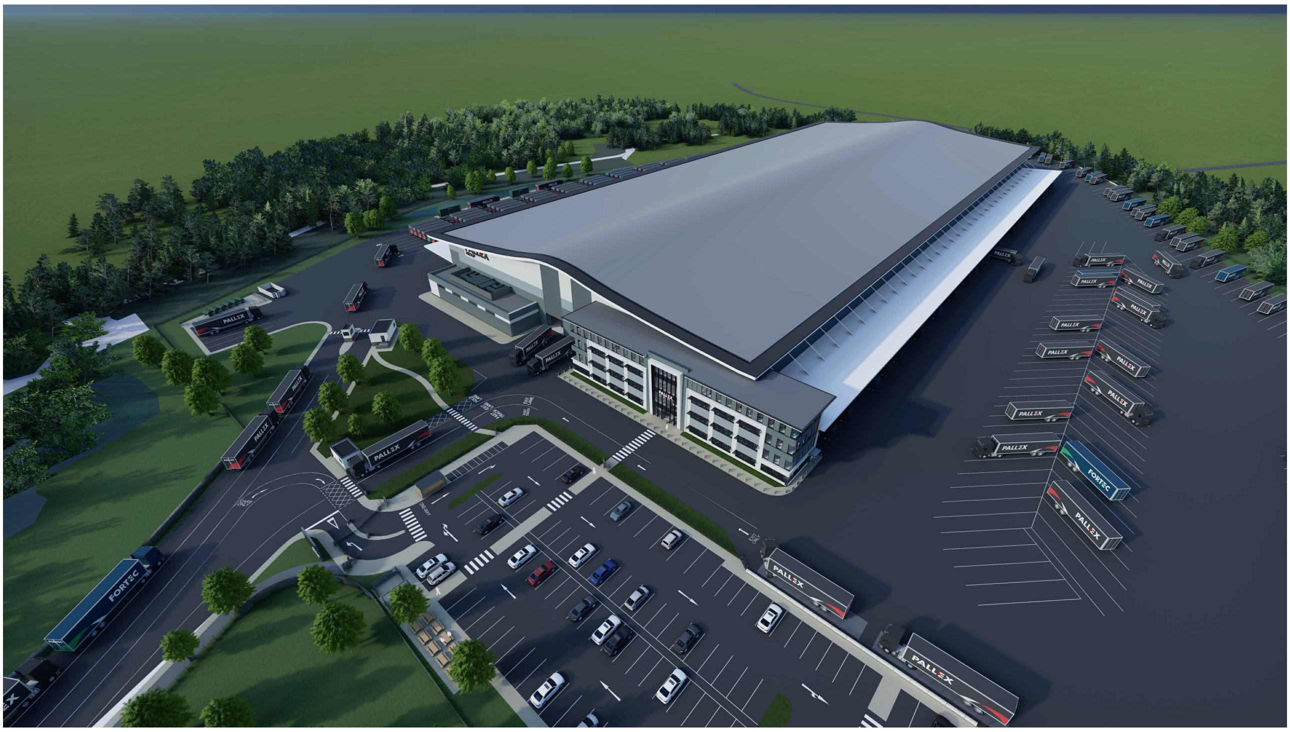
ENE 04-LZC Feasibility Study Report

Excellence, Land at Wiggs Farm,

Station Road, Coalville



Author: Hadi Mozaffari
D.W.Pointer
4 Sugar Brook Court
Aston Hall Road
Bromsgrove
B60 3EX

DWP
D.W.POINTER & PARTNERS LTD

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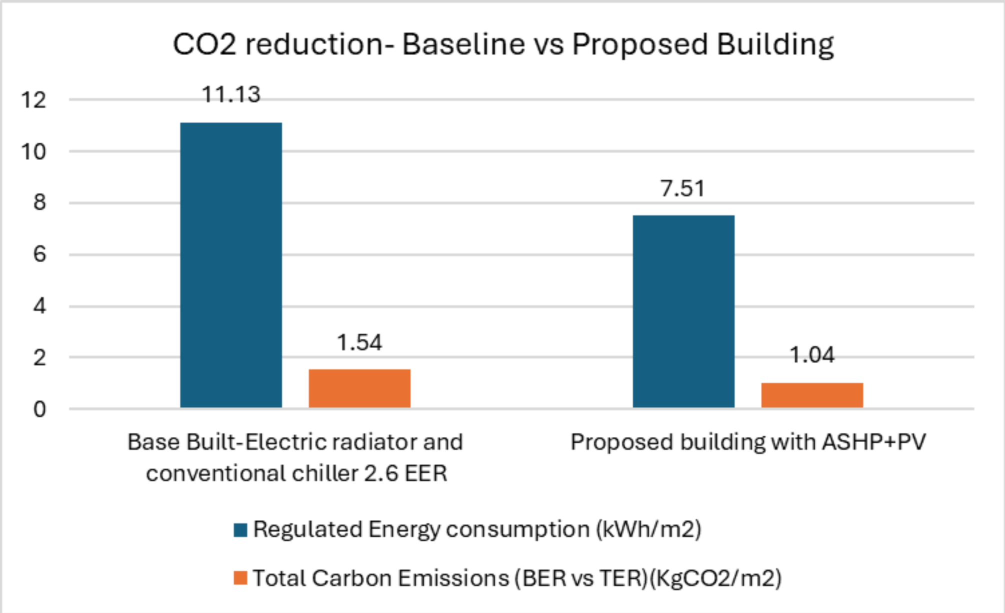
EXECUTIVE SUMMARY

DW Pointers has been appointed by Barberry Bardon Limited and conducted a Low and Zero Carbon (LZC) feasibility study and prepare a report for the proposed project Excellence, Land at Wiggs Farm, Station Road, Coalville, Leicestershire. The study has identified three appropriate technologies for the site and development: Variable Refrigerant Volume (VRV) systems, Air Source Heat Pumps (ASHP), and Photovoltaic Panels (PV). Further analysis of these technologies revealed that ASHPs and PVs are the most feasible options based on the calculated payback period. By implementing these low and zero carbon technologies, the building is projected to achieve a 32.5% reduction in carbon emissions, generating 78,950 kWh per year from renewable sources (500 m^2 Photovoltaics).



BREEAM Credits

Based on the BRUKL results (please refer to Appendix A), inclusion of 500 m^2 of photovoltaic panels and 32.5% CO2 reduction, the BREEAM calculator shows that for ENE04, LZC, 1 credit can be awarded, as well as 6 credits for EN01 Energy Performance.

BREEAM NC Version 6 Pre-Assessment

Wiggs Farm for Barberry

45734

Energy				Available	Target
Ene 01	Reduction of Energy Use & Carbon Emissions	Energy Performance	Developed Design	9	6
		Energy Modelling & Reporting	Developed Design	4	4
Ene 02	Energy Monitoring	Sub-Metering of End-Use Categories	Technical Design	1	1
		Sub-Metering of High Energy Load & Tenancy Areas	Technical Design	1	1
Ene 03	External Lighting	External Lighting	Developed Design	1	1
Ene 04	Low Carbon Design	Passive Design Analysis	Concept Design	1	1
		Free Cooling	Concept Design	1	0
		Low & Zero Carbon Technologies	Concept Design	1	1
Ene 06	Energy Efficient Transportation Systems	Energy Consumption	Developed Design	1	1
		Energy Efficient Features - Lifts	Technical Design	1	1
			Section Total	21	17
			Section Score %	14.00	11.33
			Single Credit Value %	0.67	

Energy performance - Building score

Heating and cooling demand energy performance ratio (EPRdem)	0.259
Primary energy consumption performance ratio (EPRpe)	0.072
CO_2-eq energy performance ratio (EPRco2-eq)	0.28
Overall building energy performance ratio (EPRnc)	0.612
Total BREEAM credits achieved	6.0
Is the primary energy consumption the same or lower than that of the notional building?	Yes
Is the primary energy consumption at least 10% lower than that of or higher than that of the notional building?	Yes

Calculate score | Clear

Contents

1 INTRODUCTION

DW Pointer has been commissioned to conduct a Low and Zero Carbon (LZC) feasibility study and prepare a report for the proposed project known as Excellence, Land at Wiggs Farm, Station Road, Coalville, Leicestershire. This report will contribute to the BREEAM Assessment, New Constructions, V6 for the development.

This Energy Report comprises:

- A scheme overview
- A review of the planning context
- Analysis of Low and Zero Carbon Technologies
- Review of available grants and funding
- Calculation of Life cycle costs and payback periods for the suitable technologies
- Proposed design energy and carbon calculations

2 SCHEME OVERVIEW

The provided information indicates that the project entails the construction of an industrial warehouse with office area of Excellence, Land at Wiggs Farm, Station Road, Coalville, Leicestershire. The development encompasses a total area of 34,780 m^2 and is intended to serve multiple purposes, including:

- Warehousing space: The main function of the facility, providing ample floor area for storage.
- Offices: Positioned on the ground, first, second and third floors to facilitate administrative and operational activities.
- QC office with 164 m^2 located in south-west of the site.
- Restroom and kitchenette facilities: Designed to support the staff working within the development.

3 PURPOSE & REQUIREMENTS OF THE LZC ASSESSMENT

This feasibility study has been commissioned to fulfil the requirements of the BREEAM assessment, New Construction Version 6 concerning credit Ene 04.

The Ene 04 credit, titled 'Low and Zero Carbon Feasibility Study,' outlines the following criteria:

One credit is awarded for the completion of a Low and Zero Carbon Feasibility Study (BREEAM Criteria 9 to 12).

An energy specialist must finalize the feasibility study by the conclusion of the Concept Design phase.

The study should identify the most suitable recognized local (on-site or nearby) low and zero carbon (LZC) energy sources for the building or development. It should also recommend local LZC technologies for the project in accordance with the findings of the feasibility study.

Finally, the study must quantify the reduction in regulated carbon dioxide (CO_2-eq) emissions resulting from its recommendations.

Assess the quantified reduction in regulated carbon dioxide (CO_2–eq) emissions resulting from the feasibility study. The LZC report includes, at a minimum, the following elements:

1. Annual energy production from the LZC energy source, detailed in Table 4 of the document.

2. Annual carbon dioxide reductions attributable to the LZC energy source, as presented in Table 3 of the document.

3. The life cycle cost associated with the proposed specification, including payback period, is outlined in Tables 1 and 2 of this document.

4. Local planning considerations, such as land use and noise regulations, are addressed in section 4 of the document.

5. The feasibility of exporting heat or electricity from the system is evaluated, noting that no combined heat and power (CHP) system has been considered, thus preventing heat export.

6. Information regarding any available grants can be found in Section 7 of the report.

8. An evaluation of the feasibility of renewable technologies is detailed in Section 5 of this report.

9. If applicable:

a. The building is linked to an existing local community combined heat and power (CHP) system, or

b. The building is connected to a current source of waste heat or power, or

c. A CHP system for the building or site is proposed, with the capability to export surplus heat or power through a local community energy initiative, or

d. A source of waste heat or power is identified, with the potential to export excess heat or power via a local community energy initiative.

(Note: CHP is not suitable for this type of building.)

4 REGULATIONS & POLICIES

4.1 National Level Policies – National Planning Policy Framework

The National Planning Policy Framework was revised in response to the Levelling-up and Regeneration Bill: reforms to national planning policy consultation on 19 December 2023 and sets out the government's planning policies for England and how these are expected to be applied. On 5 September 2023 the Secretary of State for the department issued a written ministerial statement to update policy on planning for onshore wind development in England.

This revised Framework replaces the previous National Planning Policy Framework published in March 2012, revised in July 2018, updated in February 2019, revised in July 2021 and updated in September 2023.

The NPPF set out the Government's planning policies for England and how these are expected to be applied. The NPPF is designed to make the planning system less complex and more accessible; to protect the environment and promote sustainable growth. It provides a framework within which local people and their respective councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

At the heart of the NPPF is a presumption in favour of sustainable development (paragraph 11). The three dimensions of sustainable development can be defined as the economic, social and environmental.

Plans should provide a framework for addressing housing needs and other economic, social and environmental priorities; and a platform for local people to shape their surroundings. Strategic policies should set out an overall strategy for the pattern, scale and quality of development.

The NPPF (paragraph 150) states that new development should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change; and help to reduce greenhouse gas emissions. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

The NPPF aims to strengthen local decision making, with the use of decision-taking in a positive way, as a means of fostering the delivery of sustainable development.

Finally, the NPPF (paragraph 16) also highlights that plans should be prepared with the objective of contributing to the achievement of sustainable development and in a way that is aspirational but deliverable.

4.2 Building Regulations Part L[1]

Building Regulations are statutory instruments that seek to ensure that the policies set out within any relevant UK legislation are carried out. Building regulations approval is required for the majority of building work carried out in the United Kingdom.

Part L of these regulations covers the requirements with respect to the conservation of fuel and power in all building types. It controls the insulation values of building fabric elements and openings, the air permeability of the structure, the heating efficiency of heating, ventilation and air conditioning systems together with hot water storage and lighting efficiency. It also sets out the requirements for calculating the carbon dioxide emissions and the Carbon Emission Targets for each building type.

Part L 2013 is split into four sections[2]:

- L1A New Dwellings.
- L1B Existing Dwellings.
- L2A New Buildings other than Dwellings.
- L2B Existing Buildings other than Dwellings.

4.3 Regional Level Policies

The relevant authority for this site is Leicester Council.

The key policy framework applicable to the energy aspects of the development is outlined below. The Local Development Plan comprises of the Leicester Council Core Strategy Local Plan and is supported by a number of Supplementary Planning documents.

[1] BREEAM New Construction Version 6 follows Part 2021 regulation.

[2] Currently, Part L is divided into Volume 1 for dwellings and Volume 2 for non–dwellings, focusing on energy efficiency and carbon emission reductions.

Leicester City Council/ Supplementary Planning Document

The purpose of this guide is to provide advice to planners, architects and developers on how to address the issue of climate change in relation to new developments and renovations. The document supplements the Core Strategy, in particular Policy CS02 Addressing Climate Change and Flood Risk (See Box One), and will:

- Support the transition to a low carbon future in a changing climate.
- Help shape places so as to cut greenhouse gas emissions.
- Actively support and drive renewable and low carbon energy production.
- Help secure new developments against the impacts of climate change.

It sits alongside and supports the Energy Efficiency and Renewable Energy Supplementary Planning Document (SPD), adopted November 2005 which supports the Local Plan (adopted 2006).

CS POLICY 2. ADDRESSING CLIMATE CHANGE AND FLOOD RISK

All development must mitigate and adapt to climate change and reduce greenhouse gas emissions. The Council will prepare a Climate Change Supplementary Planning Document to provide more detailed guidance and information on sustainable energy, building methods and climate change adaptation to minimise the impact of development.

The following principles provide the climate change policy context for the City:

1. Code for Sustainable Homes Level 3 will be required where feasible. This will be increased progressively over the plan period where feasible to support the Government's longer term aspiration for new homes to achieve Level 6. (Not applicable for this development).
2. Best practice energy efficiency and sustainable construction methods, including waste management, should be incorporated in all aspects of development, with use of locally sourced and recycled materials where possible, and designed to high energy and water efficiency standards.
3. Wherever feasible, development should include decentralised energy production or connection to an existing Combined Heat and Power or Community Heating System.
4. Development should provide for and enable, commercial, community and domestic scale renewable energy generation schemes. Development of large-scale renewable energy schemes will be considered in all suitable locations.

5. Development should be directed to locations with the least impact on flooding or water resources.
6. Where development is proposed in flood risk areas, mitigation measures must be put in place to reduce the effects of flood water. Both greenfield and brownfield sites should be assessed for their contribution to overall flood risk, taking into account climate change. All development should aim to limit surface water run-off by attenuation within the site as a means to reduce overall flood risk and protect the quality of the receiving watercourse by giving priority to the use of sustainable urban drainage techniques in development.
7. Development should ensure a shift to the use of sustainable low emission transport to minimise the impact of vehicle emissions on air quality, particularly in Air Quality Management Areas. Development will be located where it is accessible by sustainable transport to support the use of public transport, walking and cycling as an alternative to the car. Higher density development will be located in areas with easy access to local facilities to reduce the need to travel.
8. Green Infrastructure should be used as a way of adapting and mitigating for climate change through the management and enhancement of existing habitats and the creation of new ones to assist with species migration, to provide a source of locally grown food through local allotments and to provide sustainable transport routes, to provide shade and counteract the urban heat island and flood mitigation strategies.
9. Existing development should wherever possible be adapted to climate change and help contribute to the reduction in carbon emissions by, where appropriate, including the introduction of green roofs, microrenewable energy, recycling facilities, building efficiency measures and cycle parking.

What To Aim For:

1. All buildings oriented with longest face 30° from south to maximise potential for solar.
2. Improvement of thermal performance by 44% on 2006 Building Regulations, Part L.
3. Maximise the thermal mass of the building.
4. Achieve a minimum of Level 3: Code for Sustainable Homes.
5. Connect to an existing decentralised energy system or develop a stand-alone system.
6. Install onsite renewable technologies.
7. Targets for onsite renewables = page 10, Energy Efficiency and Renewables SPD.

Leicester City local development framework- CORE STRATEGY adopted July 2014

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8. Existing development should wherever possible be adapted to climate change and help contribute to the reduction in carbon emissions by, where appropriate, including the introduction of green roofs, micro-renewable energy, recycling facilities, building efficiency measures and cycle parking.

5 ANALYSIS OF LOW AND ZERO CARBON TECHNOLOGIES

To fulfil the Ene04 credit requirement for the on-site LZC feasibility study, an assessment was conducted regarding the installation of solar thermal panels, photovoltaic systems, wind turbines, biomass, and heat pumps.

Solar Thermal Feasibility Analysis

Solar thermal systems generate energy for the provision of domestic hot water (DHW) by converting sunlight into heat. These systems typically work in tandem with conventional boilers to ensure hot water demand is met during periods of low solar energy availability. However, it is important to note that no gas installations have been included in this project, which would typically be required for a conventional boiler to support the solar thermal system. The two primary solar thermal technologies considered are flat plate collectors and evacuated tubes, with the latter typically being more efficient, especially in colder climates like Northamptonshire.

Warehouses generally have low hot water demand, as they are not typically designed for activities requiring large amounts of DHW. In this case, the warehouse office spaces itself is likely to have minimal hot water requirements, such as for:

- Handwashing in restrooms
- Occasional cleaning tasks

This demand would be too low to justify a solar thermal system, as the energy generated may not be efficiently utilized, leading to underutilisation of the system and poor return on investment.

Integration with Existing Systems

The warehouses would need to integrate the solar thermal system with a backup water heater or alternative solution, as gas installations (for conventional boilers) have not been included in the design. Relying solely on solar may not be sufficient, particularly during periods of low sunlight. The complexity and cost of integrating these systems into an auxiliary building may reduce the attractiveness of this option.

In conclusion, a solar thermal system may <u>not be feasible</u> for Excellence, Wiggs Farm development, as the primary hot water demand is expected to be low.

Wind Turbines

Based on data from the Global Wind Atlas[3] and general assessments, the average wind speed in the NN12 6HP area, especially at standard turbine hub heights (around 100 meters), tends to fall in the range of 5.5 to 6.5 meters per second (m/s). Wind speeds above 6 m/s are generally considered viable for wind power generation, though exact feasibility depends on specific turbine models and local topography. For example, small increases in wind speed can significantly improve energy output.

In conclusion, based on the wind data and regional conditions in the Excellence, land at Wiggs Farm, wind power is not considered to be the optimal renewable energy solution for the warehouses. While wind speeds in the area approach the threshold needed for economic viability, the marginal wind potential combined with the typical energy needs of a warehouse and possible physical obstacles could result in inefficient energy generation. Furthermore, the cost of wind turbine installation and the need for long-term wind measurements to fully assess the potential make it a less attractive option without clearer wind resource evidence.

Photovoltaic Panels

Photovoltaic (PV) technology has been selected as the optimal renewable energy solution for the site, particularly due to the extensive roof space available. These large, unobstructed roof areas provide an ideal platform for solar panel installation, enabling the generation of significant amounts of electricity without impacting the usable space within the building or surrounding property.

The choice of PV is further justified by the ability of the system to generate electricity directly on-site, which can be used to power both communal areas and individual systems. Unlike other renewable options, such as wind power, PV systems have a lower visual and operational impact and require minimal maintenance once installed. This is particularly advantageous for a warehouse or commercial building, where operational simplicity is a priority.

Additionally, the relatively straightforward integration of PV with existing electrical infrastructure allows for energy cost savings over the long term. Given the available roof area, the scheme can maximize solar energy production, ensuring a higher return on investment and supporting long-term sustainability goals. The site's location and climate conditions are also well-suited for solar energy generation, making it a reliable and efficient choice.

[3] The **Global Wind Atlas** is a free online tool that provides high-resolution data on wind resources worldwide. It is designed to help users assess the potential for wind energy development in different regions by offering detailed wind speed maps and related data at various heights (typically ranging from 50m to 200m above ground).

By capitalising on the available roof space, the PV system can meet a substantial portion of the site's electricity needs, reducing reliance on grid electricity and lowering operational costs, thus reinforcing the selection of PV as the most feasible option for this site.

Energy storage via batteries, while offering the advantage of retaining generated energy for later use, involves additional considerations that do not fully align with the current project objectives. Batteries require significant initial investments, regular maintenance, and have an environmental impact due to their production and end–of–life disposal. Moreover, since the solar energy generation capacity at the site is sufficient to meet a substantial portion of the electrical needs during daylight hours, the investment in battery storage is not justified in terms of additional cost and operational complexity. he use of photovoltaic (PV) technology provides an optimal renewable energy solution, utilizing the extensive roof areas available for direct on–site electricity generation, without the need for additional storage.

Therefore, maximizing direct electricity production and immediate usage on–site is preferred, reducing reliance on grid electricity and lowering operational costs without the complications associated with battery systems. This approach not only simplifies operations but also ensures a quicker return on investment and supports the long–term sustainability goals of the project

5.5 Heat Pumps

A heat pump is a device that transfers heat from one location (the source) at a lower temperature to another location (the heat sink) at a higher temperature, using mechanical work. The two main types of heat pumps are Ground Source Heat Pumps (GSHP) and Air Source Heat Pumps (ASHP). Both operate on the same basic principles but differ in their heat source.

Ground Source Heat Pumps rely on heat from the ground, which can be captured using various techniques such as vertical boreholes, horizontal coils, or slinky coils, depending on the local geological and hydrological conditions.

The Air Source Heat Pump (ASHP) is an alternative to the GSHP, but instead of extracting heat from the ground, it uses ambient outdoor air. Although air temperatures fluctuate seasonally, ASHP technology has improved significantly, offering a reliable and efficient option for heating and cooling in many climates.

For warehouse offices, Air Source Heat Pumps (ASHP) have been selected.

The QC office is benefiting from DX system which is a type of air-conditioning system that removes heat from a space through evaporation and condensation of a refrigerant.

Compared to chilled water and other types of cooling systems, DX cooling offers more flexibility and can operate at lower costs if the number of heat exchanges is minimised.

The selection of ASHP over GSHPs is due to several key technical and practical advantages, listed below:

- Simplicity and Cost–Effectiveness: ASHP systems do not require the extensive groundwork necessary for GSHP installations, such as drilling boreholes or laying coils. This reduces both installation complexity and cost, particularly in a warehouse setting where ground disruption may not be ideal.
- Flexibility in Operation: ASHP systems are easier to install on sites with limited space or where the ground conditions are unsuitable for GSHP systems. Since the warehouses have ample external air exposure, the ASHP can efficiently harness ambient air without the need for complex geological assessments or the installation of ground loops.
- Advancements in Technology: Modern ASHP systems are now more capable of delivering efficient heating and cooling, even in fluctuating temperatures. This makes them particularly suited for warehouses, where the cooling demand might be as important as heating, and where consistency across seasons is key.
- Lower Initial Investment: The upfront cost of an ASHP is significantly lower than a GSHP system, particularly for large commercial buildings. Given the available budget and the operational demands of the warehouses, ASHP provides a more economical solution without compromising energy efficiency.

For these reasons, ASHP was selected as the more appropriate and cost–effective heating and cooling solution.

Biomass

Biomass refers to organic material from plants and animals that can be used as fuel to generate energy. Common biomass sources include wood, straw, and energy crops such as willow or poplar. Biomass can be considered carbon neutral if sourced from sustainably managed sources.

However, for Excellence, Wiggs Farm development, biomass technology is not an efficient solution due to the specific energy demands of the buildings. Biomass systems are primarily designed to generate heat, making them incompatible with the significant cooling requirements associated with air conditioning. Furthermore, biomass installations require substantial fuel storage space and constant deliveries of wood chips or pellets, which could introduce logistical challenges for the site.

Additionally, the need for a well-designed flue system to manage emissions and air quality issues further complicates the feasibility of biomass in this setting.

CHP

Combined Heat and Power plant (CHP) consists essentially of an electrical generator combined with equipment for recovering and using the heat produced by the generator. The generator may be a prime mover such as a gas turbine or a reciprocating engine. Alternatively, it may consist of a steam turbine generating power from high-pressure steam produced in a boiler. In some cases, a CHP scheme may be a combination of prime mover(s), boiler(s) and steam turbines.

CHP systems are generally categorized into four types:

- Packaged CHP: Designed as complete unit that can easily connect to a building’s electrical and heating systems.
- Custom-built CHP: Tailored to meet the specific energy requirements of a particular site.
- Micro CHP: Designed for small-scale, domestic, or light commercial use, replacing conventional boilers.

Renewable CHP: Systems that utilize renewable fuels or feedstocks to generate heat and power.

In conclusion, while CHP is a powerful solution for sites requiring both electricity and significant heat output, it is not the most efficient technology for the development. The primary issue lies in the cooling and air conditioning needs of the warehouse environment, which are not compatible with the heat generation capabilities of CHP systems. CHP is designed to maximize the use of both heat and power, which is ideal for sites with high heating demand (such as hospitals or industrial facilities). However, in a warehouse setting where cooling is more critical than heating, the heat produced by a CHP system would likely go unused, reducing the system's overall efficiency and making it an unnecessary investment.

Furthermore, the additional complexity of integrating a CHP system for electricity alone, without taking advantage of the heat recovery, does not justify the cost.

A high-level analysis of suitability of the available technologies is conducted bellow. Technologies that are deemed suitable for the site and the building are analysed further in section 7.

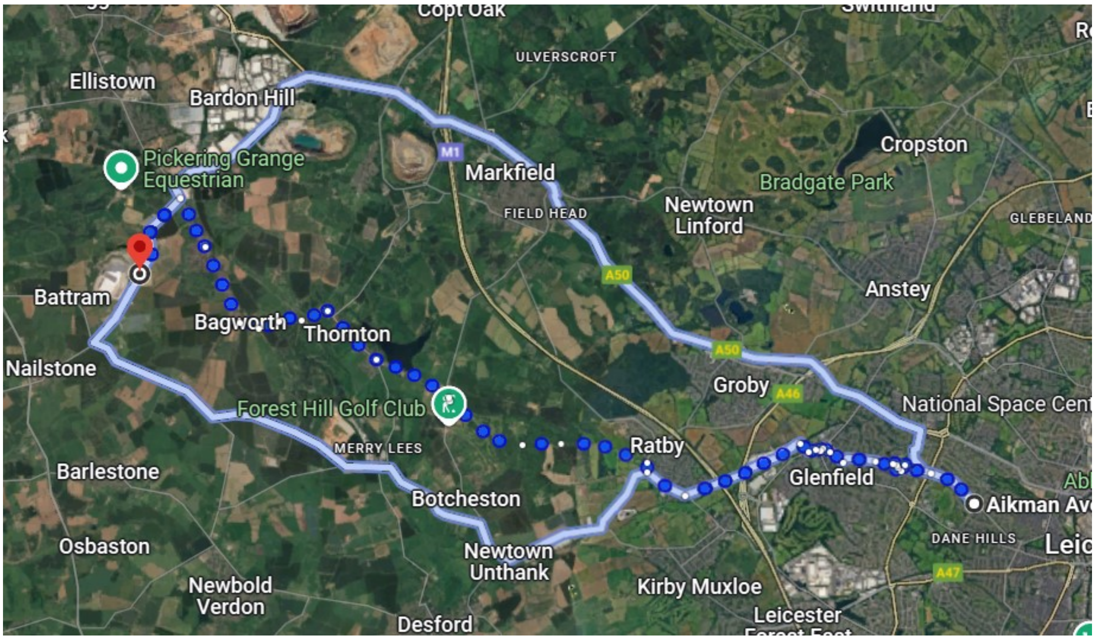
Community Heating System

A community heating system refers to a local energy solution where heat is generated in a centralised location and distributed to multiple buildings through a network of insulated pipes. This system is often referred to as district heating when it serves a larger urban area.

These systems are designed to provide heat for space heating and hot water more efficiently compared to individual boilers. By utilising technologies such as combined heat and power (CHP), district heating systems can reduce carbon emissions and operational costs, especially when integrated with renewable or waste heat sources.

In the case of the this development, there is no existing infrastructure to connect them to a community heating system. This means heating for the development must be independently managed on–site, which can result in higher energy consumption and emissions compared to centralized solutions.

If there are plans for future developments or retrofits, integrating these warehouses into a community heating system could offer economic and environmental benefits while aligning with broader sustainability goals. However, the only community heating system currently planned is located in Aikman Avenue, LE3, 11 miles from our development.



[4] https://www.data.gov.uk/dataset/8a5139b3–e49b–47bd–abba–d0199b624d8a/beis–heat–networks–planning–database

LZC Technology	Basic Technical Information	Technical, Environmental and Economic Implications / Considerations	Suited Application	Site Specific Comment	Further Analysis
Solar Thermal	Solar collectors (flat plate or tube) transfer energy into liquid to a closed loop twin coil hot water cylinder	Can meet a significant proportion of the DHW demand – Efficiency affected by site factors shading, orientation and roof/ground space. – Requires considerable hot water demand all year round to be financially beneficial	Domestic and commercial applications with high annual hot water load; leisure centres, canteens, washrooms	Project has low hot water demand	No
Wind Turbine	Turbine/generator converts wind energy to electrical power.	Allows on site generation of renewable electricity – Can create structural, vibrations and noise implications. – Not suited for urban environments – Electricity generation varies due to wind speed. – Generally, payback over 20 years	Large sized turbines in non–urban or offshore locations	Not appropriate due to low efficiency and high capital cost, and noise requirements	No
Photovoltaic	Convert sunlight to electrical power.	+ Allows on site generation of renewable electricity. + Generally, payback between 7–12 years + Low maintenance requirements Efficiency affected by site factors – shading, orientation, and roof/ground space	Applicable to all buildings with limited solar shading and available roof	Available roof space, therefore, PV panels have been incorporated into the design	Yes
Air Source Heat Pump (ASHP)	ASHP captures heat from the outside air and transfers the heat directly to the air inside the building or transfers the heat to a liquid medium that can be pumped around the building.	+ Lower installation cost that ground source heat pump + Can provide heating and cooling. COP is lower during the heating season	Wide range of building types of particularly buildings designed to have low temperature heat emitters. Combines well with cooling systems	Effective technology to provide simultaneously heating and cooling or heating only. Sufficient external space required for condensers.	Yes
Ground Source Heat Pump (GSHP)	GSHP captures heat from the ground and transfer the	More heat is supplied to the building than energy is	Wide range of building types of particularly buildings	The footprint of the development is not adequate.	No

	heat to a liquid medium that can be pumped around the building.	consumed by the heat pump. COP is much better than air source heat pumps – – Requires area for ground collector or borehole – High initial capital cost – Can restrict distribution strategies. – Subject to soil conditions	designed to have low temperature heat emitters and sufficient space for necessary ground works	Therefore, this technology has not been considered further.	
Biomass	Uses biomass as a fuel source for space heating and hot water.	Renewable source of heating – Requires large fuel storage capacity. – Generally, a large capital cost – Potential issue with air quality especially in urban areas	Building/site with sufficient access and storage facilities. Local supply of fuel.	Due to proximity to commercial and residential areas, it may not be appropriate due to air quality issues.	No
CHP	Electricity is generated by an on–site electrical generator, commonly fueled by gas, liquid fuel or biomass, and heat is recovered from the exhaust gases and cooling systems which is used to provide hot water	Cheap heat and DHW generated – High initial capital cost – High maintenance costs – Impact on air quality	Where there is high heat and DHW demands for a large proportion of the day throughout the year i.e., hospitals, hotels, leisure centres or larger mixed used developments.	No high heating and DHW demand for this type of building	No

6 REVIEW OF AVAILABLE GRANTS AND FUNDINGS

For Excellence, land at Wiggs Farm development, a proposal has been made to install 500 m^2 of photovoltaic (PV) panels, which corresponds to a capacity of 100 kWp, in order to meet the net zero carbon objective. The implementation of PV panels presents numerous financial and operational advantages, leveraging current UK initiatives and strategies. Below are the primary methods to enhance the returns on this investment:

- Smart Export Guarantee (SEG): With substantial PV capacity installed, the Smart Export Guarantee (SEG) scheme allows the business to receive payments for any excess solar energy exported back to the grid. Given the sizes of the development, if the generated energy exceeds onsite consumption, it can be sold to energy suppliers through SEG tariffs, creating a steady additional income stream.
- Annual Investment Allowance (AIA): The AIA scheme is crucial for reducing the tax burden related to solar investments. Businesses can deduct up to £1 million of qualifying capital expenditure in the first year. With the installation of substantial PV capacity in warehouses, utilizing the AIA scheme allows the deduction of the total solar panel investment costs from taxable income, significantly reducing the tax payable in the initial year of investment.
- Capital Allowances: If the investment in PV panels exceeds the AIA limit of £1 million, the business can still benefit from Capital Allowances. This mechanism enables the company to amortize the remaining investment costs over subsequent years, ensuring continued tax relief and improving long–term financial viability.
- Private Power Purchase Agreements (PPAs): For this scheme, the scale of solar energy production makes it feasible to explore Private PPAs. Under this arrangement, the generated electricity can be sold directly to other businesses, depending on the overall production and buyer interest. Private PPAs can secure long–term contracts at negotiated prices, providing a stable revenue stream and reducing reliance on standard grid pricing.

7 CALCULATION OF LIFE CYCLE COSTS AND PAYBACK PERIODS

The technologies deemed suitable from Table 1 are further analysed to calculate life cycle costs and payback periods.

Air Source Heat Pumps (ASHP)

In the case of Air Source Heat Pump systems, the payback calculation is established by evaluating the energy savings generated by the heating capabilities of the system in relation to a specified baseline. This baseline comprises electric radiators used for heating and a Split System that has a Seasonal Energy Efficiency Ratio of 2.6 for cooling purposes.

Please refer to Appendix B for list of assumptions.

Table 1. Capital Costs and Payback Period of Air-to-Air Heat Pumps

Air to Air Heat Pumps	
INPUTS	
Size of Heat Pump system (kW)	198.5
Cost CAPEX	£228,616
Cost of maintenance (per year)	£6,858
HP COP (heating)	4.3
HP EER (Cooling)	6.81
electricity price (£/kWh)	0.25
heating demand (kWh/year)	52,343
Cooling demand (kWh/year)	94,740
Elect price (£/kWh)	0.25
Conventional chiller COP	2.6
Cost Elec Rad +chillers	£84,874
Cost of maintenance chiller (per year)	£6,000
RHI Tariff (p/kWh)	0
OUTPUTS	
Total Capex	£228,616
HP Cost of maintenance	£6,858
Cost of electricity	£6,521
Total OPEX heat pumps	£13,380
total CAPEX (Chiller +rad)	£84,874
Elect rad cost of maintenance +chiller	£90,874
Cost of electricity Using Chiller 2.6 for cooling	£9,110
Cost of Electricity using Radiator 1 for heating	£13,086
Total CAPEX and OPEX Radiators and chillers	£113,069
Income from RHI per annum (£)	£0
Benefit (HP vs Elect Rad)	£14,816
Simple payback (years)	10

Photovoltaics

Payback for photovoltaic (PV) systems is realized by decreasing reliance on grid electricity. Export tariffs have not been utilized, as it is more cost-effective to use the entire electricity output for the building's advantage. The table below presents the projected energy savings and payback durations for an appropriately sized system.

Please refer to Appendix B for list of assumptions.

Table 2. Capital Costs and Payback Period of PV Installation

PV INPUTS		
Size of PV system (kWp)	100	kW
Cost of installation per kWp (£)	1000	£
Cost of maintenance (per year) (£/yr)	1000	£/yr
Cost of electricity export (£/kWh)	0	£/kWh
FIT for PV (£/kWh)	0	£/kWh
Cost of imported electricity (£/kWh)	*0.25*	£/kWh
Annual PV electricity generation (kWh/yr)	78,950	kWh/yr
% of exported electricity	0%	%
OUTPUTS		
CAPEX (£)	100,000	£
OPEX (£/yr)	1000	£/yr
Income from FIT (£/yr)	£0	£/yr
Income from electricity exports (£/yr)	£0	£/yr
Benefit from non-imported electricity (£/yr)	£19,738	£/yr
Net Annual Saving £/yr)	£18,738	£/yr
Simple payback (years)	5	yr
Annualized CAPEX (25years)	£4000	£/yr

8 PROPOSED DESIGN ENERGY AND CARBON SAVINGS CALCULATIONS

Air Source Heat Pump (VRV) Selection

The Daikin VRV system has been selected for the development, based on its exceptional energy efficiency and suitability for the warehouse environment.

This selection is justified by several key factors: Energy Efficiency: With a SEER of 6.8, the VRV system offers a high cooling efficiency, essential for maintaining optimal indoor conditions in the warehouse offices. Similarly, the SCOP of 4.3 ensures effective heating performance during colder months, reducing energy consumption compared to conventional heating systems.

Flexibility and Scalability: The Daikin VRV system offers flexible installation options and scalable capacity, ideal for climate control in offices within large warehouses. It efficiently manages the diverse heating and cooling needs across different areas of the development, ensuring optimal comfort in office spaces and addressing the need for uniform temperature management throughout.

For the QC office area, DX system has been suggested. The Air is directly chilled in, at the edge of, or immediately next to the room being conditioned in DX units.

Direct heat exchange occurs as refrigerant travels through a nearby cooling coil. An expansion valve controls the refrigerant, which expands during the process. Some of the benefits of DX system can be summarised as Low cost of installation, the system is simple to test, modify, and balance, minimum wall or ceiling space is required, minimal energy usage and low noise level.

Low Environmental Impact: By utilising advanced heat pump technology, the VRV and DX systems minimise carbon emissions and support the sustainability goals of the project. Its performance metrics align with modern energy efficiency standards, contributing to significant operational cost savings and lower environmental impact over time.

photovoltaic (PV) system

A standalone photovoltaic (PV) system has also been modelled. This arrangement will benefit the council, as the electricity generated can be utilised, reducing reliance on grid electricity. The electricity is fed into an inverter which converts it from a direct current supply to an alternating current supply, which can then be used to supply the demands within the building. The PVs can be coupled by solar batteries to store surplus solar power for later use. The solar battery extends the use of a PV–system's generated energy and will provide free, sustainable power even when the panels do not produce energy due to the lack of solar energy (overcast periods etc.).

Therefore, with a solar battery little to no electricity is fed into the grid while also avoiding having to buy expensive electricity from the grid later. Due to the increased self-consumption, the electricity costs decrease significantly.

In line with Ene 04, the baseline building employs a gas-fired system to establish a foundation for assessing the carbon emissions reduction potential of low and zero carbon (LZC) technologies. Energy modelling software was utilized to simulate the building's performance and to compute energy usage and carbon emissions. The table below presents a summary of the estimated regulated energy consumption and carbon emissions for the baseline building, as well as for the building equipped with ground source heat pumps (GSHP) and the building featuring both GSHP and photovoltaic systems (PVs). The data provided were extracted from the BRUKL documents generated for each scenario (see Appendix 1 for details).

Table 3. Energy and Carbon Calculations.

	Regulated Energy Consumption (kWh/m^2)	Total Carbon Emissions (BER) ($kgCO_2/m^2$)	Cumulative Carbon Savings ($kgCO_2/m^2$)	Cumulative Carbon Saving (%)
Base Built – electric radiator and Conventional chiller 2.6 EER	11.13	1.54		
Proposed Building with ASHP + PV	7.51	1.04	0.5	32.5%

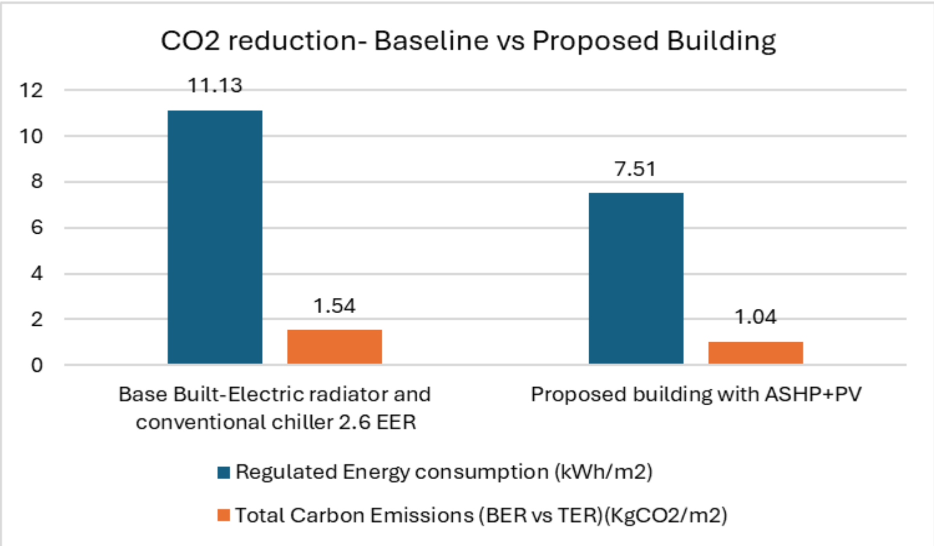


Figure 1. CO_2 reduction

The total primary energy usage following the implementation of air source heat pumps and photovoltaic panels has decreased by 5.43 kWh/m^2, while CO_2 emissions have been reduced by 0.5 kg CO_2/m^2. The energy produced by photovoltaic panels is presented in Table 4.

Table 4. Energy Generated by the LZC Technologies.

	Proposed Building
Energy generated by PVs (kWh/year)	78,950

APPENDIX A- BRUKL DOCUMENT.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Excellence Land at Wiggs Farm 500m2 PV

As designed

Date: Tue May 13 11:49:39 2025

Administrative information

Building Details

Address: Station Road, Coalville, Leicestershire, LE67 1GE

Certifier details

Name: Worcestershire

Telephone number: DW Pointer & Partners

Address: 4 Sugar Brook Court, Aston Road, Bromsgrove, +44 01527 578257

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.28

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.28

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 611

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	1.54	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	1.04	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	16.54	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	11.11	
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	0.24	0.26	WR000000:Surf[173]
Floors	0.18	0.15	0.15	WR000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.16	0.16	WR000000:Surf[211]
Windows** and roof windows	1.6	1.31	1.31	WR000003:Surf[6]
Rooflights***	2.2	1.3	1.3	WR000000:Surf[183]
Personnel doors^	1.6	1.3	1.6	G0000009:Surf[1]
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/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K

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
m³/(h.m²) at 50 Pa	8	3

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Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- AHU- REYA20A

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.14	6.63	0	1.56	0.81
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

2- AHU-DX ERA250AYF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	7.3	0	-	0.81
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

3- AHU- REYA22A

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.41	7.17	0	1.56	0.81
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- DHW Heat Pump

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.35	0.005
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

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

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
G0.Warehouse	130	-	-
G0. Forklift Maintenance	130	-	-
G0. Stairs	130	-	-
G0. Offices 01	130	-	-
G0. Dis WC	130	-	-
G0.Shower	130	-	-
G0. Fem WC	130	-	-

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General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
G0. Stairs	130	-	-
G0. Lobby	130	130	1.038
G0.Plant Room	130	-	-
G0. Offices 02	130	-	-
G0. Escape Stairs 2	130	-	-
G0. Cleaners	130	-	-
F1. Dis WC	130	-	-
F1.Shower	130	-	-
F1. Fem WC	130	-	-
F1. Stairs	130	-	-
F1. Reception	130	130	1.038
F1.Male WC	130	-	-
F1.Cleaners	130	-	-
G0.Office	130	-	-
F1. Offices 01	130	-	-
F1. Reception	130	130	1.038
F1. Offices 02	130	-	-
F2. Dis WC	130	-	-
F2.Shower	130	-	-
F2. Fem WC	130	-	-
F2. Reception	130	130	1.038
F2.Male WC	130	-	-
F2.Cleaners	130	-	-
F2. Offices 01	130	-	-
F2. Reception	130	130	1.038
F3. Dis WC	130	-	-
F3.Shower	130	-	-
F3. Fem WC	130	-	-
F3.Male WC	130	-	-
F3.Cleaners	130	-	-
F3. Reception	130	130	1.038
F3. Offices 02	130	-	-
F3. Reception	130	130	1.038
F3. Offices 01	130	-	-
G0 QC offices	130	-	-
G0. Reception	130	130	1.038
G0. Reception	130	130	0
F2. MR	130	-	-
F2.MR	130	-	-
F2. Offices 02	130	-	-

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The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
G0.Warehouse	NO (-10.4%)	NO
G0. Offices 01	NO (-9.3%)	NO
G0. Dis WC	N/A	N/A
G0.Shower	N/A	N/A
G0. Fem WC	N/A	N/A
G0. Lobby	N/A	N/A
G0. Offices 02	YES (+20%)	NO
F1. Dis WC	N/A	N/A
F1.Shower	N/A	N/A
F1. Fem WC	N/A	N/A
F1. Reception	YES (+114%)	NO
F1.Male WC	N/A	N/A
F1.Cleaners	N/A	N/A
G0.Office	N/A	N/A
F1. Offices 01	YES (+9.7%)	NO
F1. Reception	N/A	N/A
F1. Offices 02	YES (+49.4%)	NO
F2. Dis WC	N/A	N/A
F2.Shower	N/A	N/A
F2. Fem WC	N/A	N/A
F2. Reception	N/A	N/A
F2.Male WC	N/A	N/A
F2.Cleaners	N/A	N/A
F2. Offices 01	YES (+10%)	NO
F2. Reception	N/A	N/A
F3. Dis WC	N/A	N/A
F3.Shower	N/A	N/A
F3. Fem WC	N/A	N/A
F3.Male WC	N/A	N/A
F3.Cleaners	N/A	N/A
F3. Reception	N/A	N/A
F3. Offices 02	YES (+134.4%)	NO
F3. Reception	N/A	N/A
F3. Offices 01	YES (+56.8%)	NO
G0 QC offices	NO (-58.1%)	NO
G0. Reception	YES (+215.4%)	NO
G0. Reception	YES (+104.5%)	NO
F2. MR	YES (+259.3%)	NO
F2.MR	YES (+224.7%)	NO
F2. Offices 02	YES (+51.5%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	34779.6	34779.6
External area [m²]	82172.2	82172.2
Weather	LEE	LEE
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	20195.4	27695.3
Average U-value [W/m²K]	0.25	0.34
Alpha value* [%]	25	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
100	**Storage or Distribution**
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	0.35	0.88
Cooling	0.4	0.19
Auxiliary	0.38	0.83
Lighting	6.84	3.48
Hot water	1.81	5.74
Equipment*	34.17	34.17
TOTAL**	**9.78**	**11.13**

* 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/m²]

	Actual	Notional
Photovoltaic systems	2.27	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*2.27*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	12.35	12.06
Primary energy [kWh_{PE}/m²]	11.11	16.54
Total emissions [kg/m²]	1.04	1.54

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HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	64.3	108	4.2	6.5	6.3	4.27	4.61	4.14	6.63
	Notional	100.2	49	10	2.9	13.6	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	58	111.8	3.5	6.2	6.3	4.55	4.99	4.41	7.17
	Notional	88.1	49.5	8.8	3	13.5	2.78	4.63	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	186.7	29.3	11.8	1.5	0	4.41	5.46	4.5	7.3
	Notional	330.4	25.1	33	1.5	0	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

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APPENDIX B- LIST OF ASSUMPTIONS.

1. Electricity Price

The average electricity price for final industrial consumers in the United Kingdom, considering production, supply, and security, is approximately £0.20 to £0.25 per kWh (20 to 25 pence per kWh).

This value includes wholesale energy costs, transmission and distribution charges, supply security fees, and applicable taxes.

https://www.ofgem.gov.uk/retail-market-indicators

$$\text{Electricity Bill} = \left(\frac{\text{Heating Demand}}{\text{Efficiency of Heating System}}\right) \times \text{Cost per kWh} + \left(\frac{\text{Cooling Demand}}{\text{Efficiency of Chiller}}\right) \times \text{Cost per kWh}$$

2. Cost of maintenance (per year) (£/yr)

Photovoltaics: Assumed 1% of the cost per year.

ASHP: Assumed 3% of the cost per year.

3. Conventional chiller COP

Assumed 2.6.

4. Cost of maintenance chiller (per year)

The annual maintenance of 4 chillers would cost approximately between £750 and £1,500 per year, depending on the scope of the contract (preventive only or including corrective) and the location. We take a conservative value of £1,500.

Total CAPEX and OPEX Radiators and chillers

CAPEX (Capital Expenditure).This is the initial capital expense to purchase or install something, like the cost of the radiator or the installation of the heating system. Basically, it’s the investment in physical assets that will last for years.

OPEX (Operational Expenditure). These are the operational or running costs. In this case, it would include maintenance, repairs, energy consumption, and even cleaning if applicable. It’s all the money you continue to spend to keep the radiator running over time.

APPENDIX C- FABRIC VALUES AND SYSTEM.

Project Excellence, Land at Wiggs Farm, Station Road, Coalville

Leicestershire

IES-VE As Designed BRUKL Assumptions

Drawings

- SGP Architects + Masterplanners drawings,
- 4092 - 10Z - Proposed Site Plan
- 4092 - 11E - Warehouse – Plan
- 4092 - 59C - Cat A - Main Office - Floor Plans
- 4092 - 63B - Cat A - Forklift Maintenance - Plans & Section
- 4092 - 64A - Cat A - Maintenance Unit - Floor Plans
- 4092 - 20250411 - Incomoing Gatehouse - Floor Plan
- 4092 - 20250411 - Outgoing Gatehouse - Floor Plan
- 4092 - 20250411 - QC Building - Ground Floor
- 4092 - 20250411 - QC Office - Ground Floor

Fabric Assumptions

The following assumptions have been included in the As Designed BRUKL to enable the production of the As Designed BRUKL and to inform the designers and developers of the parameters upon which this BRUKL has been produced.

- England Building Regulations Part L 2021 applied to this project
- Building Type – B8 Storage & Distribution
- Fabric Elements

Ext Metal Clad Wall U-Value	0.24 W/m²K	0.4mm liner sheet 160mm insulation	
Internal walls Between heated and warehouse	0.30 W/m²K		
Heated Internal Walls	1.0 W/m²K		
Ground Floor U-Value	0.15 W/m²K		
Roof	0.16 W/m²K	0.4mm liner sheet 260mm insulation	
Doors U – Value	1.3 W/m²K		
Vehicle access and similar large doors	1.3 W/m²K		
Glazing and Glazed doors	1.3 W/m2K (g-value 40% LT 60%)		
Rooflights	1.3 W/m2K (g-value 50% LT 50%)	Zenon Pro, 4mm polycarbonate, 1.5W/m²K, LT 53%, G-value 53%	Zenon Pro, 10mm polycarbonate, 1.2W/m²K, LT 44%, G-value 44%
Internal ceiling to unheated area (First Floor)	0.18 W/m²K		
Permeability	3 ($m^3/(h.m^2)$ @ 50 Pa)		

HVAC Systems: Heated and Unheated

Main Office VRV: Daikin VRF SSER: 6.81, SCOP: 4.3

Office Ventilation AHU

Demand controlled via BMS monitoring CO_2 and air quality sensors

SFP 1.54

HR=81% thermal wheel

Warehouse	Unheated
Escape Stair, Landing and Stairs	Unheated
Shower and changing area provision	Unheated
Risers /Lift	Unheated
Ground Floor (Level 00)	
GF Reception Lobby	VRV for heating and cooling + Ventilated
Acc WC	Unheated directly, heated by VRV for heating and cooling from reception and lobby + Ventilation
Stairs	Unheated directly, heated by VRV for heating and cooling from landing reception and lobby
Cleaners Store	Unheated between heated areas
First Floor, Second Floor & Third Floor (Level 01, Level 02 & Level 3)	
Meeting Room / FF Landing	VRV for heating and cooling + Ventilation
Stairs	Unheated directly, heated by VRV for heating and cooling from landing reception
Acc WC	Unheated directly, heated by VRV for heating and cooling from FF landing + Extract ventilation by MVHR
Kitchenette and Eating Area	VRV for heating and cooling + Mech ventilated (Extract)

Toilet	Heated VRV + Ventilated by supply air into corridor and drawing air through into individual cubicles by MVHR extract
Open Office	VRV for heating and cooling + Ventilated
Cleaners Store	Unheated between heated areas

Lighting

All general lighting assumed to be LED and to have minimum efficacy of 130 Luminaire lumens per circuit watt

Auto on-off occupancy sensors (maximum parasitic power 1 Watt per sensor) assumed in toilets

Photoelectric sensors (maximum parasitic [power 1 Watt per sensor) assumed in:-

GF Entrance & Stairs (sensors controlling all light fittings)

Offices and Meeting Room (sensors controlling all light fittings)

Lighting systems have the provision for metering. Electric Power factor 0.95

Hot water

Main Office ASHP Cylinder 3.346 seasonal efficiency

Performance	
SCOP	3.346

Office Local electric water heaters: Modutherm Juniper type heat pump water heaters

Extract

Ducted and achieve a SFP of 0.4 W/l/s : Kitchenette & Cleaners

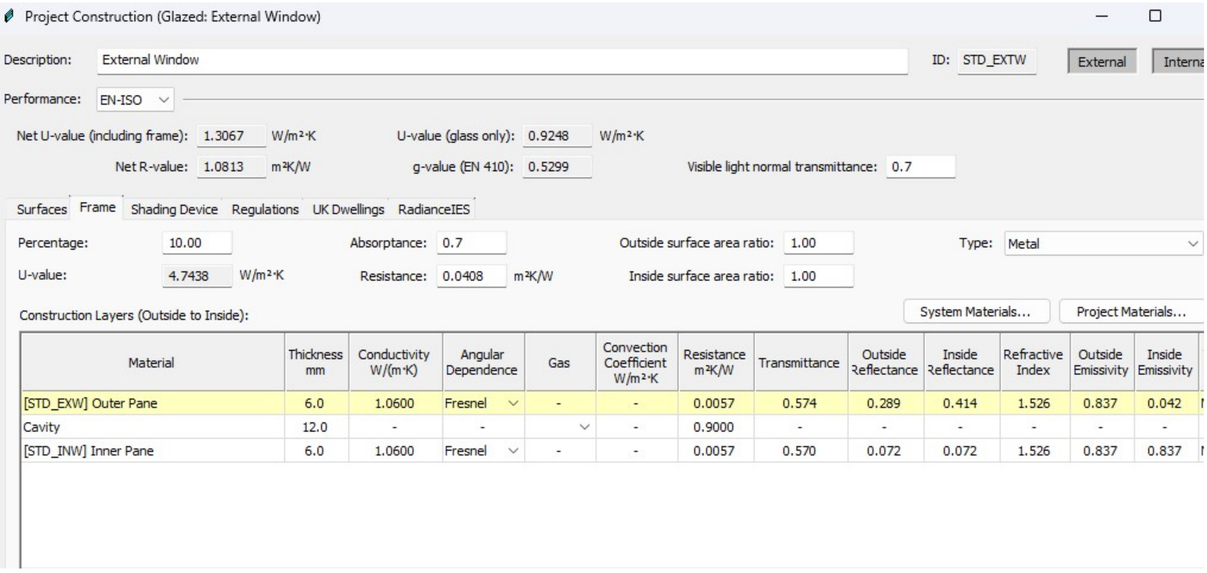
Cleaners extract operates 24/7

Kitchenette extract operates intermittently via PIR or Humidistat.

IES Evidences.

Uvalues

ID	Category	Description	Data source	U value (W/m²·K)	Thickness (mm)	Notes etc.	g-value (glass only EN-410)	Glazed frame percent
STD_WAL1	External Wall	1. External Wall Office	Generic	0.2100	208.900		-	-
STD_WAL2	External Wall	2. External Wall Warehouse	Generic	0.2600	80.984		-	-
STD_ROOF	Roof	3. Roof Office	Generic	0.1500	317.000		-	-
STD_FLO1	Ground/Exposed Floor	5. Exposed Floor Off	Generic	0.1500	268.200		-	-
STD_PART	Internal Partition	7. Internal Partition Heated	Generic	1.0000	75.000		-	-
STD_PAR2	Internal Partition	8. Internal Partition Unheated	Generic	0.3000	75.000		-	-
STD_CEIL	Internal Ceiling/Floor	2013 Internal Ceiling/Floor	Generic	1.0866	282.500		-	-
STD_DOOR	Door	Door	Generic	1.3000	37.000		-	-
STD_EXTW	External Window	External Window	Generic	1.3067	24.000		0.5299	10
STD_DOO3	Door	Personal Door	Generic	1.6000	81.400		-	-
STD_ROO1	Roof	Roof Warehouse	Generic	0.1600	317.000		-	-
STD_RFLT	Roof Light	Rooflight	Generic	1.3000	24.000		0.5301	15


Project Construction (Glazed: External Window)

Description: External Window ID: STD_EXTW External Interna

Performance: EN-ISO

Net U-value (including frame): 1.3067 W/m²·K U-value (glass only): 0.9248 W/m²·K

Net R-value: 1.0813 m²K/W g-value (EN 410): 0.5299 Visible light normal transmittance: 0.7

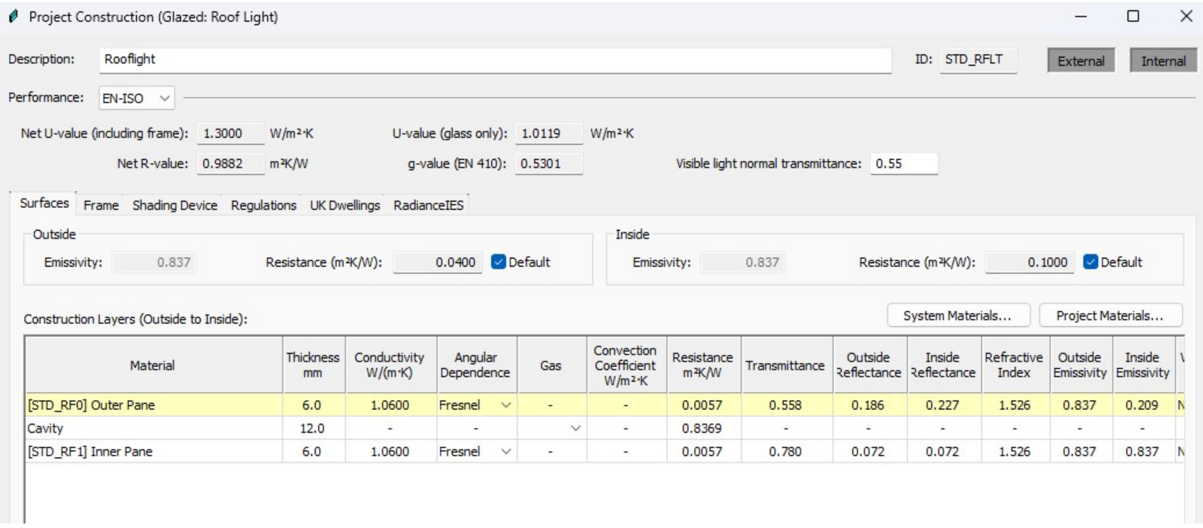
Surfaces Frame Shading Device Regulations UK Dwellings RadianceIES

Percentage: 10.00 Absorptance: 0.7 Outside surface area ratio: 1.00 Type: Metal

U-value: 4.7438 W/m²·K Resistance: 0.0408 m²K/W Inside surface area ratio: 1.00

Construction Layers (Outside to Inside): System Materials... Project Materials...

Material	Thickness mm	Conductivity W/(m·K)	Angular Dependence	Gas	Convection Coefficient W/m²·K	Resistance m²K/W	Transmittance	Outside Reflectance	Inside Reflectance	Refractive Index	Outside Emissivity	Inside Emissivity
[STD_EXW] Outer Pane	6.0	1.0600	Fresnel	-	-	0.0057	0.574	0.289	0.414	1.526	0.837	0.042
Cavity	12.0	-	-		-	0.9000	-	-	-	-	-	-
[STD_INW] Inner Pane	6.0	1.0600	Fresnel	-	-	0.0057	0.570	0.072	0.072	1.526	0.837	0.837


Project Construction (Glazed: Roof Light)

Description: Rooflight ID: STD_RFLT External Internal

Performance: EN-ISO

Net U-value (including frame): 1.3000 W/m²·K U-value (glass only): 1.0119 W/m²·K

Net R-value: 0.9882 m²K/W g-value (EN 410): 0.5301 Visible light normal transmittance: 0.55

Surfaces Frame Shading Device Regulations UK Dwellings RadianceIES

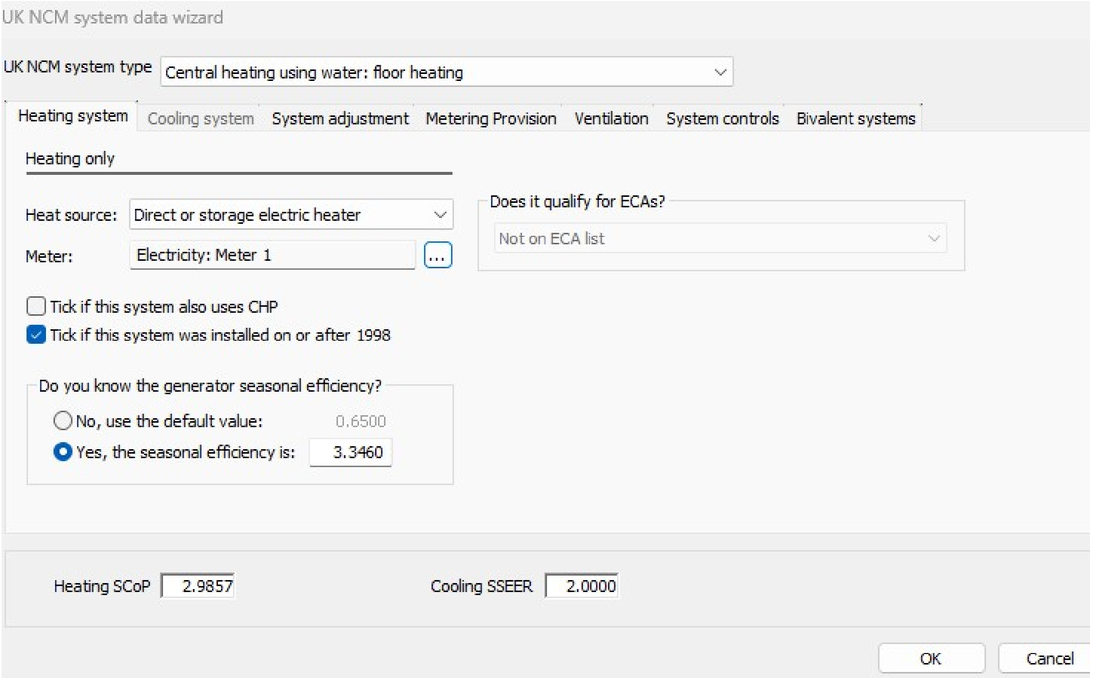
Outside — Emissivity: 0.837 Resistance (m²K/W): 0.0400 Default

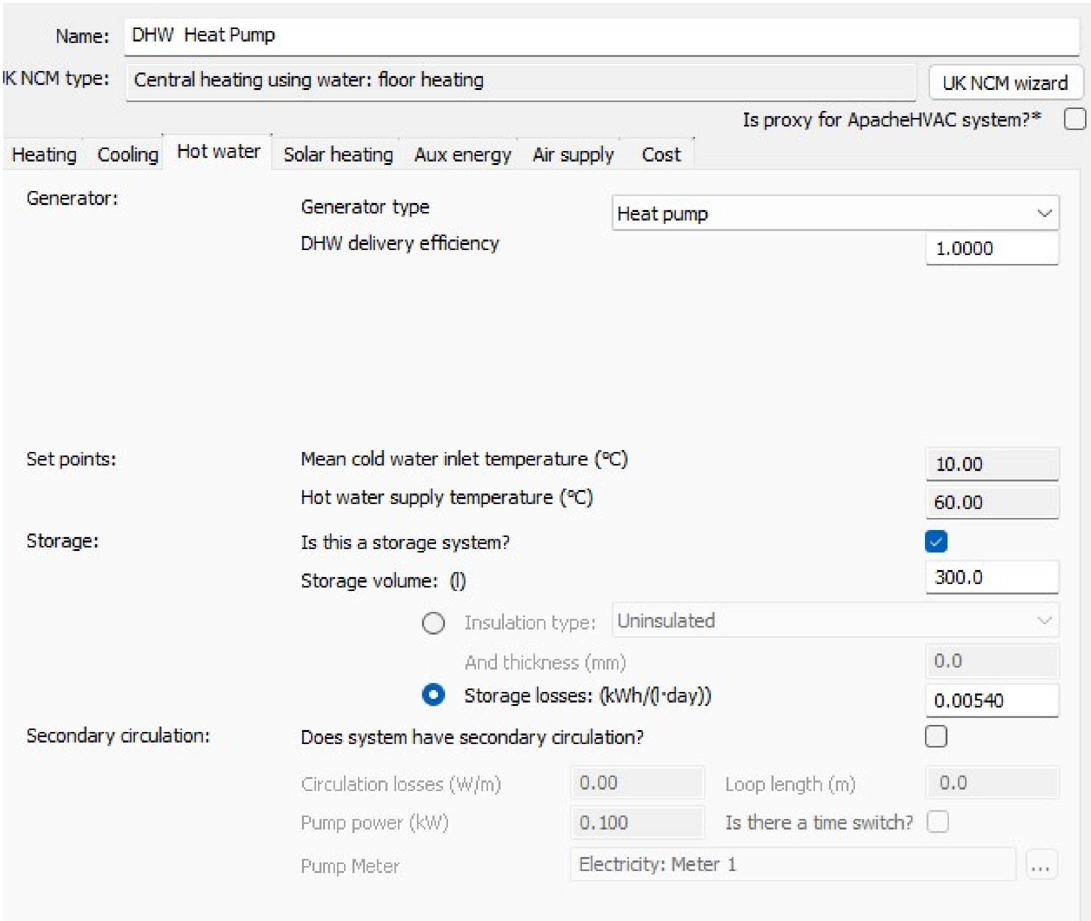
Inside — Emissivity: 0.837 Resistance (m²K/W): 0.1000 Default

Construction Layers (Outside to Inside): System Materials... Project Materials...

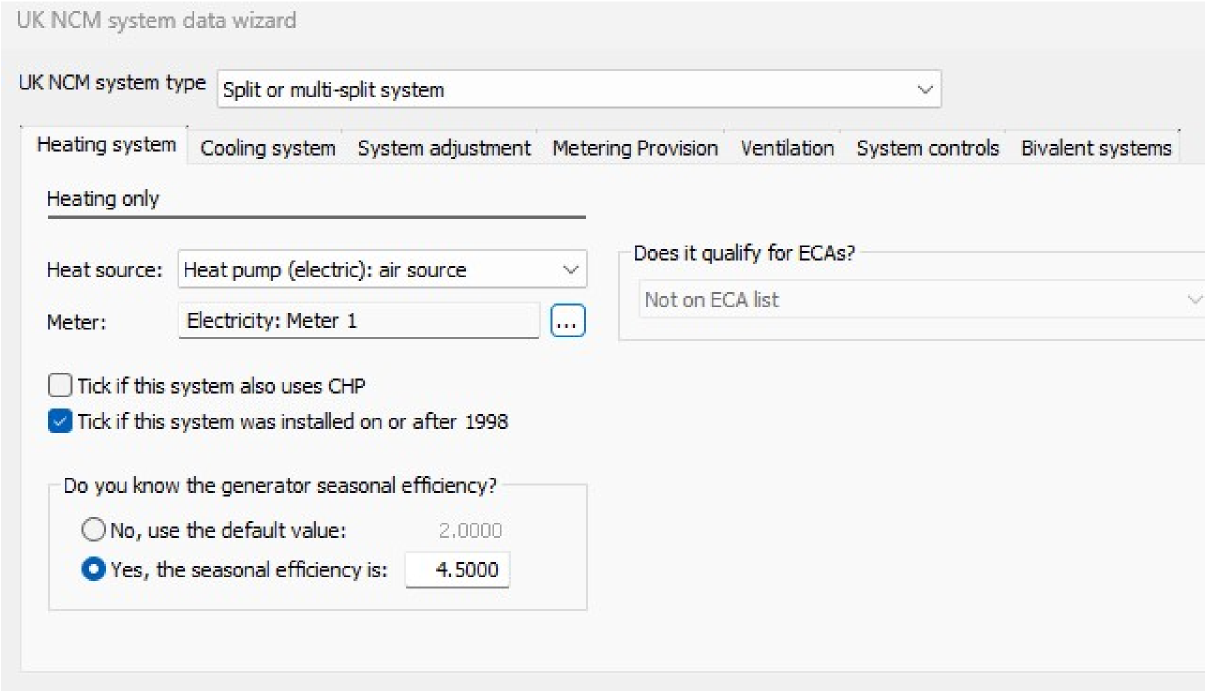
Material	Thickness mm	Conductivity W/(m·K)	Angular Dependence	Gas	Convection Coefficient W/m²·K	Resistance m²K/W	Transmittance	Outside Reflectance	Inside Reflectance	Refractive Index	Outside Emissivity	Inside Emissivity
[STD_RF0] Outer Pane	6.0	1.0600	Fresnel	-	-	0.0057	0.558	0.186	0.227	1.526	0.837	0.209
Cavity	12.0	-	-		-	0.8369	-	-	-	-	-	-
[STD_RF1] Inner Pane	6.0	1.0600	Fresnel	-	-	0.0057	0.780	0.072	0.072	1.526	0.837	0.837

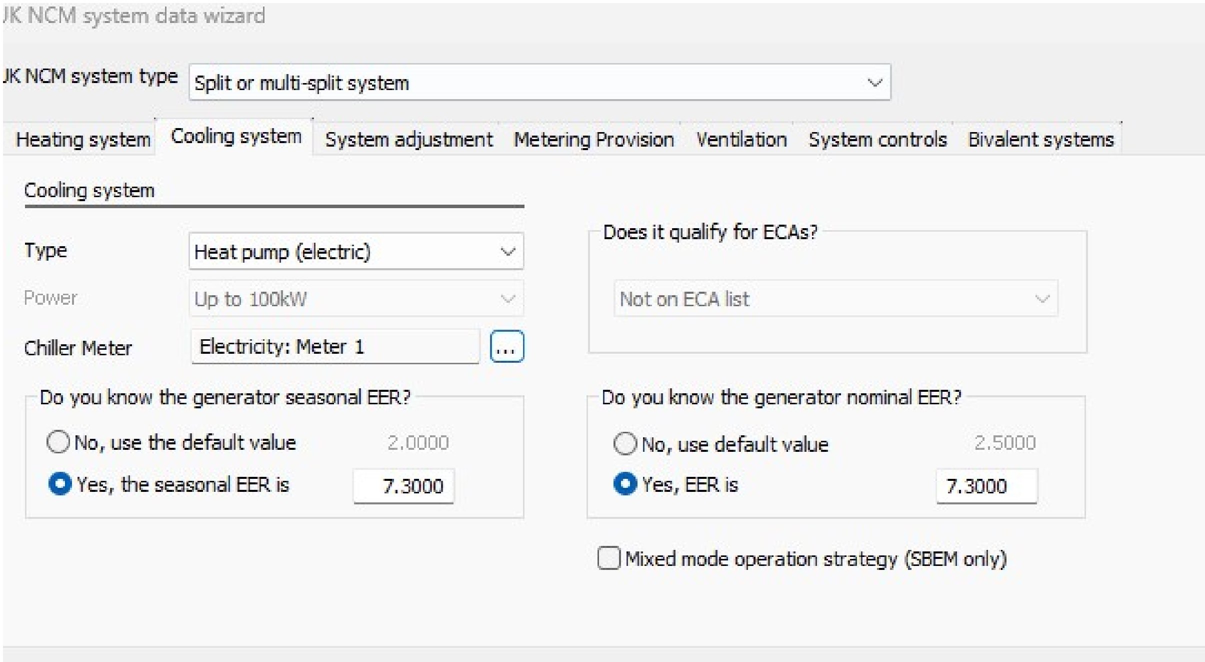
DHWS

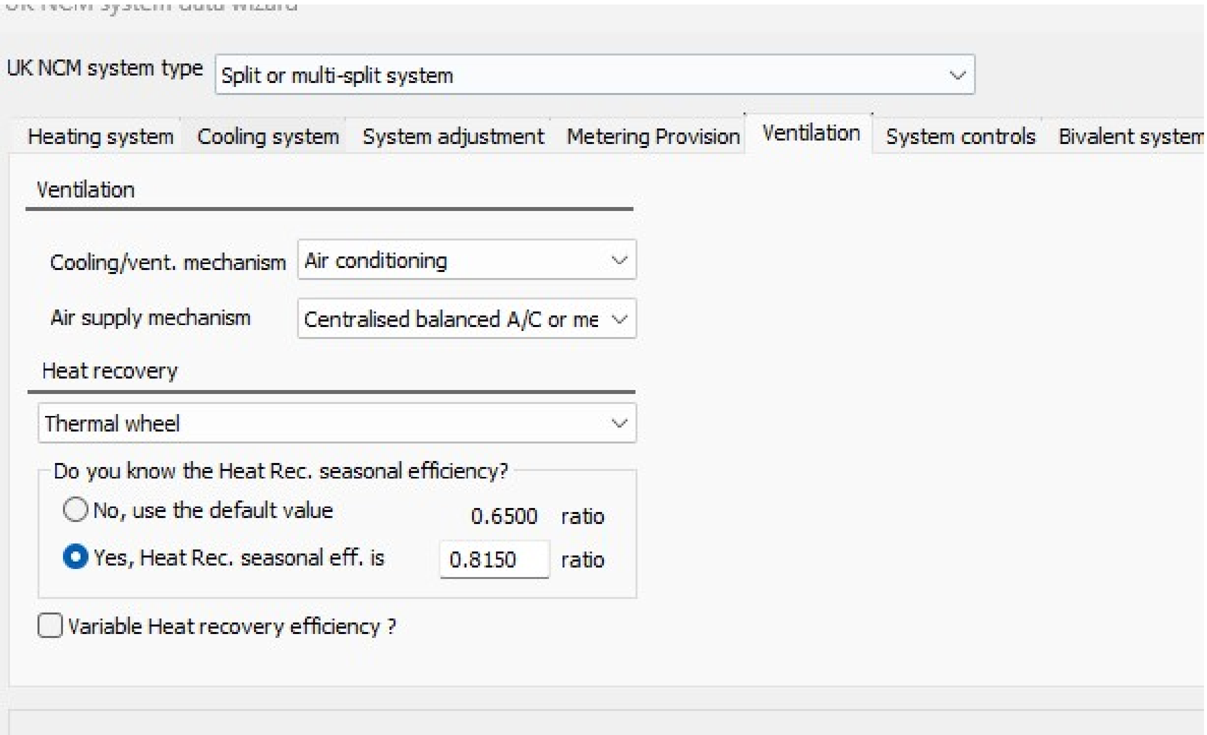




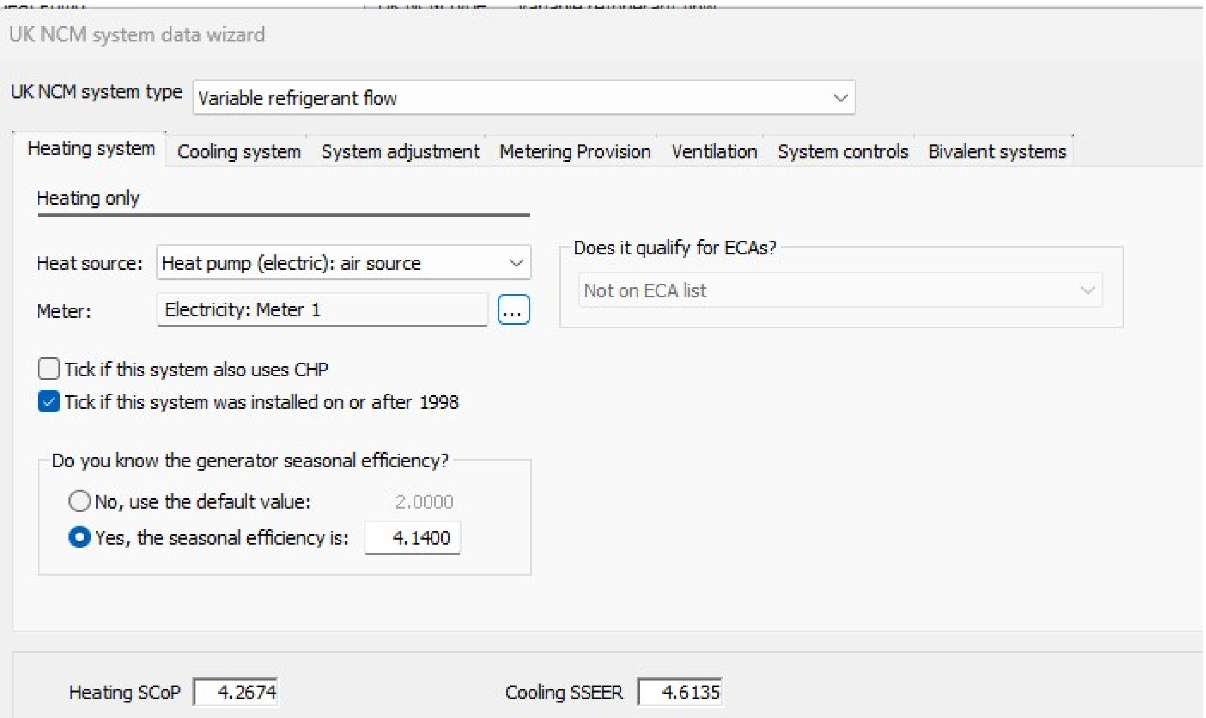
AHU with SPLIT

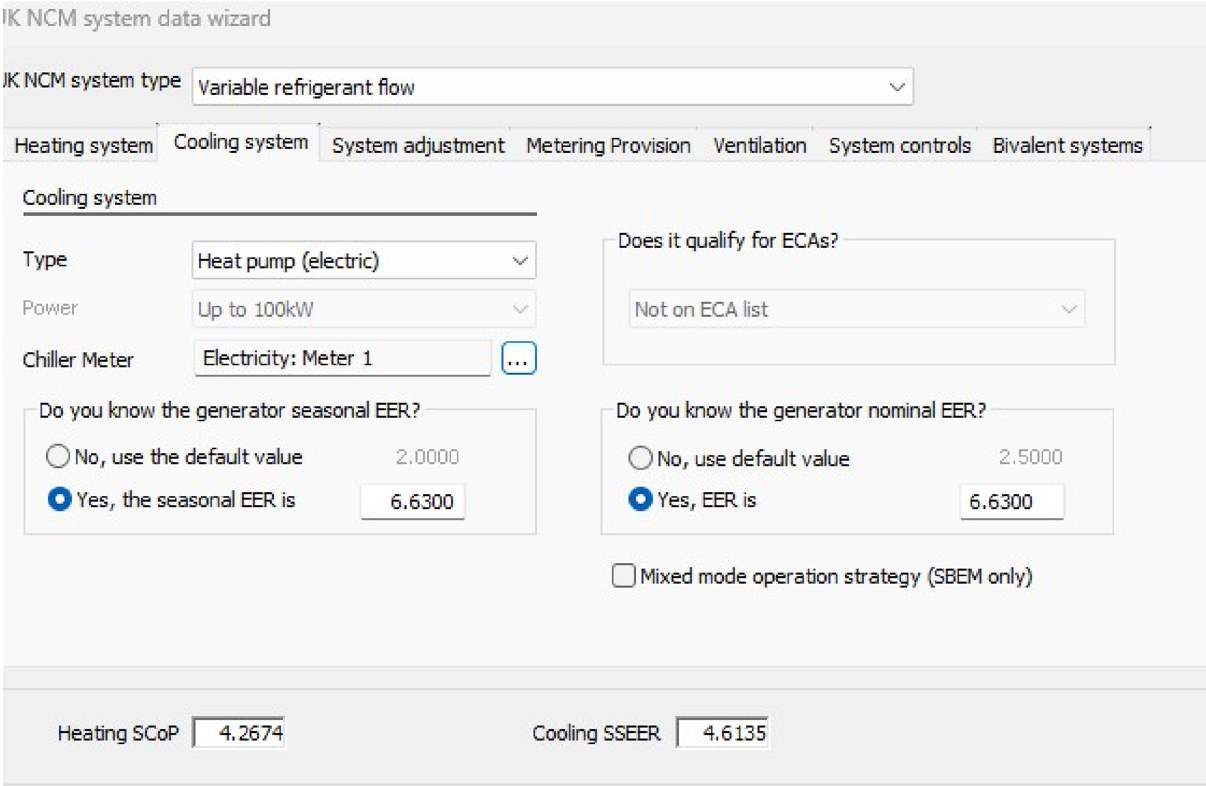

UK NCM system data wizard
UK NCM system type
Split or multi-split system
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Heating only
Heat source:
Heat pump (electric): air source
Meter:
Electricity: Meter 1
Does it qualify for ECAs?
Not on ECA list
Tick if this system also uses CHP
Tick if this system was installed on or after 1998
Do you know the generator seasonal efficiency?
No, use the default value:
2.0000
Yes, the seasonal efficiency is:
4.5000

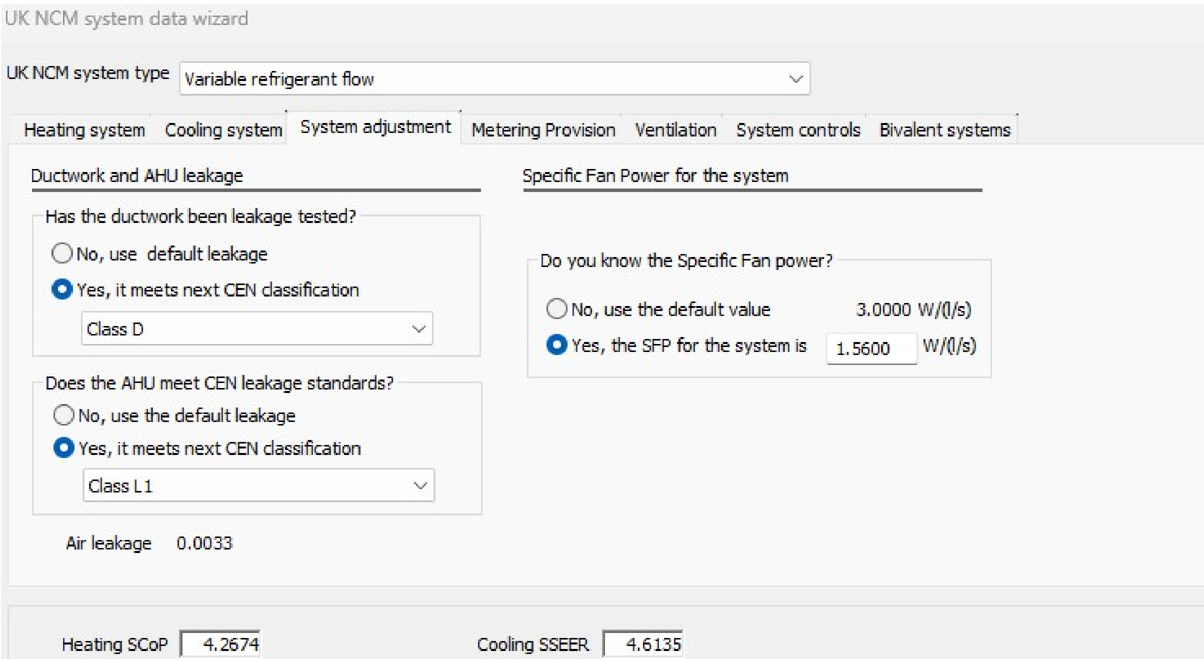

JK NCM system data wizard
JK NCM system type
Split or multi-split system
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Cooling system
Type
Heat pump (electric)
Power
Up to 100kW
Chiller Meter
Electricity: Meter 1
Does it qualify for ECAs?
Not on ECA list
Do you know the generator seasonal EER?
No, use the default value
2.0000
Yes, the seasonal EER is
7.3000
Do you know the generator nominal EER?
No, use default value
2.5000
Yes, EER is
7.3000
Mixed mode operation strategy (SBEM only)

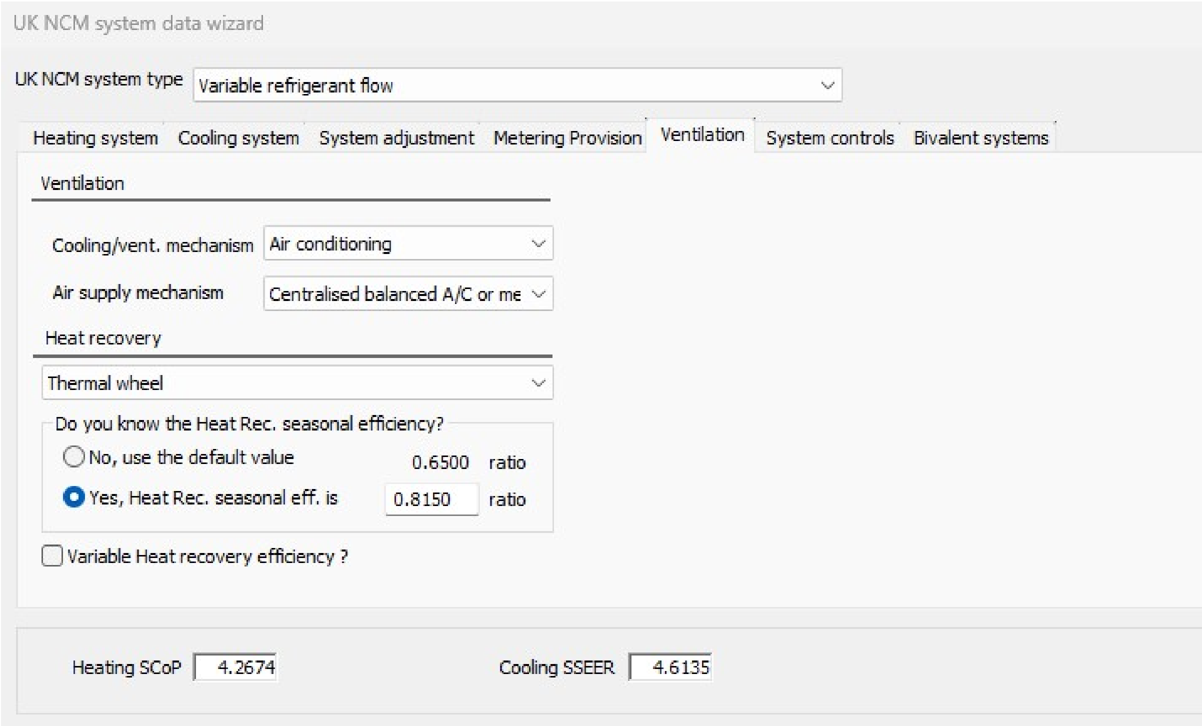

UK NCM system type
Split or multi-split system
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent system
Ventilation
Cooling/vent. mechanism
Air conditioning
Air supply mechanism
Centralised balanced A/C or me
Heat recovery
Thermal wheel
Do you know the Heat Rec. seasonal efficiency?
No, use the default value
0.6500
ratio
Yes, Heat Rec. seasonal eff. is
0.8150
ratio
Variable Heat recovery efficiency ?

VRV REYA20A

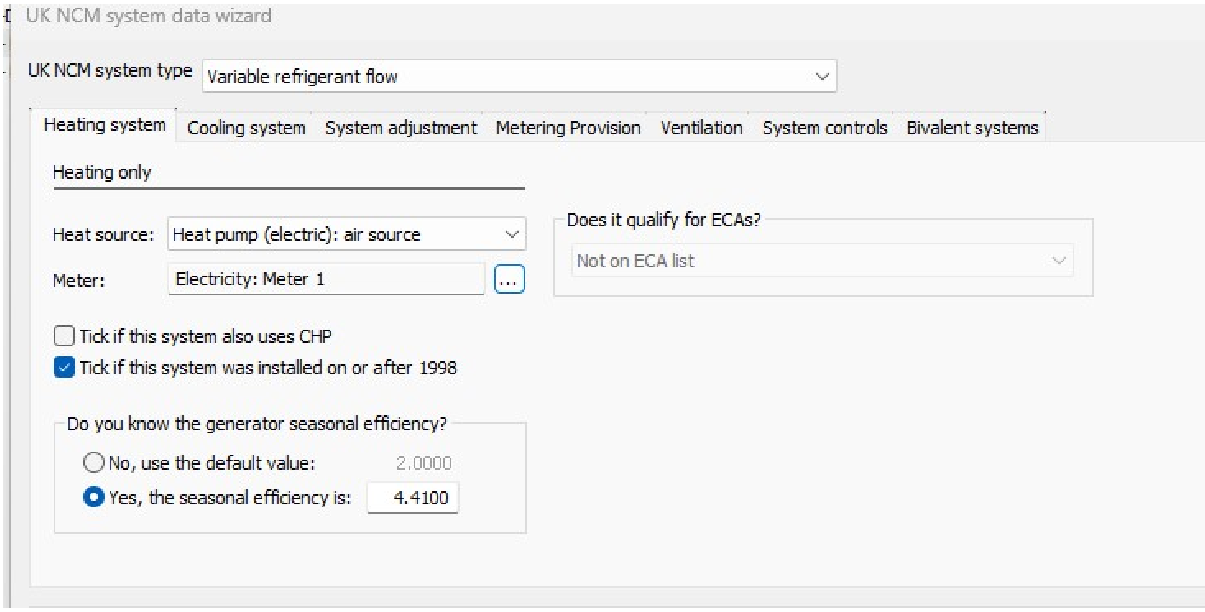

UK NCM system data wizard
UK NCM system type
Variable refrigerant flow
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Heating only
Heat source:
Heat pump (electric): air source
Meter:
Electricity: Meter 1
Does it qualify for ECAs?
Not on ECA list
Tick if this system also uses CHP
Tick if this system was installed on or after 1998
Do you know the generator seasonal efficiency?
No, use the default value:
2.0000
Yes, the seasonal efficiency is:
4.1400
Heating SCoP
4.2674
Cooling SSEER
4.6135

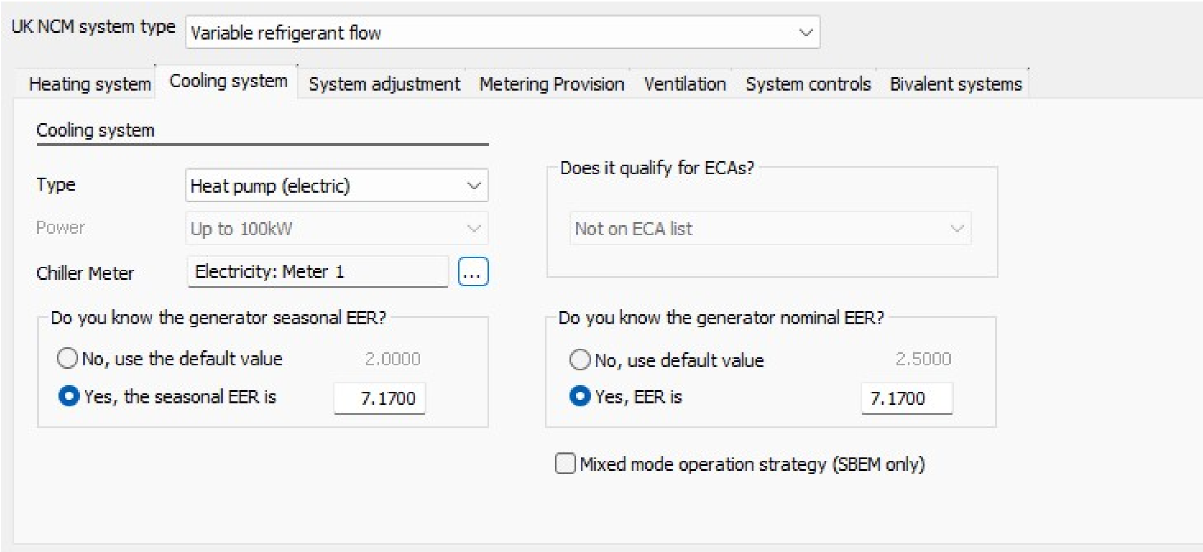

IK NCM system data wizard
IK NCM system type
Variable refrigerant flow
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Cooling system
Type
Heat pump (electric)
Power
Up to 100kW
Chiller Meter
Electricity: Meter 1
Does it qualify for ECAs?
Not on ECA list
Do you know the generator seasonal EER?
No, use the default value
2.0000
Yes, the seasonal EER is
6.6300
Do you know the generator nominal EER?
No, use default value
2.5000
Yes, EER is
6.6300
Mixed mode operation strategy (SBEM only)
Heating SCoP
4.2674
Cooling SSEER
4.6135

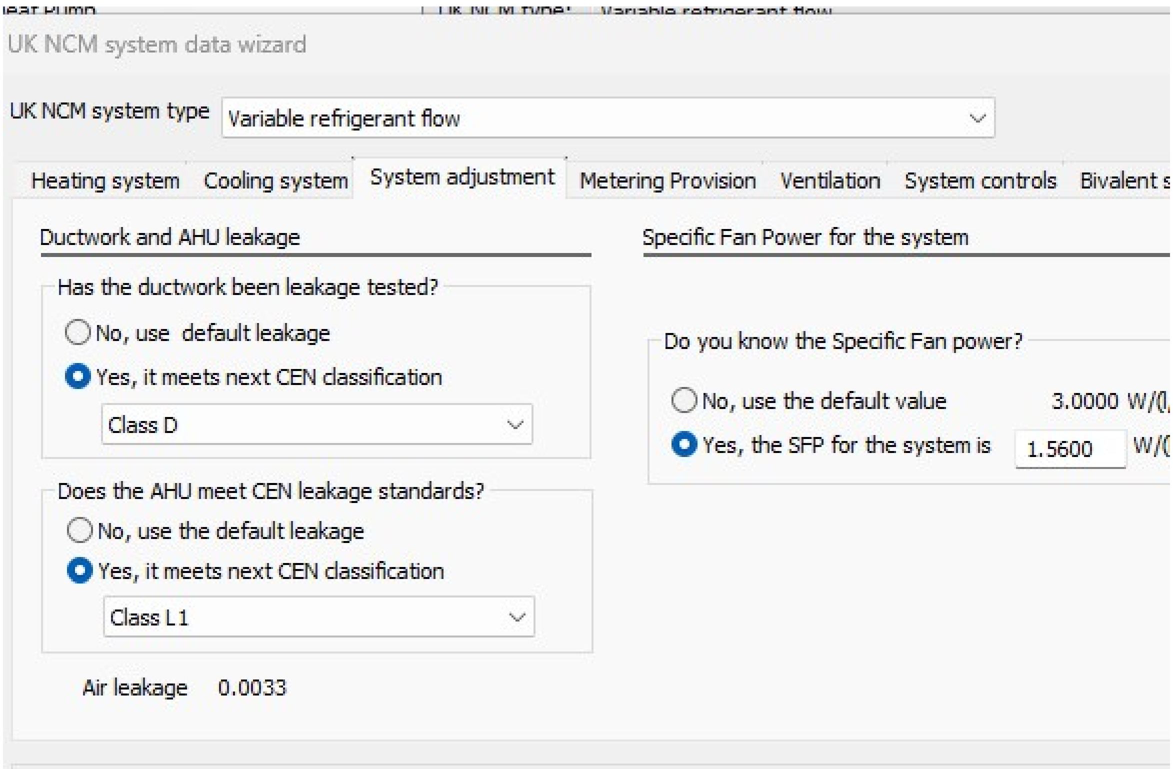

UK NCM system data wizard
UK NCM system type
Variable refrigerant flow
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Ductwork and AHU leakage
Has the ductwork been leakage tested?
No, use default leakage
Yes, it meets next CEN classification
Class D
Does the AHU meet CEN leakage standards?
No, use the default leakage
Yes, it meets next CEN classification
Class L1
Air leakage
0.0033
Specific Fan Power for the system
Do you know the Specific Fan power?
No, use the default value
3.0000 W/(l/s)
Yes, the SFP for the system is
1.5600
W/(l/s)
Heating SCoP
4.2674
Cooling SSEER
4.6135

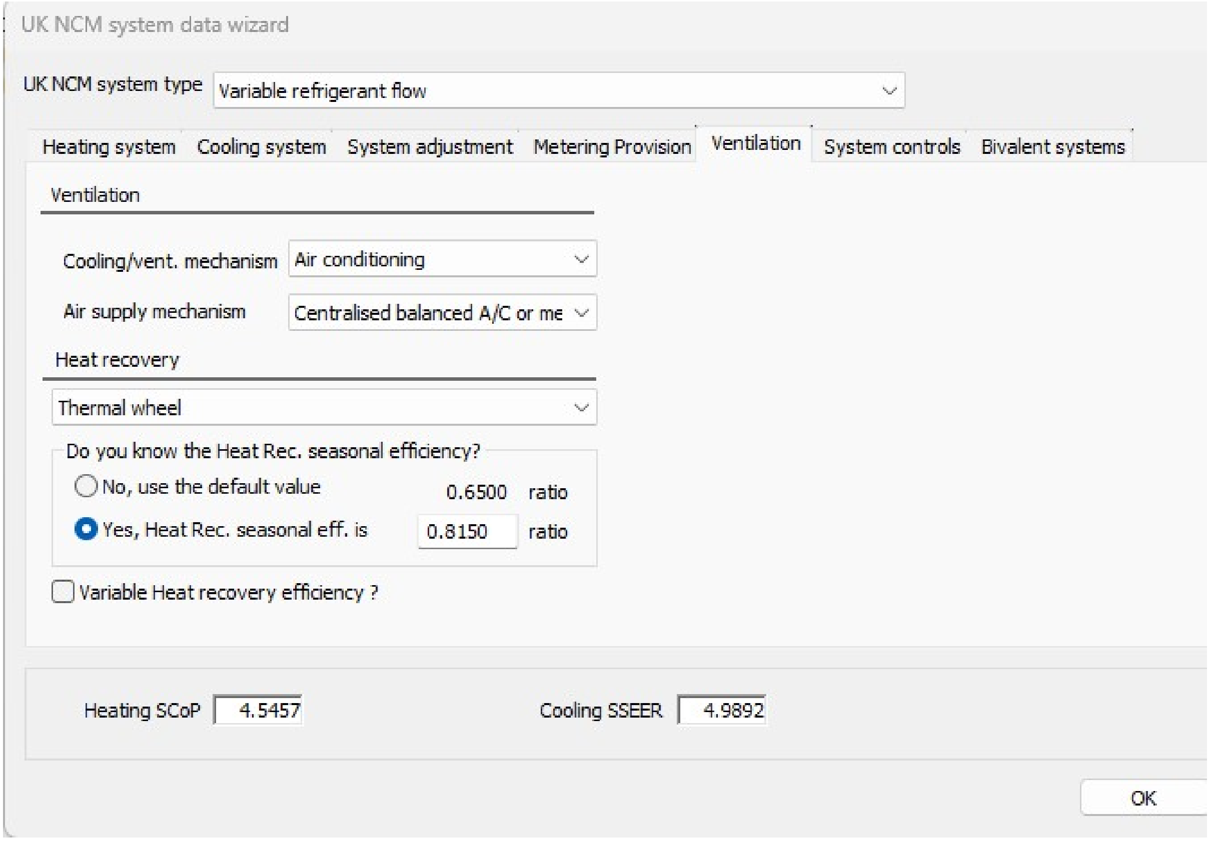

UK NCM system data wizard
UK NCM system type
Variable refrigerant flow
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Ventilation
Cooling/vent. mechanism
Air conditioning
Air supply mechanism
Centralised balanced A/C or me
Heat recovery
Thermal wheel
Do you know the Heat Rec. seasonal efficiency?
No, use the default value
0.6500
ratio
Yes, Heat Rec. seasonal eff. is
0.8150
ratio
Variable Heat recovery efficiency ?
Heating SCoP
4.2674
Cooling SSEER
4.6135

REYA 22A


UK NCM system data wizard
UK NCM system type
Variable refrigerant flow
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Heating only
Heat source:
Heat pump (electric): air source
Meter:
Electricity: Meter 1
Does it qualify for ECAs?
Not on ECA list
Tick if this system also uses CHP
Tick if this system was installed on or after 1998
Do you know the generator seasonal efficiency?
No, use the default value:
2.0000
Yes, the seasonal efficiency is:
4.4100


UK NCM system type
Variable refrigerant flow
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Bivalent systems
Cooling system
Type
Heat pump (electric)
Power
Up to 100kW
Chiller Meter
Electricity: Meter 1
Does it qualify for ECAs?
Not on ECA list
Do you know the generator seasonal EER?
No, use the default value
2.0000
Yes, the seasonal EER is
7.1700
Do you know the generator nominal EER?
No, use default value
2.5000
Yes, EER is
7.1700
Mixed mode operation strategy (SBEM only)


UK NCM system data wizard
UK NCM system type
Variable refrigerant flow
Heating system
Cooling system
System adjustment
Metering Provision
Ventilation
System controls
Ductwork and AHU leakage
Has the ductwork been leakage tested?
No, use default leakage
Yes, it meets next CEN classification
Class D
Does the AHU meet CEN leakage standards?
No, use the default leakage
Yes, it meets next CEN classification
Class L1
Air leakage
0.0033
Specific Fan Power for the system
Do you know the Specific Fan power?
No, use the default value
3.0000
Yes, the SFP for the system is
1.5600



Lighting 130lm/W

Lighting controls

Space Name (Actual)	Local Manual Switching? (Actual)	Occupancy Sensing (Actual)
G0. Offices 01	Yes	AUTO-ON-OFF (Foc = 0.90)
G0. Lobby	Yes	AUTO-ON-OFF (Foc = 0.90)
G0. Offices 02	Yes	AUTO-ON-OFF (Foc = 0.90)
F1. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
G0.Office	Yes	AUTO-ON-OFF (Foc = 0.90)
F1. Offices 01	Yes	AUTO-ON-OFF (Foc = 0.90)
F1. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
F1. Offices 02	Yes	AUTO-ON-OFF (Foc = 0.90)
F3. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
F3. Offices 02	Yes	AUTO-ON-OFF (Foc = 0.90)
F3. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
F3. Offices 01	Yes	AUTO-ON-OFF (Foc = 0.90)
G0. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
G0. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
F2.MR	Yes	AUTO-ON-OFF (Foc = 0.90)
F2. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
F2. Offices 01	Yes	AUTO-ON-OFF (Foc = 0.90)

F2. Reception	Yes	AUTO-ON-OFF (Foc = 0.90)
F2. MR	Yes	AUTO-ON-OFF (Foc = 0.90)
F2. Offices 02	Yes	AUTO-ON-OFF (Foc = 0.90)
G0. Dis WC	No	AUTO-ON-OFF (Foc = 0.90)
G0.Shower	No	AUTO-ON-OFF (Foc = 0.90)
G0. Fem WC	No	AUTO-ON-OFF (Foc = 0.90)
F1. Dis WC	No	AUTO-ON-OFF (Foc = 0.90)
F1.Shower	No	AUTO-ON-OFF (Foc = 0.90)
F1. Fem WC	No	AUTO-ON-OFF (Foc = 0.90)
F1.Male WC	No	AUTO-ON-OFF (Foc = 0.90)
F1.Cleaners	No	AUTO-ON-OFF (Foc = 0.90)
F2. Dis WC	No	AUTO-ON-OFF (Foc = 0.90)
F2.Shower	No	AUTO-ON-OFF (Foc = 0.90)
F2. Fem WC	No	AUTO-ON-OFF (Foc = 0.90)
F2.Male WC	No	AUTO-ON-OFF (Foc = 0.90)
F2.Cleaners	No	AUTO-ON-OFF (Foc = 0.90)
F3. Dis WC	No	AUTO-ON-OFF (Foc = 0.90)
F3.Shower	No	AUTO-ON-OFF (Foc = 0.90)
F3. Fem WC	No	AUTO-ON-OFF (Foc = 0.90)
F3.Male WC	No	AUTO-ON-OFF (Foc = 0.90)
F3.Cleaners	No	AUTO-ON-OFF (Foc = 0.90)
G0 QC offices	No	AUTO-ON-OFF (Foc = 0.90)
G0. Cleaners	No	AUTO-ON-OFF (Foc = 0.90)
G0.Warehouse	No	NONE (Foc = 1.0)
G0. Forklift Maintenance	No	NONE (Foc = 1.0)
G0. Riser	No	NONE (Foc = 1.0)
G0. Stairs	No	NONE (Foc = 1.0)
G0. Stairs	No	NONE (Foc = 1.0)
G0.Lift	No	NONE (Foc = 1.0)
G0. Riser	No	NONE (Foc = 1.0)
G0.Plant Room	No	NONE (Foc = 1.0)
G0. Escape Stairs 2	No	NONE (Foc = 1.0)
F1. Riser	No	NONE (Foc = 1.0)
F1. Stairs	No	NONE (Foc = 1.0)
F1. Riser	No	NONE (Foc = 1.0)
F2. Riser	No	NONE (Foc = 1.0)
F2. Riser	No	NONE (Foc = 1.0)
F3. Riser	No	NONE (Foc = 1.0)
F3. Riser	No	NONE (Foc = 1.0)