carbon technology – efficiency of gas boiler – Knowledge Base \(breeam.com\)](#)

² [Gas and electricity prices in the non-domestic sector - GOV.UK \(www.gov.uk\)](#)

³ <https://www.ofgem.gov.uk/environmental-programmes/smart-export-guarantee-seg/about-smart-export-guarantee-seg>

⁴ <https://www.ofgem.gov.uk/environmental-and-social-schemes/boiler-upgrade-scheme-bus>

3.0 Baseline scenario

3.1 Baseline energy strategy

The indicative energy strategy forming the baseline scenario for the building is as follows:

- + Low temperature HW served from ASHP (at 300% efficiency) to provide space heating via underfloor heating, radiators supplemented with radiant panels or heating coils in MVHR units
- + Domestic Hot Water – dedicated ASHP
- + Ventilation – Mechanical ventilation with heat recovery to all classrooms and admin/other rooms, AHUs with HR to halls and dining
- + Cooling – **fitness/activity studios, Server room and ICT classrooms will be served by VRF units**
- + Lighting – LED lighting with presence/absence detection and daylight dimming in perimeter rooms

System	Type	Location	Efficiency
Heating	ASHP	All	SCOP=3.0
Cooling	DX units	First floor eastern wing only	SEER=6
Mechanical ventilation	MVHR	All occupied spaces except hall and circulation	1.9 W/l/s 90% Heat recovery
Pumps	Variable speed	All areas served by boiler / heating systems	N/A
DHW	ASHP	All school DHW	HP SCOP=3.0
Lighting	LED	Daylight dimming assumed to perimeter classrooms, as layout unfinalised	100 lumens / W in all spaces

Table 3 Baseline MEP assumptions

Building Element	U-value in W/m²K
External wall	0.13
Ground floor	0.1
Roof	0.1
External glazing / glass doors / rooflights	1.2 U Value (whole unit) 0.5 G value* (centre pane) *total solar heat gain/incident solar radiation
Air permeability (m³/h-m²@50pa)	3.0

Table 4 Fabric performance of baseline building

3.2 Baseline energy consumption and carbon emissions

The above strategy was the result of preliminary dynamic simulations using the IES 2024 Compliance module in order to optimise the passive design features for low energy consumption and CO₂ emissions (see Section 8). A breakdown of energy consumption and associated CO₂ emissions for the buildings is provided in Table 5.

BREEAM Ene04 LZC only takes into consideration 'regulated' carbon emissions of the building. This excludes any emissions associated with equipment. Energy and carbon emissions associated with the building's equipment usage have therefore been excluded from the calculations presented in this report.

	Energy Consumption in kWh/m²/a	Energy Consumption in kWh/a	CO ₂ Emissions	
			Part L 2022	
			in kg CO ₂	in %
Heating	3.26	33,046	4,494	12%
Hot Water	3.66	37,101	5,046	13%
Cooling	0.06	608	83	0%
Auxiliary	10.7	108,465	14,751	39%
Lighting	9.46	95,895	13,042	35%
Total	27.1	275,115	37,416	100%

Table 5 Predicted energy consumption and CO₂ emissions of the proposed Basecase (ASHP) building (from BER).

3.3 Installation cost estimation

In order to compare the cost implications and potential savings that could be achieved through alternative technologies it is important to establish an estimation of costs associated with delivering the services strategy associated with the baseline scenario. As DHW and heating represent a significant proportion of the energy consumption of the buildings, heat generating technologies are focused on.

	End use	Plant size in kW	Unit cost in £/kW	Projected cost in £
Capital cost	ASHP	486	810	379,080
	ASHP (DHW)	226	1000	183,060
Maintenance cost	DHW and space heating	712	6	4,272
Fuel cost heating and DHW	DHW and space heating	70 MWh electricity	£0.265per kWh	18,589 (p.a.)

Table 6 Predicted capital costs of basecase ASHP space and DHW heat generators

4.0 Ground source heat pumps

4.1 Introduction

Ground source heat pumps (GSHPs) take naturally occurring low-level heat stored in the ground or ground water and convert it to high level heat (approx. 45-50°C) using a pump driven by an electrically powered compressor. The heat generated by this pump can be used to provide space heating for the building. DHW generation can also benefit from GSHP, by pre-heating DHW from the space heating plant with electrical top up (ideally via renewable generated power).

GSHPs can either transfer the heat from the ground (or groundwater) to the air or to an LTHW heating system.

There are three principal types of GSHP:

- + In open loop boreholes, ground water is abstracted from one borehole⁵; heat extracted by a heat pump and cooler water returned to a second borehole. Thus, the space requirements for this technology are minimal, provided a suitable source of ground water is available and it does not interfere with the ongoing ground remediation work on site.
- + In vertical closed-loop boreholes, vertical loops are sunk to a depth of 50-200m. The loops act as heat exchangers with the surrounding ground. Each loop can extract on average 75W per metre depth and loops need to be 10m apart
- + Horizontal (slinky type) ground loops are laid in trenches 2.0m below ground and exchange heat with the surrounding ground. Each loop can extract on average 100W per metre depth and loops need to be 5m apart

The benefits associated with GSHPs include generally having low maintenance requirements, no fuel deliveries are required and reversible heat pumps are capable of providing cooling as well as heating.

4.2 Site constraints

The feasibility of GSHP as a main heat source depends on the area of ground available for the heat exchangers or the potential ground water abstraction rate. Ground investigations at the site have revealed hard bedrock close to the surface, which makes it unsuitable for horizontal slinkies.

A rectangular area of approx. 5,609m² below the proposed school and courtyard would be available for thermal piles and could accommodate 72No 140m deep boreholes at 10m spacing within a 80m by 70m grid

Table 6 shows the heat extraction capacities available for the site. Only the vertical closed loop systems would have enough capacity to supply the 712W heating load for space heating and DHW (via 72 boreholes). An open loop system of 20l/s abstraction rate could meet 50% of the required heating capacity. An extraction rate of 40 l/s would be required to meet the heating demand fully. We assumed that this level of water abstraction would not be viable for the site.

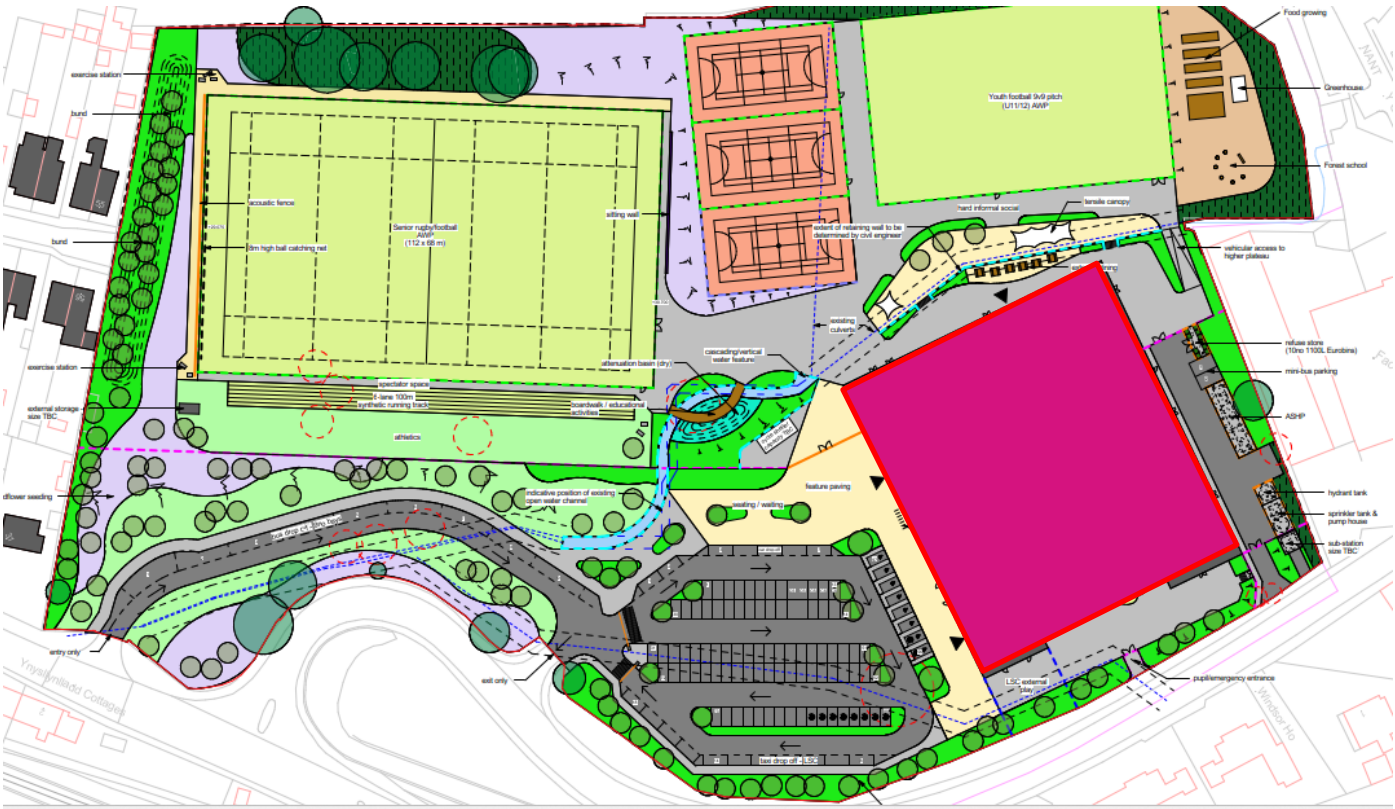


Fig.3 Assumed area for vertical GSHP on existing site view

	Vertical closed loop 26 piles, 140m deep	Vertical open loop system at 20/s abstraction rate
Potential output in kW	756	252

Table 7 Heat capacities of the two eligible systems

4.3 Planning constraints

There are no known planning constraints.

4.4 Model scenario

The ASHP exchanged for vertical closed loop system with SCOPs of 4.03 and 3.37 for space heating and DHW. respectively.

Energy	Regulated consumption in kWh/a	267,107
	Savings in %	3
	Energy cost saving in £	2,042
CO ₂ emissions	Regulated emissions in kg CO ₂ /a	36,327
	Savings in %	3
Payback	Capital cost in £	1,566,640
	Maintenance costs annual (£)	2,848

⁵ Assuming that ground water is available at the right depth and abstraction rate at the site.

	Simple payback cost in £	989,763
	Annual cost savings in £	3466
	Payback in years	286
Life cycle cost in £	Over lifespan of technology	1,954,550
	Over lifespan of building	4,111,649

Table 8: GSHP scenario results

Conclusion

Replacing the baseline ASHP with a closed loop GSHP reduces energy consumption and CO₂ emissions by 3% (as both are served by grid electricity at Part L 2022 carbon factors).

An investment in GSHP versus an ASHP would not pay for itself within the 20-year lifetime of the installation at the Q3 2024 electricity tariff. The LCC at £1,954,550 over the 20 year lifespan on the heat pump and £4,111,649 over the lifespan od the building is significant.

GSHP is therefore not recommended for this project.

6.0 Photovoltaics

6.1 Introduction

Photovoltaic (PV) panels utilise the sun’s energy to produce direct current electricity via semiconducting materials that absorb solar radiation. There are a number of different PV types including monocrystalline, polycrystalline, amorphous silicon (thin film) and hybrid panels. Panels are either mounted onto a roof or form an integral Part of the roof or vertical façades.

In order to gain the most out of these panels in the UK the optimum position is tilted at 30° facing south. They can either be mounted on a pitched roof (onto the roof itself or integrated into the roof) or independently tilted on a flat roof. In reality, panels on flat roofs are generally mounted at 10° to reduce wind loads.

PV is generally maintenance free. Once installed, PV will typically operate for 20+ years without needing any significant maintenance regime. The inverters may need to be replaced after approx. 15 years.

6.2 Site constraints

The feasibility of installing PV is highly dependent on suitable roof space and possible over shading of the building from adjacent structures and self-shading. Fig. 4 shows a proposed layout of roof PV arrays

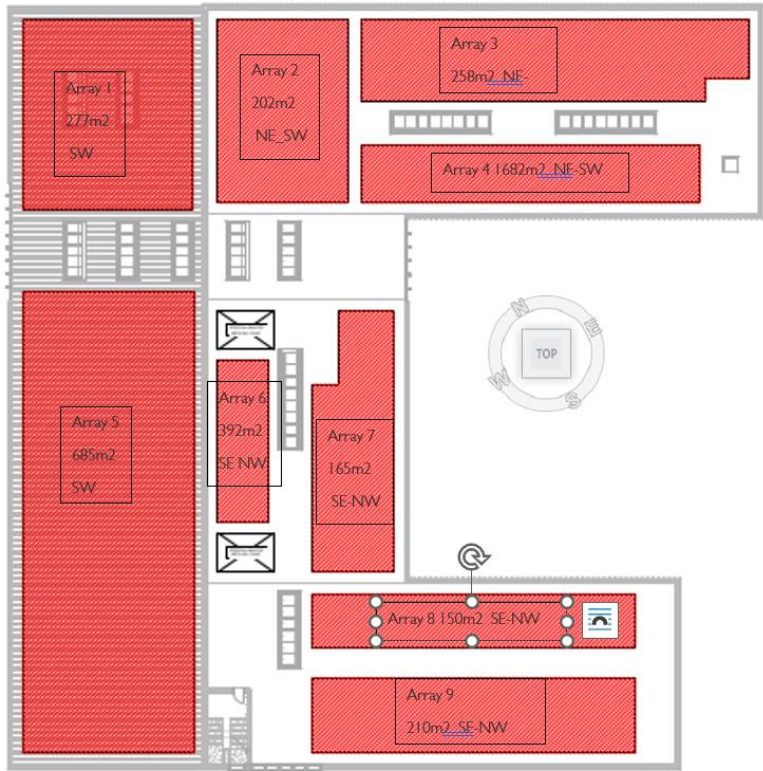


Fig. 4 proposed PV array sizes and layouts

The site is also overshadowed by a hill, which according to OS Map rises approx. 160 m to the NW of the site (Fig. 5), affecting energy generation in the late afternoon for 10 months of the year.

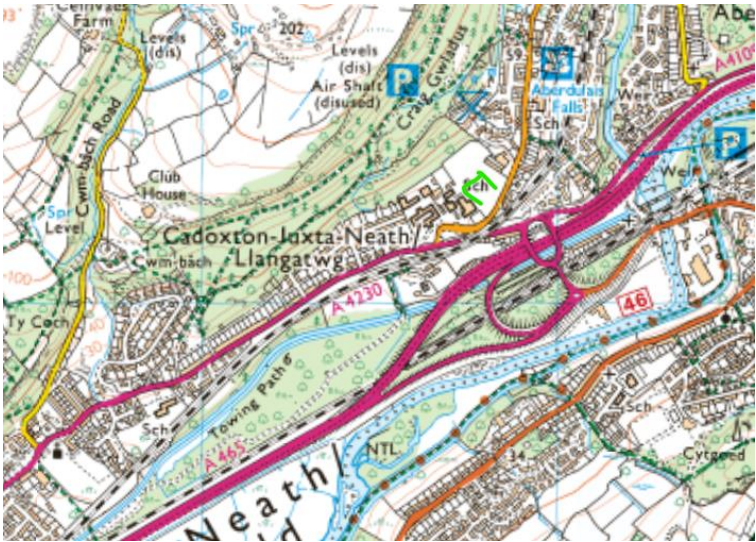


Fig. 5 OS map of site area with school marked in green and hill NW of the site

6.3 Planning constraints

There are no known planning constraints in place at this site that would prohibit the installation of PV panels on the building. However, this should be officially confirmed if this LZC option is selected. There is no noise impact associated with PV that needs to be considered.

6.4 Model scenario

A total of 2,141 m2 (469kWp) of PF in the orientations shown in Fig. 4 was modelled. Panels had 10° inclination and 22.3% efficiency. A provisional export limit of 350kVA was stated by NGED. The modelled max coincident load of the combined arrays was 329kW. Therefore, it can be assumed that all PV-generated electricity can be used on-site or exported, but this will be confirmed during Stage 3. All other details relating to the building services strategy for the building have been modelled as per the baseline scenario.

Energy	Regulated consumption in kWh/a	-120,543
	Savings in %	144%
	Energy cost saving in £	104849
CO ₂ emissions	Regulated emissions in kg CO ₂ /a	-18,894
	Savings in %	153
Payback	Capital cost in £	464,426
	Maintenance costs annual (£)	2,355
	Simple Payback cost in £	464,426
	Annual cost savings in £	102,505
	Payback in Years	4.5
Life cycle cost in £	Over Lifespan of technology	-1,585,460
	Over Lifespan of building	-4,756,379

Table 9: PV scenario results

Conclusion

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The 2,141m² (469kWp) of PV is the maximum array size for the roof at the end of Stage 2. It reduces the site's energy consumption by 144% and regulated CO₂ emissions by 153%. It pays back very quickly (4.5 years) and generates revenues of £1,585,460 over 20 years and £4,756,379 over 60 years. This scenario assumes all PV supplied electricity will displace grid supplied electricity or be exported. However, as SEG tariffs vary with supplier, Seg payments were not included in our modelling.

PV is highly recommended for this project.

Battery storage could be considered for this project as a means of increasing on-site use of PV-generated electricity where demand is exceeded by PV supply (likely to vary across seasons and daily use profiles). Installation of larger scale external battery solutions is currently not deemed viable from an economical or technological point of view (fire risk). though could be sized to store enough energy to serve the night-time baseload for the building throughout the year. Alternatively, excess PV electricity could be diverted into DHW stores via immersion heaters.

7.0 Conclusion

GSHP and PV were considered as potentially suitable LZC technologies for this development. PV generated electricity resulted in the highest reduction in regulated energy consumption (144%, making the building carbon negative for regulated energy)) followed by GSHP (3%).

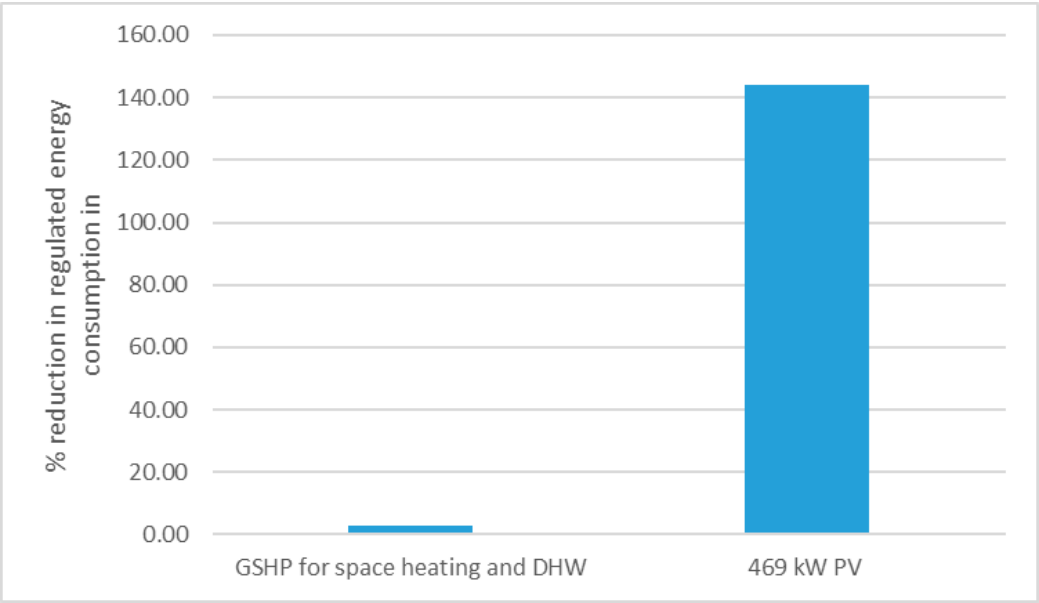


Figure 6. Reduction in energy consumption association with each LZC scenario.

GSHP reduced carbon emissions by 3%, whereas the PV array reduced it by 153%, thereby meeting and exceed the 5% carbon improvement target (Fig.7).

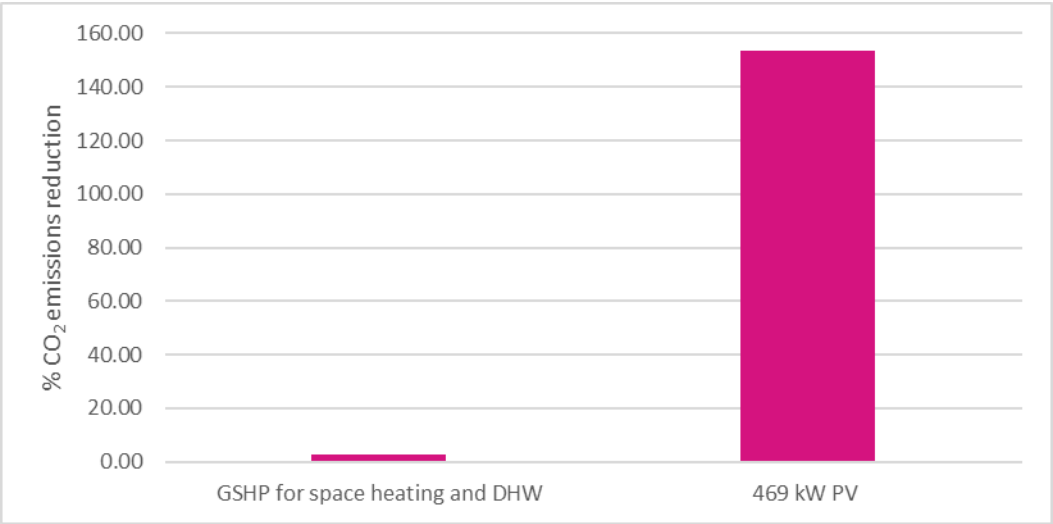


Figure 7. CO2 emissions reduction with each LZC scenario

GSHP does not pay back within its lifespan, whereas PV has a payback of 4 years (Fig. 8).

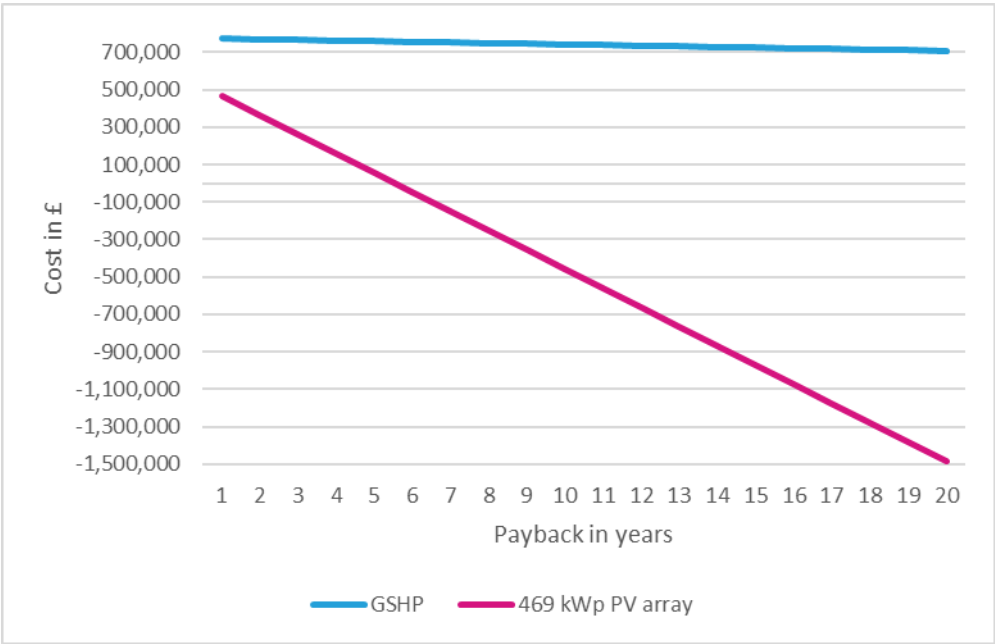


Figure 8: Line graph showing the payback periods associated with each scenario over their 20-year lifespan.

In terms of LCC, the GSHP option is very expensive, while PV generates a large, continuous revenue over each year of operation (Fig. 9).

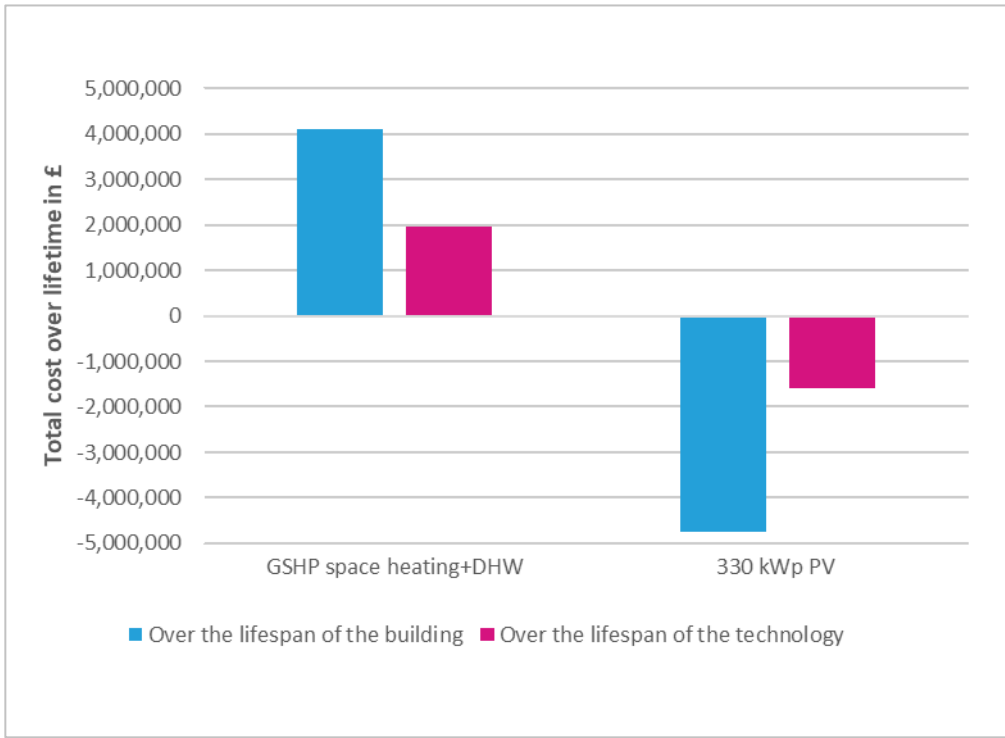


Figure 9 LCC of the LZC technologies

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Overall, installing 2,141m² of PV is highly recommended.

The GSHP option generates a modest amount of CO₂ savings but has high capital and life cycle costs associated with it and is therefore not recommended.

It should be noted that for the purpose of this study each LZC technology was looked at in isolation and the combined effect of compatible technologies was not considered

8.0 Passive design analysis

8.1 Aim

To encourage the adoption of design measures, which reduce building energy consumption and associated carbon emissions and minimise reliance on active building services systems.

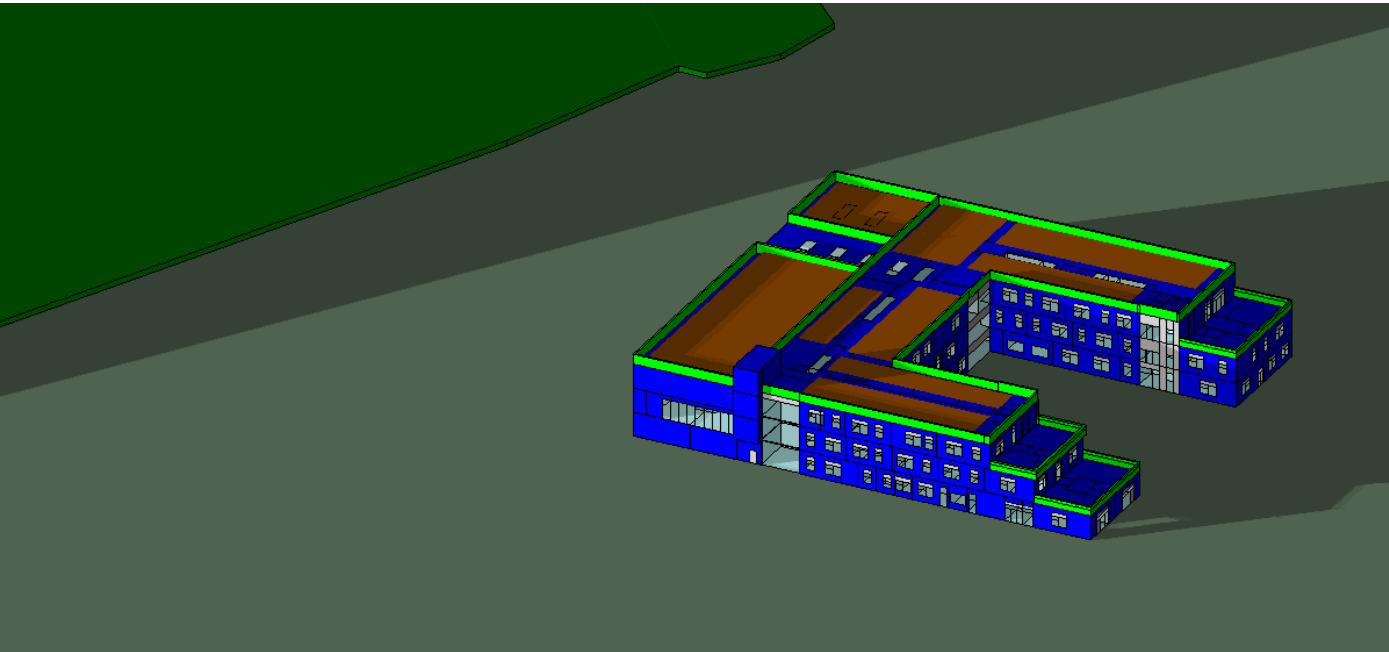


Fig. 10 Image of IES model with self-shading and shading from nearby hill

8.2 Site location

The proposed new primary school is located at Llangatwg, Aberdulais, Neath, Wales (Cymru). (5143° N, 3.47° W)

8.3 Site weather

The site is located in Marine west coast climate. Köppen Climate Classification subtype for this climate is Cfb. Westerly winds, cloudy sky, precipitation, and mild temperatures are the main characteristics of this climate.

8.4 Microclimate

The site sits within a small town setting, overshadowed by Craig Gwladus hill to the NW with a maximum elevation of 202m (approx. 160m height difference to site of proposed building). Self-shading of the building northern wing by its southern wing occurs during winter afternoons. The site location would ensure large heat island effects can be ruled out that would be present in more urban settings.

The prevailing winds come from southwest and west, as taken from the meteorological file used for the analysis. Other local microclimate factors are unknown but unlikely to have a significant impact on the building design.

8.5 Building layout

The building comprises a series of three distinct blocks, arranged in a C shape. It comprises two three-storey teaching wings connected by the hall and dining block. Two storey classroom blocks is adjoined to a larger block , the front section being only a single storey block. The ends of the teaching wings on the first and second floors are recessed to form roof terraces.

8.6 Building orientation

The main orientation of the school block of building is SE to NW.

8.7 Building form

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A heat loss factor of the school building of 1.5 was calculated, reflecting the compact three-storey geometry.

8.8 Building fabric

The building is assumed to be a highly insulated steel frame constructions meeting LETI targets for all construction elements. Details have been provided above in Table 3.

8.9 Thermal mass

Low thermal mass has been assumed due to the proposed construction method..

8.10 Building occupancy type

The building will house classrooms, Hall, , a Learning Support Centre, vocational training facilities and a Hair Salon, in addition to a small number of administration rooms. Standard circulation spaces, WCs and storage rooms are also present. The occupancy hours in are modelled based on the NCM class of building (D1 Secondary School and activity class suitable to each room (e.g. NCM D1:Teaching Areas).

8.11 Daylighting strategy

Teaching spaces and most offices are arranged around the building perimeter to take advantage of daylighting with automatic dimming of luminaires.

8.12 Ventilation strategy

The mechanical ventilation systems will operate in mixed mode, i.e. mechanical supply air with heat recovery during the winter months. Outside the heating season, the building will be largely naturally ventilated.

8.13 Adaptation to climate change

It is anticipated that activity spaces, gym and ICT classrooms will require mechanical cooling on account of the high internal gains. However, the necessity for this will be confirmed during Stage 3 thermal comfort modelling..

External shading devices for the SE and SW facades will be explored during the thermal comfort analysis.

During RIBA Stage 2, the design measures in Table 12 were discussed and implemented where details were available.

Category	Measure proposed	Impact	Measure implemented
Heating	Improve fabric U-values to LETI standard	Reduces heating load and consumption	Yes
Ventilation/Cooling	Low G value (total solar gain gain) windows specified.	Reduces the need for mechanical ventilation in perimeter zones	Yes
Lighting	Auto dimming to classrooms and offices around the perimeter specified.	Maximise daylighting, reduce electricity consumption	Yes

Table 10 Passive design options included

The implementation of these measures resulted in a CO₂ emissions reduction of 17.5% as demonstrated in Table 11 (see Appendix B for corresponding BRUKL documents).

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	Annual Demand		Annual CO ₂ Emissions	
	kWh/m ² /yr		kgCO ₂ /m ² /yr	
	Proposed	Standard	Proposed	Standard
Heating	8.96	11.84	1.88	2.49
Cooling	0.03	0.09	0.00	0.01
Auxiliary	10.68	10.84	1.45	1.47
Lighting	9.46	11.99	1.29	1.63
Total	29.12	34.76	4.62	5.60
Total Reduction	5.64		0.98	
% Improvement	16.22		17.49	

Table 11. Passive design improvement

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Appendix A - Discontinued LZC technologies

Mini Hydro

The confluence of two culverted streams on the site raises the possibility of using the flow for a microhydro turbine for year-round energy generation. However, the shallow gradient across the site combined with weak flow observed at a site visit in February 2025 appears to make even a small micro hydro turbine unfeasible.



Fig. Appendix A1 Photo of culverted stream running through the existing school site

Wind turbine

Whilst Wales has an average annual wind speed of 5.5 mph (as used in the UK SAP dataset) which would appear to make it just above the suitable level to further analyse wind power (ca 5mph as a rule of thumb), the site itself would not lend itself to wind turbines due to valley location and the hill to the NW of the site, which is the direction of the prevailing wind.

Solar thermal

Solar thermal can have an impact in buildings with high baseline DHW demand, which is not the case in this building. In addition, a solar thermal array would compete with the PV array for suitable roof space.

CHP

Gas-fired Combined Heat and Power systems are no longer desirable, from a carbon perspective, given that gas has now a higher carbon factor than electricity and heat pump efficiencies far exceed those of gas boilers. Even fuel cell CHPs ultimately rely on natural gas and are therefore no longer deemed a realistic LZC technology.

Appendix B – BRUKL’s

1.1 BRUKL Standard Building

BRUKL Output Document
Compliance with Wales Building Regulations Part L 2022



Project name	WA0347_Llangatwg School_Standard building	As designed
Date:	Tue Feb 11 14:17:06 2025	

Administrative information	
Building Details	Certification tool
Address: Address 1, City, Postcode	Calculation engine: Apache
	Calculation engine version: 7.0.27
	Interface to calculation engine: IES Virtual Environment
	Interface to calculation engine version: 7.0.27
	BRUKL compliance module version: v5.1.e.1
Certifier details	
Name: Name	
Telephone number: Phone	
Address: Street Address, City, Postcode	

The CO ₂ emission and primary energy rates of the building must not exceed the targets		
The building does not comply with Wales Building Regulations Part L 2022		
Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	5.3	
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	4.3	
Target primary energy rate (TPER), kWh _p /m ² annum	27.11	
Building primary energy rate (BPER), kWh _p /m ² annum	45.82	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER > TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency				
Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.18	0.18	0000000B:Surf[6]
Floors	0.22	0.15	0.15	00000000:Surf[0]
Pitched roofs	0.2	0.16	0.16	01000005:Surf[8]
Flat roofs	0.2	0.18	0.26	02000024:Surf[3]
Windows**	1.6	1.4	1.4	0000000B:Surf[1]
Roof windows	1.8	1.2	1.2	01000030:Surf[1]
Rooflights***	2.2	1.25	1.25	02000022:Surf[2]
Personnel doors	1.8	1.2	1.2	0000000B:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for roof windows. ** Automatic U-value check by the tool does not apply to glazed doors whose limiting standard is similar to that for personnel doors. Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				
Air permeability	Limiting standard	This building		
m ³ /(h.m ²) at 50 Pa	8	3		

1.2 BRUKL proposed/basecase building

BRUKL Output Document
Compliance with Wales Building Regulations Part L 2022



Project name	WA0347_Llangatwg School_Design Basecase LZC without PV arrays	As designed
Date:	Tue Feb 11 14:46:14 2025	

Administrative information	
Building Details	Certification tool
Address: Address 1, City, Postcode	Calculation engine: Apache
	Calculation engine version: 7.0.27
	Interface to calculation engine: IES Virtual Environment
	Interface to calculation engine version: 7.0.27
	BRUKL compliance module version: v5.1.e.1
Certifier details	
Name: Name	
Telephone number: Phone	
Address: Street Address, City, Postcode	

The CO ₂ emission and primary energy rates of the building must not exceed the targets		
The building does not comply with Wales Building Regulations Part L 2022		
Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	5.3	
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.8	
Target primary energy rate (TPER), kWh _p /m ² annum	26.63	
Building primary energy rate (BPER), kWh _p /m ² annum	40.34	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER > TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency				
Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.13	0.13	0000000B:Surf[6]
Floors	0.22	0.1	0.1	00000000:Surf[0]
Pitched roofs	0.2	0.12	0.12	01000005:Surf[8]
Flat roofs	0.2	0.1	0.19	02000024:Surf[3]
Windows**	1.6	1.2	1.2	0000000B:Surf[1]
Roof windows	1.8	1.2	1.2	01000030:Surf[1]
Rooflights***	2.2	1.25	1.25	02000022:Surf[2]
Personnel doors	1.8	1.2	1.2	0000000B:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for roof windows. ** Automatic U-value check by the tool does not apply to glazed doors whose limiting standard is similar to that for personnel doors. Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				
Air permeability	Limiting standard	This building		
m ³ /(h.m ²) at 50 Pa	8	3		

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