CGP | MEP

Project:	**Millom Leisure Centre**
Document No.:	**14810-CGP-00-ZZ-RP-N-0003**
Document Title:	**Energy Use Design Note**
Date:	**29th June 2023**

Revision History

Revision 1 – Stage 3 report issue.

Purpose of Design Note

The purpose of this design note is to demonstrate the difference is predicted annual energy/carbon use for the systems proposed as part of the Stage 3 design proposals for the Millom Leisure Centre in Millom, Cumbria and compares the proposed system performance to the energy performance of a 'notional' leisure centre.

The notional building has been generated by the government approved energy performance software, IES VE Compliance which, in accordance with government requirements, utilises national calculation methodology (NCM) templates to generate a 'notional' building to provide a compliance target for the type of building assessed. The notional building is constructed within the software to match the geometry, internal layout, services strategy, operating profiles, etc. of the proposed leisure centre. The notional building will be utilised as the baseline for comparison and will be based on the comparative input data for proposed option 1.

Within the software, the proposed energy solution efficiencies and operational profiles are inputted and the software, relative to the NCM templates, generates a Building Regulations UK Part L (BRUKL) compliance report providing comparative carbon usage relative to the notional building.

The current proposed engineering strategies has been developed to achieve the governments and local councils objective of providing decarbonised buildings to achieve the carbon emission targets.

This design note includes compliance confirmation for Building Regulations Part L2 (2021) and the predicted EPC of each option assessed.

It should be noted that the BRUKL generated energy use is for regulated energy only, this includes general heating and cooling, ventilation, domestic hot water and lighting only.

The calculation methodology does not include for energy usage associated with unregulated or process related energy including; the pool plant system, kitchen, general small power, specialist equipment such as treadmills, gym equipment, specialist or feature lighting, etc. As these are classified as process loads so cannot be compared to the notional building for compliance and as such associated energy usage and costs are not included in the assessment.

It is therefore important to note that the actual energy used by the building will be significantly higher than the loads stated within this design note.

Strategic Sustainability Priorities

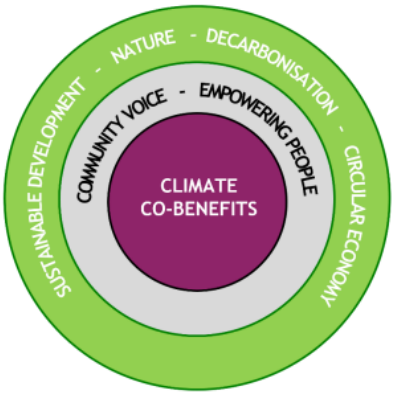
This Sustainability Strategy & Climate Action Plan is aligned to the doughnut economics[14] and community wealth building[15] principles of the Copeland Vision 2040. In relation to the Nature and Climate Crises, the Bruntland definition[16] of sustainability is not enough, because we have to regenerate in order to avoid imposing unfair risks and costs on future generations.

Our strategic sustainability priorities are:

1. **Decarbonisation**: We must urgently move to a post-carbon economy
2. **Circular Economy**: We must urgently reduce dependence on linear usage of energy and resources
3. **Nature**: We will establish regenerative systems that restore life
4. **Sustainable Development**: We will ensure that physical development is aligned to this sustainability strategy
5. **Community**: We will empower communities and influence action by partners
6. **Co-benefits**: We will focus on inclusive climate co-benefits for our people and communities (see below)

We will hold ourselves and others to account against these priorities.

Focus on Climate Co-Benefits: This Sustainability Strategy identifies areas of co-benefit that can be achieved by taking action to adapt to and mitigate the future effects of climate change. The focus here is to consider a more socially and environmentally purposeful approach to economic growth, in a way that generates positive, inclusive outcomes for people and place now and for the future.



Above: Exert from Copeland Borough Council Sustainability Strategy and Climate Action Plan 2022-23

Options Assessed

The 3 options we have assessed are:

1. Combined air source heat pump and VRF solution - all pool plant, AHU coils and hot water requirements within the building provided via the air source heat pumps and heating and cooling to rooms provided via VRF
2. Combined air source heat pump and natural gas solution - AHU coils and hot water requirements within the building provided via the air source heat pumps, room heating and cooling provided via VRF and pool plant provided with gas fired boilers to serve the heat exchangers
3. Combined air source heat pump and natural gas solution - air source heat pumps to act as primary heat source to a % with support/remainder via gas technology (boilers, gas fired water heaters, CHP), room heating and cooling provided via VRF

Heating System Operating Hours

The following assumptions have been made for the operation of the heating plant:

- Hot water – 80% full load from 60 minutes before opening to closing
- General heating – as required to maintain either operational temperatures or frost protection, calculated within the model
- Air Handling Unit Coils – fully operational when centre is open, Pool AHU runs continuously but assumed 80% recirculation when pool is closed, Wet Change AHU runs at lower volume when centre is closed to provide make up air to the pool
- Pool – unoccupied load from closing until opening with 2-hour period allowed for daily backwash, occupied load when pool is open

Leisure Centre Opening Hours

The leisure centre opening hours have been assumed as the following and used to inform the calculation.

Monday to Friday – 7:00am to 10:00pm
Saturday – 8:00am to 8:00pm
Sunday – 8:00am to 6:00pm

Fabric Performance

The table below indicates the U-Values that have been used for the construction on this project.

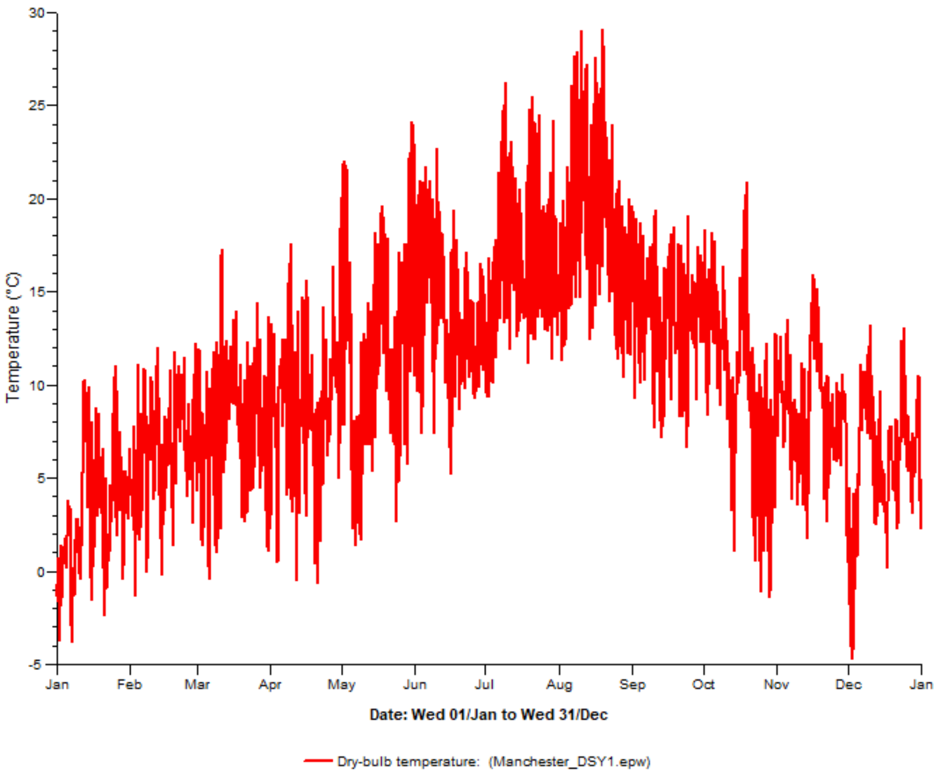
Element	U-values (W/(m^{2}K))
Roof	0.14
Wall	0.16
Curtain wall	n/a
Floor	0.14
Doors	1.26
Glazing elements/rooflight (including frame)	1.26
Air Permeability (m^3/hr per m$_2$ @ 50Pa)	3

Above: Proposed Design U-Values

All other information has been input as per the Stage 2 MEPH Design Proposals Report (14810-CGP-00-ZZ-RP-N-0001) and NCM templates within the IES model.

Temperature Profile

The following graph shows the annual temperature profile for Manchester using the DSY template for the assessments.

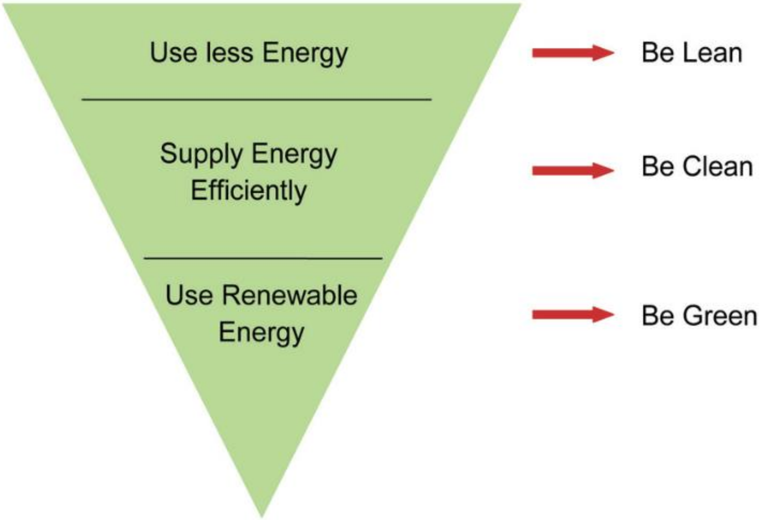


Above: Annual temperature profile for Manchester (closest location to Millom)

Energy Hierarchy

The proposed design will be modelled on the energy efficiency hierarchy of "Be Lean, Be Clean, Be Green" approach to energy efficiency in buildings.

- Reducing the building energy consumption "Be Lean" by optimising the design and construction of the building to ensure less energy is required;
- Supplying the energy required in an efficient manner, district heating etc "Be Clean";
- Supplying the energy from Low Zero Carbon and Renewable Energy Sources, ASHP, PV, etc "Be Green";



Heat Network Opportunities

Consideration has been given to the possible connection to an existing or proposed area wide decentralised energy network. The UK CHP Development Map is an interactive tool, using an interactive GIS system, which allows users to identify opportunities for decentralised energy projects in the UK. This tool details the existing heat loads and supplies within the UK as well as existing heat distribution networks.

Following a review of Heat Map, it has been established that there are currently no existing district heating networks located in the vicinity, that the proposed development could link to (see Figure 1 below).

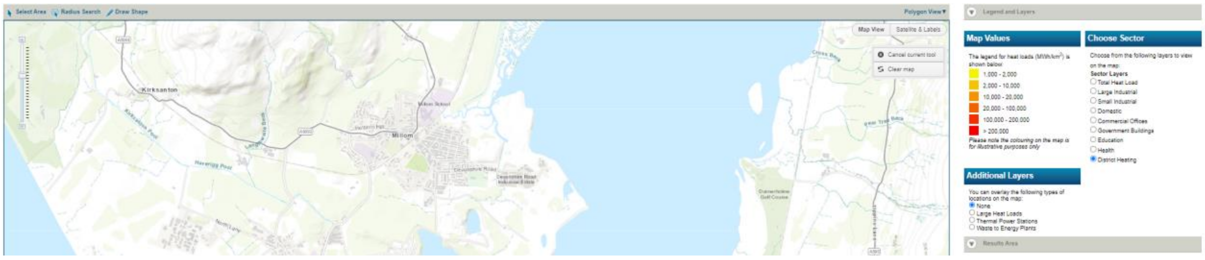


Figure 1: District Heating connections.

As a result of a comprehensive research, it can be concluded that at this stage no firm plans exist for this particular focus area to confirm the timescale for the potential network. Thus, as there is no heating network in the area to connect to and it is unclear when any potential networks will be completed, the proposed development will not be connected to the district heating network.

Option 1 – Combined ASHP and VRF Solution

Heating serving domestic hot generating plant, AHU coils and pool hot water plate heat exchangers is to be via an air to water ASHP system with a seasonal efficiency of 2.74.

Heating and cooling to individual rooms, not provided with heating only, is to be via a VRF solution with efficiencies of 3.5 heating and 5.0 cooling.

Option 2 – Combined ASHP, VRF and Gas Proposal (Pool Plant by Gas Boilers)

System Description

Heating serving domestic hot generating plant, AHU coils and pool hot water plate heat exchangers is to be via an air to water ASHP system with a seasonal efficiency of 2.74.

Heating and cooling to individual rooms, not provided with heating only, is to be via a VRF solution with efficiencies of 3.5 heating and 5.0 cooling.

Pool water plate heat exchangers is to be via gas fired boilers with a seasonal efficiency of 0.95.

Option 3 – Combined ASHP, VRF and Gas Proposal (CHP)

System Description

Heating serving domestic hot generating plant, AHU coils and pool hot water plate heat exchangers is to be via an air to water ASHP system with a seasonal efficiency of 2.74.

The building central plant is to be supplemented by a Combined Heat and Power (CHP) unit with a nett thermal efficiency of 70.2% and nett electrical efficiency of 35.1%

Heating and cooling to individual rooms, not provided with heating only, is to be via a VRF solution with efficiencies of 3.5 heating and 5.0 cooling.

Note:

For the three options the mechanical and electrical services equipment will be selected to comply with the non-domestic compliance guide for performance and energy efficiency.

Option Comparison

The following table summarises the performance of each option as a percentage of the baseline building:

	Option 1	Option 2	Option 3
Predicted Annual Gas Use (kWH)	N/A	N/A	473,040
Predicted Annual Electricity Use (kWH)	261,490	261,490	95,050
Predicted Annual Gas Use (Tonne CO2)	N/A	N/A	95,7
Predicted Annual Electricity Use (Tonne CO2)	54.2	54.2	19.7

Notes:

- The predicted energy use is based from industry standard templates (NCM).
- Energy usage associated with; the pool plant system, kitchen, general small power, specialist equipment such as tag active, treadmills, etc, specialist or feature lighting, etc. is not included within the above.
- Option 2 Gas consumption is classified as a process load and therefore predicted consumption figures are unknown.
- Carbon Conversion Factors based on UK Government GHG Conversion Factors published 7th June 2023 of Gas – 0.20226 and Electricity – 0.207074

It is therefore important to note that the actual energy / carbon used by the building will be significantly higher than the loads stated within this design note.

Operational Costs Comparison

The following table summarises the performance of each option:

	Option 1	Option 2	Option 3
Predicted Annual Gas Use (£)	N/A	N/A	£24,409
Predicted Annual Electricity Use (£)	£61,084	£61,084	£22,204
Total Cost (£)	£61,084	£61,084	£46,613

Notes:

- The above total costs have been based on the below costs per kWh as stated for Medium Buildings (exc. CCL) within the Energy Prices Non-Domestics Prices provided by the Department for Energy Security and Net Zero.
  Electricity = 23.36 (pence per kWh)
  Gas = 5.16 (pence per kWh)
- The above costs exclude associated standing charges.

Unregulated Loads Assessment

The following details an initial high-level assessment of unregulated loads within the building, these loads are early-stage assessments only and the assumptions stated below;

Pool Plant Heating:

Main Pool -

Occupied Load =	97 hours/week x 75.00 kW x 52 weeks/year	=	378,300 kWh/annum
Unoccupied Load =	57 hours/week x 38.00 kW x 52 weeks/year	=	112,632 kWh/annum
Backwash Load =	14 hours/week x 110.0 kW x 52 weeks/year	=	80,080 kWh/annum
Cold Fill Load =	80 hours x 110.0 kW	=	8,800 kWh/annum

TOTAL LOAD = 579,812 kWh/annum

Electrical load based on a seasonal efficiency of 2.74 = 579,812 ÷2.74 = 211,610 kWh/annum

Notes:

- Pool plant loadings estimated only based on similar leisure facility loadings
- Cold fill load based on a heat up rate of 0.25°C/hr heating cold water from 10°C to 30°C

Pool Plant Electrical:

Pool Pumps and Ancillaries = 168 hours/week x 31.00 kW x 52 weeks/year = 270,816 kWh/annum

Notes:

- Based on similar pool electrical loadings with a diversity of 0.75 applied

Kitchen:

Simultaneous peak load = 21 hours/week x 20.00 kW x 52 weeks/year = 21,840 kWh/annum

Notes:
- It is assumed that the kitchen will have a peak electrical consumption for a period of 3 hours per day
- Kitchen equipment loadings estimated only based on similar leisure facility loadings

Fitness:

Simultaneous peak load = 22 hours/week x 40.00 kW x 52 weeks/year = 45,760 kWh/annum

Notes:
- It is assumed that the fitness equipment will have a peak electrical consumption for approximately 25% of the Pool and Fitness Centres opening hours
- Electrical loadings for fitness equipment estimated only based on similar leisure facility loadings

External Lighting:

External lighting electrical estimated only based on similar leisure facility loadings = 7,394 kW/annum

Option Comparison incorporating Unregulated Loads

The following table summarises the above estimated performance / use of each option for combining both the regulated and unregulated loads:

	Option 1	**Option 2**	**Option 3**
Predicted Regulated Annual Gas Use (kWh)	N/A	N/A	473,040
Predicted Regulated Annual Electricity Use (kWh)	261,490	261,490	95,050
Predicted Unregulated Annual Gas Use (kWh)	N/A	608,803	N/A
Predicted Unregulated Annual Electricity Use (kWh)	557,420	345,810	557,420
Predicted Total Annual Gas Use (kWh)	N/A	608,803	473,040
Predicted Total Annual Electricity Use (kWh)	818,910	607,300	652,470
Predicted Annual Gas Use (Tonne CO2)	N/A	123.2	95.7
Predicted Annual Electricity Use (Tonne CO2)	169.6	125.8	135.1
Total Predicted Carbon Output (Tonnes CO2)	169.6	249.0	230.8
Energy Performance Certificate Rating	A	A	A

Notes:
- The predicted regulated energy use is based from industry standard templates (NCM).
- The estimated unregulated energy use is based on the calculations completed earlier in the report.
- Carbon Conversion Factors based on UK Government GHG Conversion Factors published 7th June 2023 of Gas – 0.20226 and Electricity – 0.207074

Operational Costs Comparison incorporating Unregulated Loads

The following table summarises the performance of each option incorporating the estimated unregulated loads:

	Option 1	Option 2	Option 3
Predicted Annual Gas Use (£)	N/A	£31,414	£24,409
Predicted Annual Electricity Use (£)	£191,297	£141,865	£152,417
Total Cost (£)	£191,297	£173,279	£176,826

Notes:

- The above total costs have been based on the below costs per kWh as stated for Medium Buildings (exc. CCL) within the Energy Prices Non-Domestics Prices provided by the Department for Energy Security and Net Zero.
  Electricity = 23.36 (pence per kWh)
  Gas = 5.16 (pence per kWh)
- The above costs exclude associated standing charges.
- The above costs have been calculated based on the day rate value for electrical consumption and will be assessed and developed further at the next stage of design.

Photovoltaic Installation

The proposed scheme currently allows for a 25kWe photovoltaic panel (PV) array to support the carbon reduction targets for the project. At this stage of the project this is a notional allowance for further discussion to allow final selection and design of a PV array to be developed.

The proposed 25kWe array, based on the BRUKL report, would generate a total of approximately 18,450kWh/annum.

The application of PV arrays as part of the Part L2 (2021) compliance software has limited effect on BRUKL output and EPC rating as the software classifies the energy produced as displaced electricity.