Lancashire Central

Energy Strategy

July 2022

Application for Outline Planning Permission

On behalf of Maple Grove Developments and Lancashire County Council

ENERGY STRATEGY

Lancashire Central Master Planning

Prepared on behalf of Maple Grove

June 2022

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Revision: V1

RIDGE

Contents

1.0 INTRODUCTION

Maple Grove and Lancashire County Council have jointly instructed ridge and Partners LLP to undertake an Energy Strategy Report for the proposed development at Lancashire Central. The report sets out the proposed design approach of the development in terms of carbon emissions to meet the requirements of the National, Regional and Local Government requirements. At outline planning stage, this approach is set out at a strategic level, setting out a framework to inform the design process at the more detailed reserved matters stage.

2.0 DESCRIPTION OF DEVELOPMENT

Application for Outline Planning Permission (with all matters reserved save for access from public highway and strategic green infrastructure/landscaping) for a mixed-use development including the provision of Employment use (use Classes B2/B8/E(g)); retail (use class E(a)); food, drink and drive-through restaurant use (Use Class E(b)/Sui Generis Drive-Through); hotel use (Use Class C1); health, fitness and leisure

use (Use Classes E(d)/F(e)/F2(b)); creche/nursery (Class E(f)); car showrooms (Use Class Sui Generis Car Showroom); Residential use (C3) the provision of associated car parking, access, public open space, landscaping and drainage, and the realignment of Public Right of Way Ref 9-12 FP12, 9-12 FP6/FP7/FP8, 9-12 FP9 and 9-12 BW11.

Illustrative outline masterplan

3.0 PLANNING POLICY

3.1 National Policy

A revised National Planning Policy Framework (NPPF) was updated and published in July 2021 which sets out the Government's planning policies for England and how they are expected to be applied. This framework replaces that published in February 2019. This framework states the purpose of Sustainable development that:

'The purpose of the planning system is to contribute to the achievement of sustainable development.'

This highlights sustainability as a critical issue that runs throughout all the planning policies. The National Planning Policy Framework (NPPF) defines sustainable development in agreement with the U.N. definition of "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The NPPF outlines how three overarching objectives need to be pursued in mutually supportive ways to achieve sustainable development. These objectives are outlined below.

The environmental objective of this framework is to:

- Contribute to protecting and enhancing our natural, built, and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

At the heart of the Framework is a 'presumption in favour of sustainable development.'

Section 14 of the National Planning Policy Framework (NPPF) specifically addresses the challenge of climate change. It states that:

'New development should be planned for in ways that:

Avoid increased vulnerability to the range of impacts arising from climate change. When new developments are brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and can help to reduce greenhouse gas emissions, such as through its location, orientation, and design.

Any local requirements for the sustainability of buildings should reflect the government's policy for national technical standard Local Plan and supplementary guidance.'

3.2 Local Plan Policy

Local planning policy documents applicable to the Proposed Development include:

- **Central Lancashire Core Strategy DPD, Adopted July 2012**
- **South Ribble Local Plan DPD, Adopted July 2015**

Also of relevance is the following Supplementary Planning Documents (SPDs):

- **Renewable and Low Carbon Energy Supplementary Planning Document, Adopted May 2014.**

- **Central Lancashire Core Strategy 2012 (CLCS):**

Policy MP seeks to ensure consistency and accordance with the National Planning Policy Framework. The policy requires that: "when considering Development proposals, the Council will take a positive approach that reflects the presumption in favour of sustainable Development contained in the National Planning Policy Framework."

CLCS Policy 27: 'Sustainable Resources and New Developments.' Seeks to incorporate sustainable resources into new development through specified measures including minimum energy efficiency standards for all non-residential buildings will be 'Very Good' (or where possible, in urban areas, 'Excellent') according to the Building Research Establishment's Environmental Assessment Method (BREEAM). The policy requires non-residential units of 500 sq metres or more floorspace shall satisfy all of the following criteria:

1. Evidence is set out to demonstrate that the design, orientation, and layout of the building minimises energy use, maximises energy efficiency and is flexible enough to withstand climate change.
2. Prior to the implementation of zero carbon building through the Code for Sustainable Homes for dwellings or BREEAM for other buildings, either additional building fabric insulation measures or appropriate decentralised, renewable, or low carbon energy sources are installed and implemented to reduce the carbon dioxide emissions of predicted energy use by at least 15%.
3. The policy also requires appropriate storage space to be provided for recyclable waste materials and composting.

CLCS Policy 28: 'Renewable and Low Carbon Energy Schemes.' Proposals for renewable and low carbon energy schemes will be supported and planning permission granted where the following criteria are met:

1. The proposal would not have an unacceptable impact on landscape character and visual appearance of the local area, including the urban environment.
2. The reason for the designation of a site with statutory protection would not be compromised by the development.
3. Any noise, odour, traffic, or other impact of development is mitigated so as not to cause unacceptable detriment to local amenity
4. Any significant adverse effects of the proposal are considered against the wider environmental, social, and economic benefits, including scope for appropriate mitigation, adaptation and/or compensatory provisions.

CLCS Policy 30: Air Quality seeks to improve air quality through delivery of Green Infrastructure initiatives and through taking account of air quality when prioritising measures to reduce road traffic congestion.

4.0 OTHER POLICY DOCUMENTS

Since the adoption of local plan policies for the area, climate change and the need to reduce carbon emissions have increased in profile with many local authorities including South Ribble (2019) declaring climate emergencies. An Independent Economic Review of Lancashire (2022) has also provided an evidence base to inform future strategic priorities and this has included a review of pathways to de-carbonisation. It is important to note that points set out in these documents have not been set as requirements in local plan or other plan policies and remain as aims and aspirations.

4.1 Lancashire Independent Economic Review, Lancashire Net Zero Pathways Options 2022

This document sets out the scale of the challenge to meet Net Zero carbon and outlines how Lancashire can meet climate emergency goals through reducing carbon emissions and removing residual emissions from the atmosphere over time to meet Net Zero.

The evidence paper recommends that all new developments should aim for Net Zero buildings from the outset and that this should be considered in setting local plan policy.

4.2 South Ribble Council Climate Strategy

In 2019, South Ribble Borough Council declared a climate emergency, pledging to work to make the Borough carbon neutral by 2030 as follows: 'This Council declares that the effect of climate change within the borough poses an immediate danger to the health and well-being of our residents and therefore proclaims a Climate Emergency with immediate effect. To combat this threat, the borough sets a goal of rendering the borough carbon neutral by the year 2030.' The aim of this strategy is to achieve carbon neutrality for the borough of South Ribble by 2030, taking account of any carbon offsetting identified. The following objectives have also been agreed:

1. To assess current activities, including estimating the current Carbon Footprint of South Ribble.
2. To research best practice and look for innovative approaches to reducing carbon emissions, carbon off setting and climate mitigation.
3. To produce a Climate Emergency Strategy and way forward for Council to consider.
4. To include those elements contained within the Greenhouse Gas Protocol defined as Scope 1 and Scope 2 emissions. Direct emissions shall be taken as including fuel (energy), vehicles, farming, quarrying, waste produced and deposited within the borough from Domestic, Commercial, Industrial, Educational, Farming and leisure activities. It does not include those emissions generated by vehicles travelling through the borough, i.e., on motorways or by railway.
5. To define all emissions and reductions against a base year of 1990.

The aim is to reduce the amount of gas and electricity used within the Borough to fuel commercial buildings and domestic properties. To this end we will:

1. Make best use of the planning processes to ensure all new housing stock is sustainable in design and affordable to heat.
2. Work with private landlords and housing associations to encourage best practice.
3. Retrofit a domestic property to use as a flagship of best practice for the Borough.
4. Work to heat our own buildings with low carbon and / or renewable heating. All carbon-based energy will be purchased via green tariffs. The Council will seek to lead by example in its use of decarbonised energy.
5. Use LED lighting across the Council estate wherever possible.
6. Enforce private rented Minimum Efficiency Standards regulations.
7. Investigate Energy from Waste options.
8. Examine the possibility of large-scale solar projects within the Borough
9. Lobby national Government to ensure low

carbon energy is available and affordable for everyone.

10. Seek funding opportunities for low carbon heating.
11. Promote national Government low carbon incentives within the Borough.
12. Make use of emerging technology to continually improve how we act as an organisation.

In addition to the carbon reductions resulting from these actions, wider benefits will include:

- Reduced energy bills for residents of the Borough.
- Reduced energy bills for the Council
- Improving the condition of housing stock within the Borough
- Improving air quality by reducing emissions of NOx from gas boilers

5.0 ENERGY VOLITALITY

Currently energy prices are extremely volatile which has resulted in high energy prices. Wholesale energy costs have fluctuated over the last few months - after a steep increase in December 2021, prices have been particularly volatile in 2022. Although they have fallen and risen quite sharply, the overall trend is upwards.

The graph above published by Ofgem shows that electricity prices were at their highest levels in mid-December 2021 when electricity prices hit a high of £240/kWh. Prices have been consistently rising during this time, but they did dip towards the end of the month.

Increasing the UK's longer-term storage facilities could help mitigate the current energy crisis as it would help harness the locally generated energy from high renewable output periods for use later. This report considers battery storage for the developments on this project to help with the current energy volatility.

5.1 Variable Tariffs

A variable energy tariff is where your per-unit gas and electricity costs can vary at the discretion of your supplier. Variable rate deals tend to be more flexible, and you can normally get out of a variable rate contract without incurring any fees.

5.1.1 Pros of Variable Tariffs

- If wholesale energy costs fall, then the price of variable tariffs often falls too.
- Variable plans do not usually come with exit fees, so you have the flexibility to switch at any time.
- If you are on a standard variable default tariff you are protected by the energy price cap, which is the maximum you can be charged for your energy use. The energy price cap is reviewed regularly, usually in April and October, by Ofgem - the energy regulator - and can go up or down.
- Your supplier will always give you advance notice before increasing your prices

6.0 ASSUMED ENERGY PROFILE PER BUILDING USE

The proposed development has a mix of proposed facilities / buildings being:

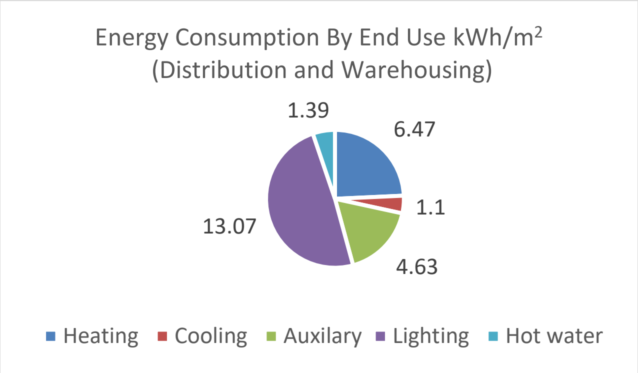
1. Distribution and Warehousing
2. Car Supermarket
3. Health Centre
4. Gym / Creche
5. Food Store
6. Food & Beverage (F&B)
7. Drive through F&B

Illustrative contextual 3D visual of overall site

All these types of buildings have differing types of energy demands in terms of heating, ventilation, lighting, power etc., and therefore there is no "one fit" strategy for the entire site but a strategic approach for the several types of buildings. Furthermore, the site will be developed on a phased basis with individual plots let / sold on to the end user on the basis requiring direct utility supplies. Therefore, the approach of the Energy Strategy is to reflect this approach and to consider the individual building types.

The following charts display examples of the typical energy consumption for the following building types. (***Note these were produced from data generated by previous BRUKL documents**).

6.1 Distribution and warehousing



6.1.1 Lighting

It can be seen that lighting is the biggest consumer of energy within a warehouse type building. This is mainly due to the large area of space that needs to be well illuminated. This can be mitigated by the appropiate usage of rooflights and daylighting controls which take advantage of natural light and can be a significant energy saver.

6.1.2 Heating

Similar to lighting, space heating is also a large consumer of energy within warehouse buildings because of the large area of space. Roof lights can also help reduce energy consumption from heating by utilising heat generated from the sun which reduces heat loss and keeps the warehouse warm.

6.1.3 Auxiliary

Auxiliary refers to the power used for pumps and fans etc. Using leak proff duct design can help reduce energy losses.

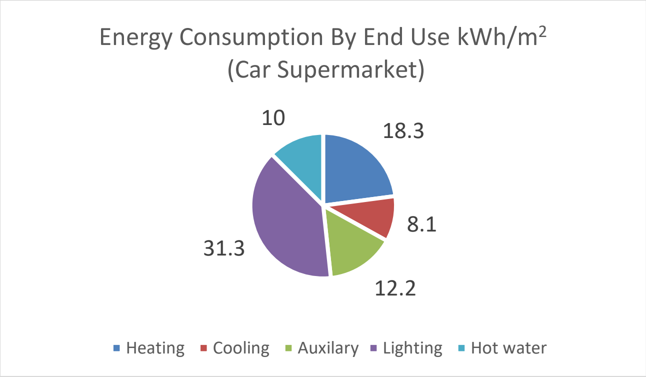
6.1.4 Hot water

Hot water demand is not a big consumer in a warehouse buidling as there is small amount of WC's that will be installed.

6.1.5 Cooling

Cooling is also a low energy consumer in a warehouse, this is because the large roller doors can be opened if needed which supplys natural ventilation.

6.2 Car Supermarket



6.2.1 Lighting

The main bulk of energy consumption in a car showroom is lighting with showlights used to display the cars on sale. This can be mitigated by using solar panels for energy production and also LED lighting.

6.2.2 Heating

Dependent on the area of the building heating can also be a large energy consumer as there may be a demand by the occupant to heat the occupied space. Mechanical ventilation with heat recovery and air source and ground source heat pumps can be a good method of reducing heating demands of car showrooms.

6.2.3 Auxilary

Not much power will be needed for pumps and fans as there will be a low cooling demand.

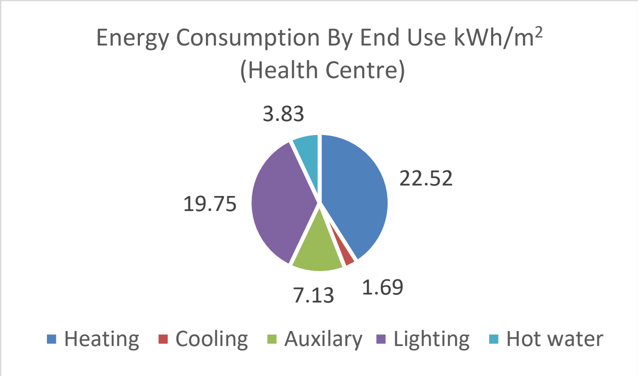
6.2.4 Hot water

There will be minimal WC's in this type of building therefore this will not be a large energy consumer.

6.2.5 Cooling

The cooling demands will not be a big energy consumer as the building can be designed efficently with adequate openings to utilise natural ventilation.

6.3 Health Centre



6.3.1 Lighting

This is a significant energy consumer as the lighting will be used a lot in this type of building. Utilising lighting controls such as dimmers and sensors can greatly reduce this demand.

6.3.2 Heating

Heating is the largest energy consumer as can be seen from the chart. In a heavyily populated building heating demand will be high. Health centres can use air source heat pumps or be connected to a district heating system as a method of reducing CO_2 emissions.

6.3.3 Auxiliary

Health centres will inclue some auxiliary energy components to assist with power for pumps and fans for the building's energy system.

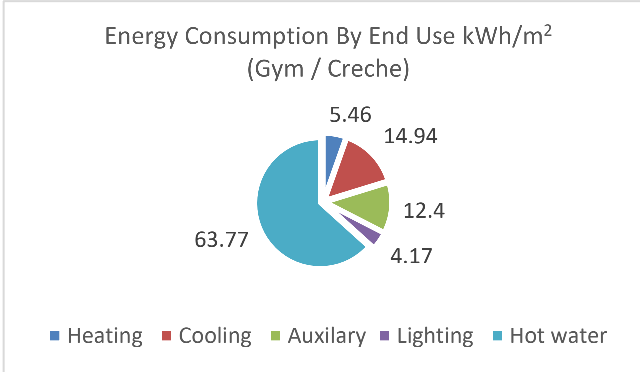
6.3.4 Hot water

Hot water demands in a health centre are significant due to the amount of WC's, sinks and showers that are installed for patient's use. Ground source and air source heat pumps can be an effective measure to reduce the CO_2 emissions that will be produced.

6.3.5 Cooling

Due to heating being a large consumer of energy in health centres cooling only accounts for a small proportion of energy consumption.

6.4 Gym / creche



6.4.1 Lighting

Gyms/creches will usually have a lot of glazing which will reduce lighting demand by utilising natural lighting.

6.4.2 Heating

As with lighting, heating will also be a small energy consumers in these forms of buildings as the glazing will help with solar gain which willl naturally heat the building.

6.4.3 Auxiliary

Auxiliary power will be a big consumer as it assists the cooling systems in the building.

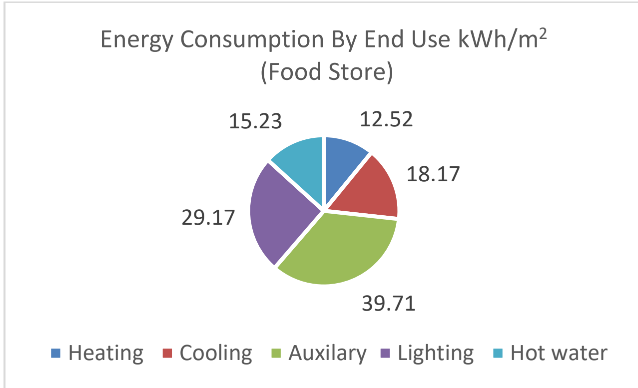
6.4.4 Hot water

This is the largest consumer due to the amount of WC's and showers and the frequency of their use.

6.4.5 Cooling

For a gym cooling will be a large consumer as the occupants will be exercising and cooling will prevent users of the gym overheating. Same as in a creche, it is important that the occupied space is not too warm. Natural ventilation can help reduce this specific demand.

6.5 Food Store



6.5.1 Lighting

Lighting can be seen as one of the biggest energy consumers in these forms of buildings due to the large area needing to be lit. This can be mitigated by using rooflights for natural daylight.

6.5.2 Heating

The need to heat or cool air introduced for ventilation purposes may account for around twice as much energy consumption as the heat lost or gained through conduction across the walls, roof, and floor of the store

6.5.3 Auxiliary

There will be a large demand for power and pumps to support the ventilation systems. This could be reduced by utilising natural ventilation.

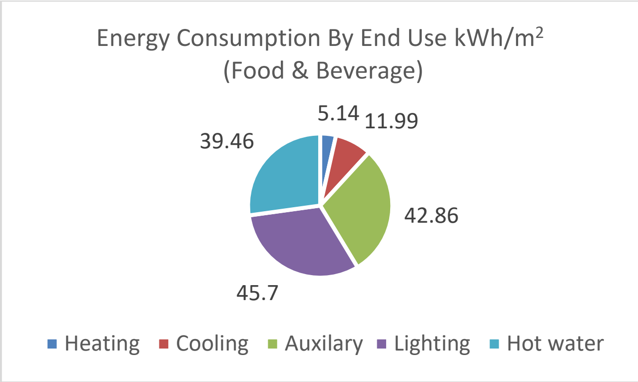
6.5.4 Hot water

Hot water is not going to be a large demand as there won't be many WC's and showers.

6.5.5 Cooling

Cooling accounts for a significant percentage of the energy use in food stores as a lot of heat is gained through conduction across the walls, roof, and floor of the stores. Ventilation is an area where further energy efficiency improvements are possible, and natural ventilation systems have started being introduced in UK stores in many cases linked with natural lighting systems. Roof vents also provide an easily controlled ventilative cooling strategy which could be utilised.

6.6 Food & beverage



6.6.1 Lighting

Depent on how large the area is this can be a huge consumer. Natural daylighting can reduce this demand.

6.6.2 Heating

As previously mentioned, this can be a large or small energy consumer dependant on the size of the building.

6.6.3 Auxiliary

If the building is large and there is a high heat and cooling demand, then a lot of energy will be required to power pumps and fans.

6.6.4 Hot water

A large building could have a lot of WC's and also hot water will be required for kitchens. Solar thermal hot water can work well in these types of buildings.

6.6.5 Cooling

If the building is well insulated and uses natural ventilation, then this may be a low energy consumer, again dependant on the building size.

6.7 Drive through food & beverage

6.7.1 Lighting

It is essential that the area of a drive through is well lit, therefore this will be a big energy consumer. This can be mitigated by the use of low energy lighting.

6.7.2 Heating

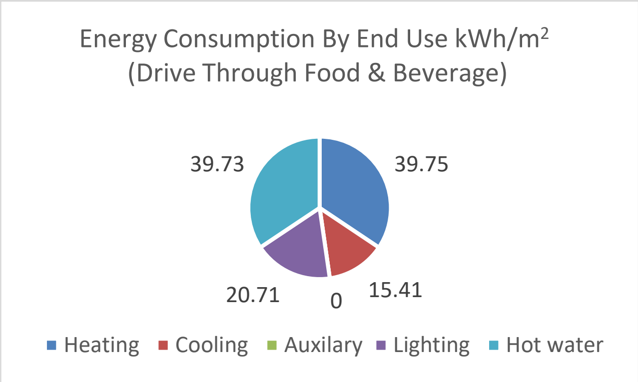
As mentioned previously, this is size dependant and could be a large or small consumer. Natural solar gain can help reduce this if it is a large consumer.

6.7.3 Auxiliary

This is also dependant on size, if large then natural methods of heating and cooling can reduce this.

6.7.4 Hot water

Hot water can be a big consumer in terms of being used in the kitchens. Solar thermal hot water can be a good solution to reduce this demand.



6.7.5 Cooling

As with kitchens in these types of premises, they can get very hot and this is were natural ventilation could be of benefit.

7.0 SUMMARY OF OPTIONS

The following tables summarises the proposed low carbon and sustainable options that can be considered for the individual types of buildings names:

1. Distribution & Warehouses (Storage)
2. Distribution & Warehouses (Offices)
3. Health Centre
4. Gym / Creche
5. Food Store
6. Food & Beverage

The tables set out the various options considered in line with the strategic approach of the design in terms of:

- Passive Design
- Energy Efficiency
- Renewable and low carbon technologies

For each building a suitability rating is provided for the considered options and a description of suitability.

SUMMARY OF OPTIONS CONSIDERED & PROPOSED

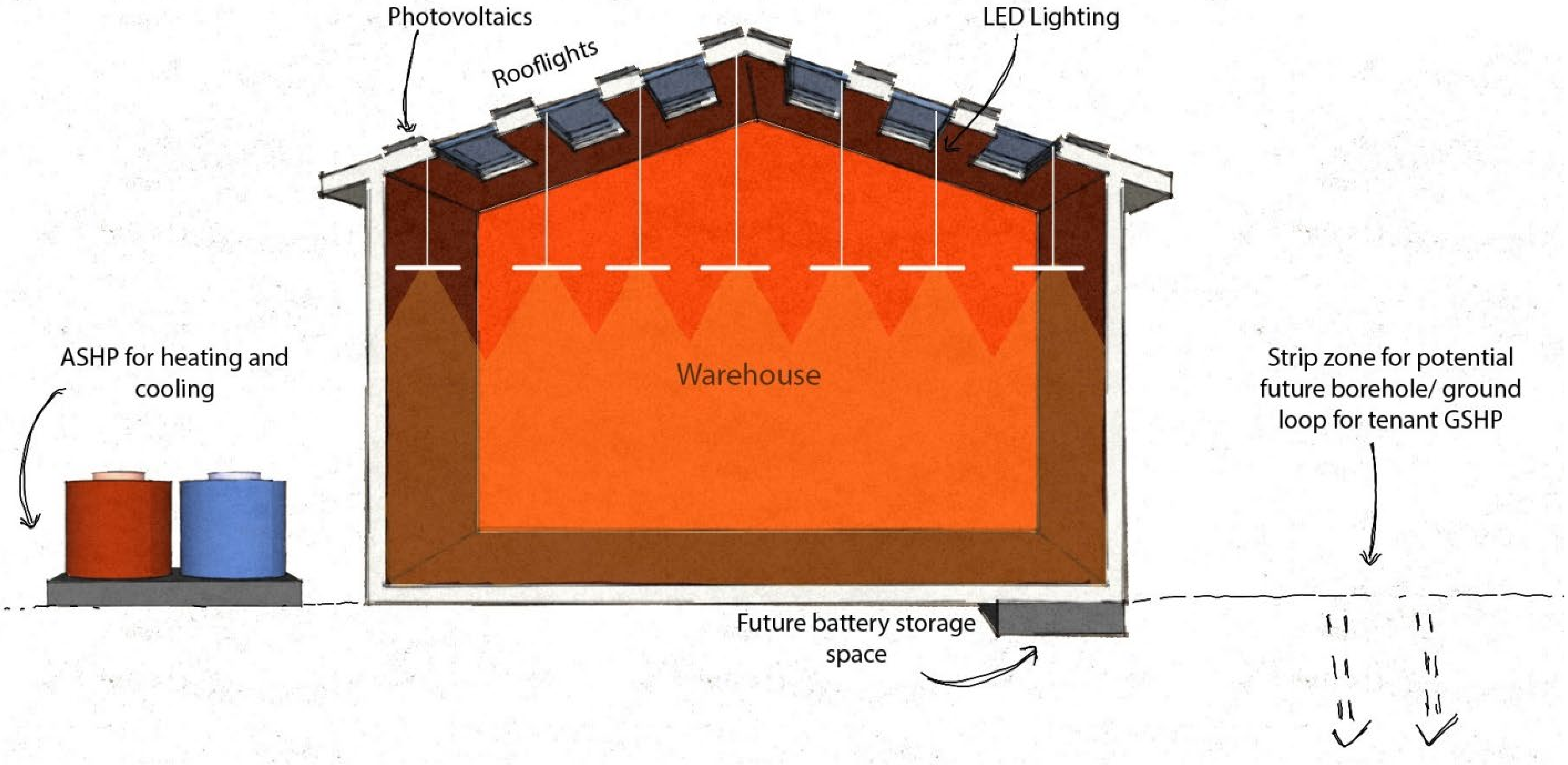
DISTRIBUTION AND WAREHOUSING (STORAGE)								
PASSIVE DESIGN			ENERGY EFFICIENCY			LOW / ZERO CARBON TECHNOLOGY		
Lean	**Suitability Rating**	**Comments**	**Clean**	**Suitability Rating**	**Comments**	**Green**	Suitability Rating	Comments
Thermal Insulation	9	The type of end user will very much depend on the impact that a highly insulated Warehouse will have, being either an ambient shed or heated space. The buildings will be insulated to meet the requirements of Part L 2021 to promote future flexibility as a minimum.	Mechanical Ventilation with Heat Recovery (MVHR)	6	Promoted as part of the tenant fit out works where applicable.	Combined Heat Power / Tri-Generation	2	The use of natural gas is not conducive with the UK Government Net Carbon targets and decarbonisation of the National Grid. Also, the introduction of Part L 2021 will present a challenge for gas to achieve Part L Betterment.
Natural Ventilation / Mixed Mode	6	Similar to the levels of insulation being very much dependent on the end user, but the shell will be designed to allow future flexibility for Natural Ventilation to the main Warehouse Hall.	Mixed Mode Ventilation	6	As with MVHR mixed mode would be promoted to be adopted by the end user tenant.	Solar Thermal Hot Water	1	Minimal demand in the Warehouse area so not ideally suitable.
Natural Daylight	10	Fundamental to reduce reliance on artificial lighting. Daylight control required. The main hall will be provided with 8-10% of the roof area being roof flights to promote natural daylight.	Low Energy Lighting (LED)	10	Essential to reduce the energy use of artificial lighting linked to daylight controls.	Ground Source Heat Pumps A) Open Loop B) Closed Loop	7	Could be adopted by future tenant if heating required to warehouse space but high capital cost. Areas to be identified in each plot for future opportunity.
Thermal Mass	2	Overheating not generally an issue unless process driven. Also, it is not economical to construct the main hall with a heavy mass fabric walls and roof.	Demand Operated Controls	9	Highly effective if daylight sensing and occupancy sensing linked to lighting control systems.	Photovoltaics (PV)	9	Abundance of roof space designed for the future expansion of PV by future tenant. A nominal amount of PV will be installed at base build to meet Part L requirements but a balance to be had in peak demand and actual use
Air Tightness	8	The type of end user will very much depend on the impact that a highly insulated Warehouse will have, being either an ambient shed or heated space. The buildings will be insulated to meet the requirements of Part L 2021 to promote future flexibility.	Variable Speed Drives (VSD's)	3	Minimal opportunities to adopt VSD's on a basic shell and core building but future tenant fit out would adopt.	Air Source Heat Pumps	9	A suitable technology to heat the warehouse if the future tenant requires heating. Area to be identified on each plot for future tenant fit out.
Solar Shading / Low G-Value Glass	1	Not effective in reducing the energy use as overheating not principal issue in the main storage area.	Battery Storage	7	Linked to Photovoltaics can improve yield by strong peak demand and utilising renewable energy stored when demand dictates.	Wind	3	Subject to analysis and site constraints but would only be small scale per plot and subject to a tenant installation.

Suitability rating key:

10 – High 5 - Medium 1 – Low

Description

As described in section 4, lighting is the largest contributor of energy in a warehouse which is why it is important natural daylighting and LED lighting are incorporated into the scheme. The reduction on the reliance of artificial lighting consequently minimises CO_2 emissions and energy costs. Due to the abundance of roof space, PV can help offset the electricity used for the required LED lighting and if coupled with battery storage can reduce dependence on electricity from the grid. Heating can also be a huge contributor of energy depending on the usage of the warehouse, if process driven it is essential to maximise thermal insulation to reduce heat losses. ASHP's can help mitigate the usage on fossil fuel heating and therefore comply with Part L building regulations.


Photovoltaics
Rooflights
LED Lighting
ASHP for heating and cooling
Warehouse
Strip zone for potential future borehole/ ground loop for tenant GSHP
Future battery storage space

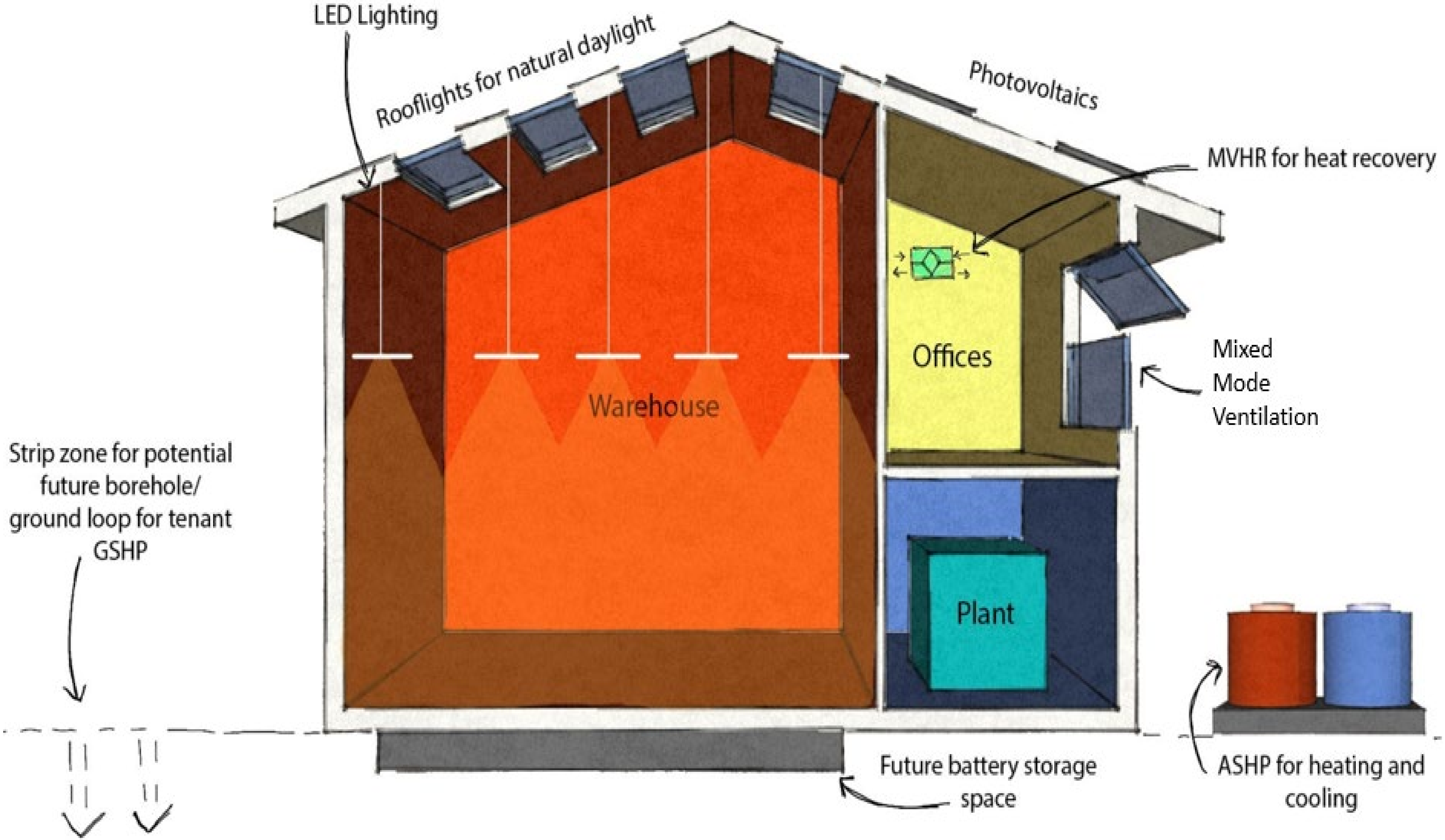
DISTRIBUTION AND WAREHOUSING (OFFICE)								
PASSIVE DESIGN			ENERGY EFFICIENCY			LOW / ZERO CARBON TECHNOLOGY		
Lean	**Suitability Rating**	**Comments**	**Clean**	**Suitability Rating**	**Comments**	**Green**	Suitability Rating	Comments
Thermal Insulation	9	To meet Part L 2021 requirement to minimise energy use for heating.	Mechanical Ventilation with Heat Recovery (MVHR)	8	Important to adopt for ventilation requirements and the recovery of heat.	Combined Heat Power / Tri-Generation	2	The use of natural gas is not conducive with the UK Government Net Zero Carbon targets and the decarbonisation of the National Grid. In addition, the introduction of Part L 2021 will present a challenge for gas to achieve a Part L Betterment.
Natural Ventilation / Mixed Mode	7	Could be adopted in peak summer periods utilising ASHP cooling system and winter reverse cycle ASHP in winter.	Mixed Mode Ventilation	6	An option to build into the base build design for future adoption by tenant.	Solar Thermal Hot Water	4	Modest demand for offices but could be adopted for hot water generator.
Natural Daylight	6	Important to optimise the natural daylight into the offices to reduce the reliance on the artificial lighting avoiding deep plan office areas.	Low Energy Lighting (LED)	10	Essential to meet Part L 2021 and reduce energy use.	Ground Source Heat Pumps (GSHP's) A) Open Loop B) Closed Loop	8	Can be adopted with heat pump system to offices but high capital cost.
Thermal Mass	4	Promoted at roof level to the office to reduce heat gain in summer and promote alternative heat transfer but will be cost prohibitive.	Demand Operated Controls	6	Important to adopt but daylight linked controls on lighting and occupancy sensing.	Photovoltaics	8	Abundance of roof space designed for the future expansion of PV by future tenant. A nominal amount of PV will be installed at base build to meet Part L requirements but a balance to be had in peak demand and actual use
Air Tightness	8	Air leakage rates to be minimised to reduce winter heat losses.	Variable Speed Drives (VSD's)	8	VSD's adopted on central plant pumps and fans and on-air source control heat pumps (ASHP) compressors.	Air Source Heat Pumps (ASHP's)	9	Favourable solution to generate both heating and cooling to offices.
Solar Shading / Low G-Value Glass	8	Useful feature to reduce solar gain in summer and therefore reduce the extent of cooling required.	Battery Storage	3	Can be linked to store renewable energy generated from Photovoltaics for use during periods of high electricity demand.	Wind	2	Not ideally suited for integrating into the office element of the building form.

Suitability rating key:

10 – High 5 - Medium 1 – Low

Description

The office element of the warehouse will need high thermal insulation levels and good levels of air tightness to minimise the buildings heating consumption as the space will be occupied. MVHR units with VSD's can be an efficient method of supplying the occupied space with the required ventilation as it will be a large space therefore this will help reduce CO_2 emissions. As the building is occupied for offices the usage of LED lighting is important as there will be specific LUX levels required and relying on natural lighting may not be sufficient to meet these levels. The large roof area lends itself to the installation of PV panels which can be an effective solution to offset the energy costs from grid electricity for the LED lighting. ASHP's and GSHP's are a favourable method of generating heating and cooling as they are low carbon technologies and not reliant in natural gas.



LED Lighting
Rooflights for natural daylight
Photovoltaics
MVHR for heat recovery
Offices
Mixed
Mode
Ventilation
Warehouse
Strip zone for potential
future borehole/
ground loop for tenant
GSHP
Plant
Future battery storage
space
ASHP for heating and
cooling

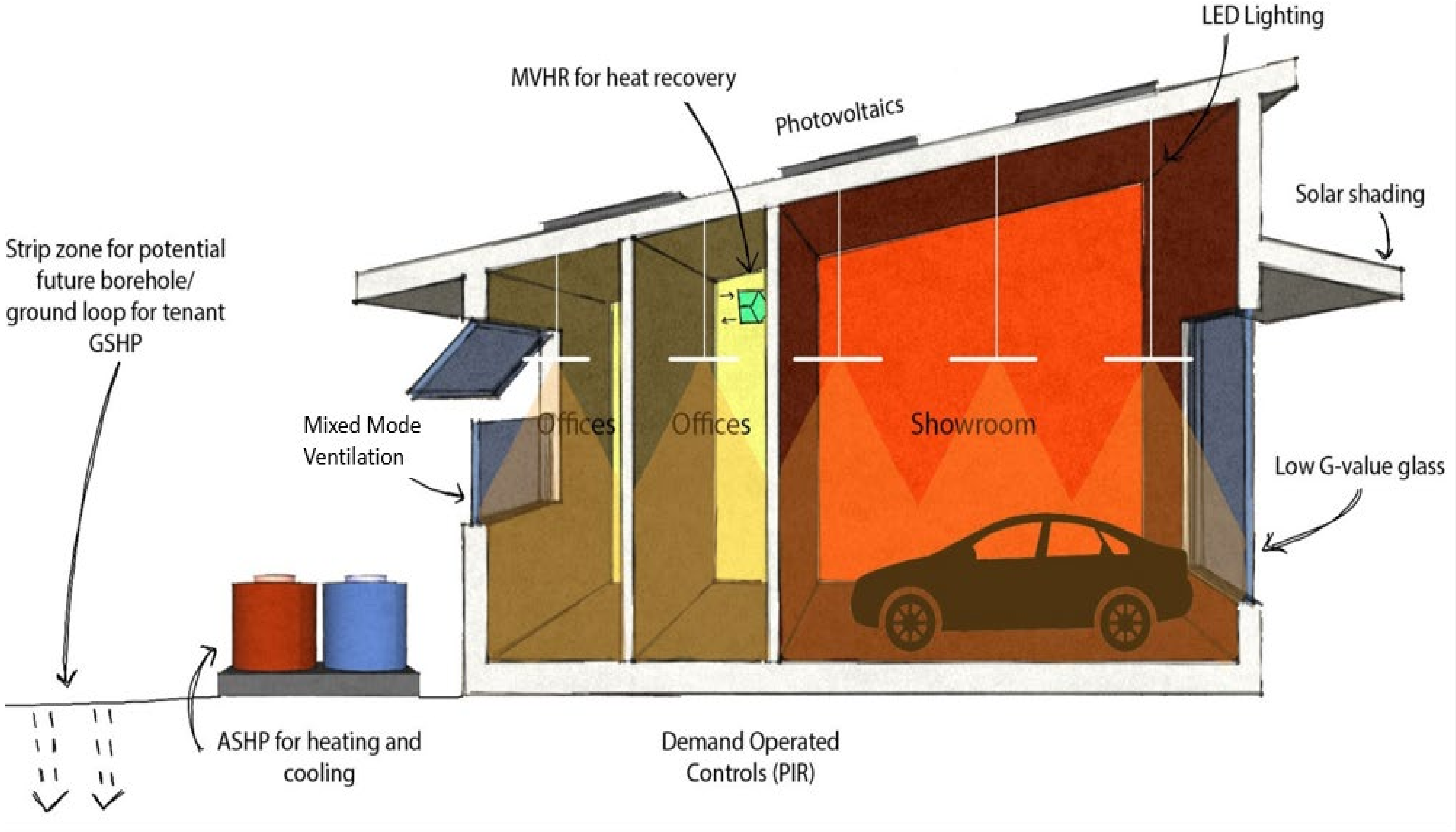
CAR SUPERMARKET								
PASSIVE DESIGN			ENERGY EFFICIENCY			LOW / ZERO CARBON TECHNOLOGY		
Lean	**Suitability Rating**	**Comments**	**Clean**	**Suitability Rating**	**Comments**	**Green**	Suitability Rating	Comments
Thermal Insulation	8	To meet Part L 2021 requirement to minimise energy use for heating.	Mechanical Ventilation with Heat Recovery (MVHR)	9	Important to adopt for ventilation requirements and the recovery of heat.	Combined Heat Power / Tri-Generation	2	The use of natural gas is not conducive with the UK Government Net Zero Carbon targets and the decarbonisation of the National Grid. In addition, the introduction of Part L 2021 will present a challenge for gas to achieve a Part L Betterment.
Natural Ventilation / Mixed Mode	3	Not ideally suitable due to limited openable windows. Deep plan offices do not lend themselves to natural ventilation / mixed mode.	Mixed Mode Ventilation	3	Deep plan offices don't lend themselves to mixed mode.	Solar Thermal Hot Water	2	Not a large hot water demand in a car supermarket.
Natural Daylight	6	Important to optimise natural daylight into car supermarket with careful consideration given to avoid excessive glare to cars on display.	Low Energy Lighting (LED)	10	Essential to meet Part L 2021 and reduce energy use.	Ground Source Heat Pumps A) Open Loop B) Closed Loop	7	Base build allowance (soft dig) of bore holes for future adoption by tenant.
Thermal Mass	2	Overheating not generally an issue. Also, it is not economical to construct the occupied area with a heavy mass fabric walls and roof.	Demand Operated Controls	7	Important to adopt because majority of systems mechanical systems reduce excessive energy consumption.	Photovoltaics	9	Abundance of roof space designed for the future expansion of PV by future tenant. A nominal amount of PV will be installed at base build to meet Part L requirements but a balance to be had in peak demand and actual use
Air Tightness	8	Air leakage rates to be minimised to reduce winter heat losses.	Variable Speed Drives (VSD's)	8	Useful feature to reduce energy demand on pumps and fans.	Air Source Heat Pumps	10	Favourable solution to generate heating and provide comfort cooling.
Solar Shading / Low G-Value Glass	8	Useful feature to reduce solar gain in summer and therefore reduce the extent of cooling required but careful consideration must be taken to minimise excess glare to the cars on display	Battery Storage	8	Can be linked to store renewable energy generated from Photovoltaics for use during periods of high electricity demand.	Wind	3	Subject to analysis and site constraints but would only be small scale per and would not be ideally suited for integrating into this type of building.

Suitability rating key:

10 – High 5 - Medium 1 – Low

Description

The main purpose of a car supermarket is to display the cars for sale therefore LED lighting is important to illuminate the show cars. Natural lighting will be limited as this can have a negative effect by producing glare on the cars, however, large windows will be used so the cars can be visible to the public from the outside which makes solar shading an important feature to reduce the excess glare on the display cars. PV linked with battery storage can be an effective means of producing electricity for the LED lighting requirements. The heating and cooling demand can be solely meet by ASHP's which are a renewable technology and therefore a favourable solution. MVHR units are an efficient method of ventilation as they can recover heat from the exhaust air, thus reducing the energy consumption of the building if they are linked with demand operated controls and VSD's.



LED Lighting
MVHR for heat recovery
Photovoltaics
Solar shading
Strip zone for potential future borehole/ ground loop for tenant GSHP
Mixed Mode Ventilation
Offices
Offices
Showroom
Low G-value glass
ASHP for heating and cooling
Demand Operated Controls (PIR)

GYM / CRECHE

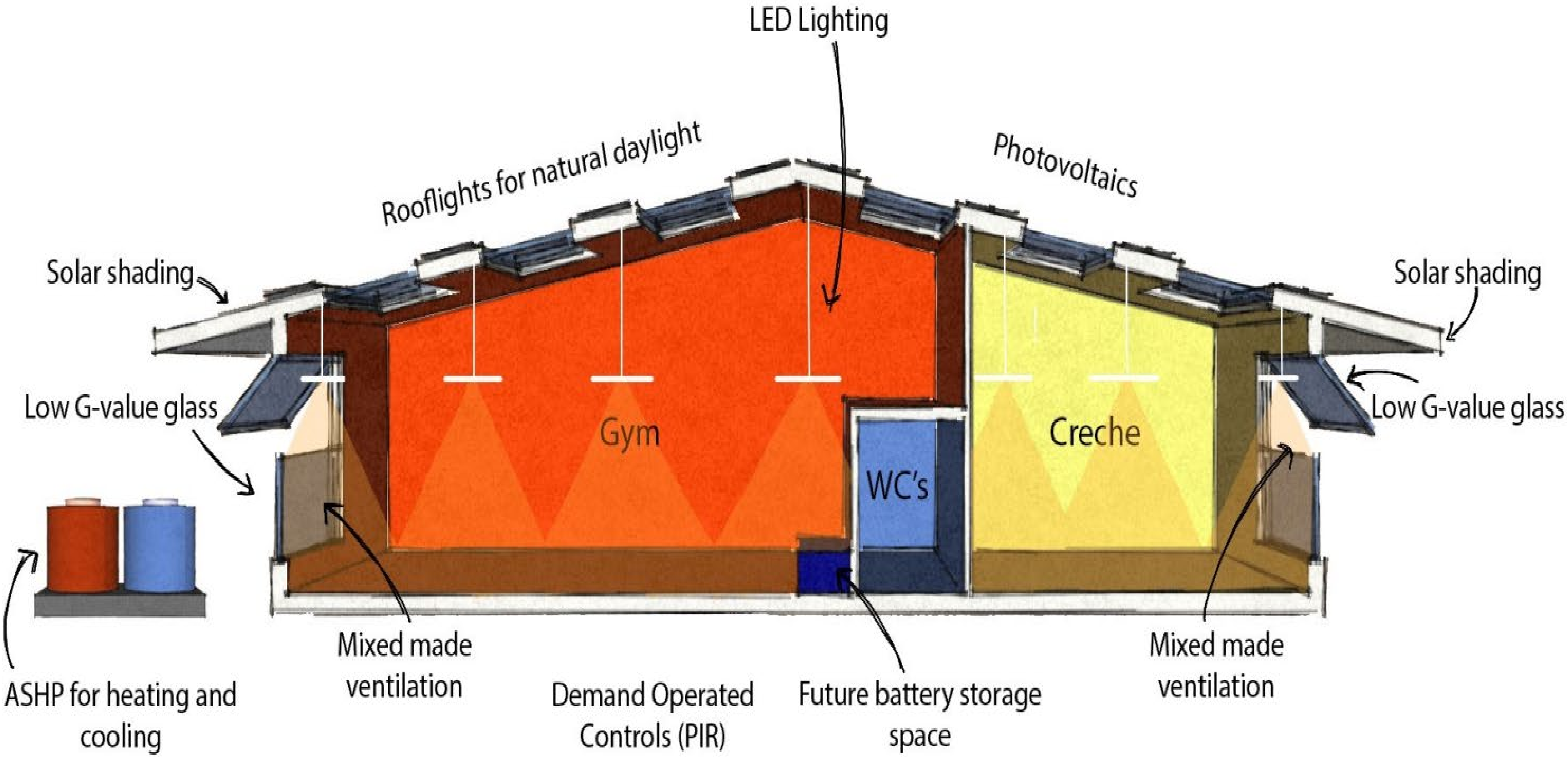
PASSIVE DESIGN			ENERGY EFFICIENCY			LOW / ZERO CARBON TECHNOLOGY		
Lean	**Suitability Rating**	**Comments**	**Clean**	**Suitability Rating**	**Comments**	**Green**	Suitability Rating	Comments
Thermal Insulation	9	Essential to reduce heating demand and to meet Part L 2021.	Mechanical Ventilation with Heat Recovery (MVHR)	6	Important to reduce the energy consumption and improve the buildings efficiency.	Combined Heat Power / Tri-Generation	2	The use of natural gas is not conducive with the UK Government Net Carbon targets and decarbonisation of the National Grid. Also, the introduction of Part L 2021 will present a challenge for gas to achieve Part L Betterment.
Natural Ventilation / Mixed Mode	9	Gym: Overheating not an issue due to inclusion of comfort cooling and therefore, it is not economical to construct the walls and roof with heavy mass materials. Creche: Thermal mass promoted to reduce the heat gain in summer and to promote heat transfer but will be cost prohibitive.	Mixed Mode Ventilation	6	Base build to be provided with louvers for the option for the future implementation of the tenant.	Solar Thermal Hot Water	1	Demand for hot water will be high, but solar thermal hot water is not dependable enough to meet demand as alternative renewable energy sources would provide more consistent source of hot water demand and could also deal with heating demand.
Natural Daylight	7	Necessary to reduce the energy consumption from artificial lighting.	Low Energy Lighting (LED)	10	Essential to reduce the energy use of artificial lighting linked to daylight controls.	Ground Source Heat Pumps A) Open Loop B) Closed Loop	7	Could reduce the price of hot water and heating demands but high capital costs. Areas to be identified for future opportunity.
Thermal Mass	5	Gym: Not of high importance as space would be comfort cooled to meet the occupants needs. Not economical to construct the gym with heavy mass fabric walls and roofs Creche: An amount of mechanical heating / cooling will be used therefore not of high importance.	Demand Operated Controls	9	Highly effective if daylight sensing and occupancy sensing linked to lighting control systems. Air temperature sensors linked to the mixed mode can also greatly reduce energy demands.	Photovoltaics	9	Abundance of roof space designed for the future expansion of PV by future tenant. A nominal amount of PV will be installed at base build to meet Part L requirements but a balance to be had in peak demand and actual use
Air Tightness	9	The type of end user will very much depend on the importance of this. Regardless, the buildings will be insulated to meet the requirements of Part L 2021.	Variable Speed Drives (VSD's)	3	Not essential as cooling / heating plant will need to be set at a specific rate for optimal comfort.	Air Source Heat Pumps	9	Due to the high heating and hot water demand could be an effective and efficient source of heating and hot water.
Solar Shading / Low G-Value Glass	7	Reduces excessive solar heat gain in the summer therefore reduces cooling demand.	Battery Storage	7	Linked to Photovoltaics can improve yield by strong peak demand and utilising renewable energy stored when demand dictates.	Wind	3	Not ideally suited for integrating into the gym / creche.

Suitability rating key:

10 – High   5 - Medium   1 – Low

Description

The hot water demand of a building of this type would be one of the largest energy contributors, conversely, ASHP's would be very suitable to meet this demand and should be considered of high importance when designing the building. Both these types of buildings would use a lot of ventilation therefore it is important that they are designed for natural ventilation to reduce reliance on mechanical ventilation. Natural daylighting and LED lighting are also an effective method of reducing the buildings energy consumption and energy costs from lighting as LED lighting can be linked to PV and battery storage to produce electricity onsite rather than using grid electricity. As LED lighting will be used a lot in these buildings it is vital to utilise demand operated controls to save energy whenever the space is not occupied.


LED Lighting
Rooflights for natural daylight
Photovoltaics
Solar shading
Solar shading
Low G-value glass
Low G-value glass
Gym
Creche
WC's
Mixed made ventilation
Mixed made ventilation
ASHP for heating and cooling
Demand Operated Controls (PIR)
Future battery storage space

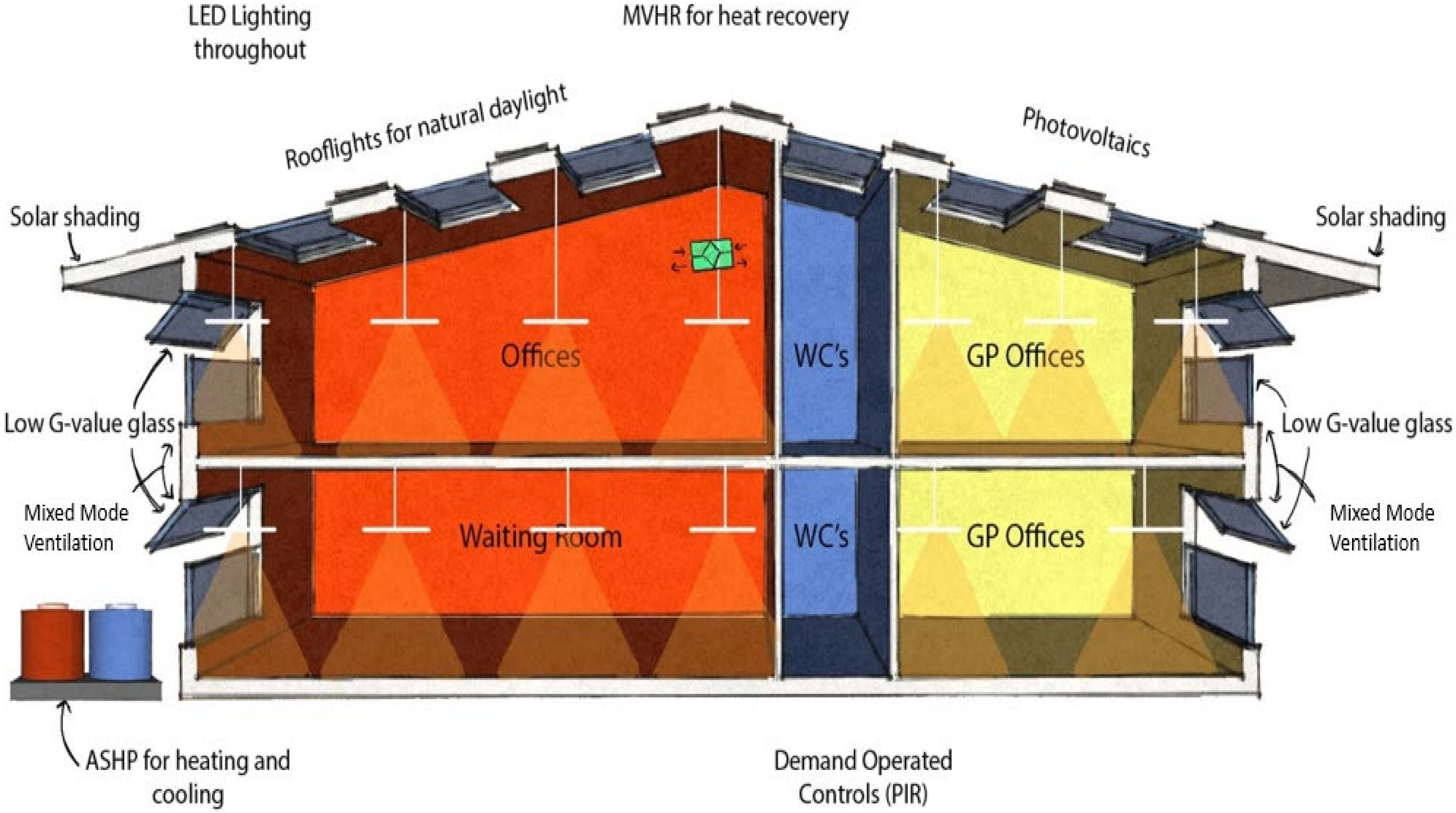
HEALTH CENTRE								
PASSIVE DESIGN			ENERGY EFFICIENCY			LOW / ZERO CARBON TECHNOLOGY		
Lean	**Suitability Rating**	**Comments**	**Clean**	**Suitability Rating**	**Comments**	**Green**	Suitability Rating	Comments
Thermal Insulation	9	Essential to reduce heating demand and to meet Part L 2021. Will reduce the large heating demand.	Mechanical Ventilation with Heat Recovery (MVHR)	9	Reduces the amount of energy required to provide heating, thus improving the efficiency of the heating system therefore helping reduce CO_2 emissions.	Combined Heat Power / Tri-Generation	2	The use of natural gas is not conducive with the UK Government Net Carbon targets and decarbonisation of the National Grid. Also, the introduction of Part L 2021 will present a challenge for gas to achieve Part L Betterment.
Natural Ventilation / Mixed Mode	9	Fundamental to meet a high proportion of the building's ventilation demand during hot weather periods.	Mixed Mode Ventilation	9	As with MVHR mixed mode would be promoted to be adopted by the end user tenant.	Solar Thermal Hot Water	5	Can help offset some of the hot water demand but may have to be backed up with an additional energy source.
Natural Daylight	6	Important to mitigate dependence of artificial lighting.	Low Energy Lighting (LED)	10	Essential to reduce the energy use of artificial lighting linked to daylight controls.	Ground Source Heat Pumps A) Open Loop B) Closed Loop	6	Could be adopted by future tenant but high initial capital cost. Soft dig spot to be provided.
Thermal Mass	5	Not economically feasible to construct the building with heavy mass fabric walls and roofs. Overheating also not generally an issue.	Demand Operated Controls	4	The purpose of the building does not lend itself to the extensive use of PIR for lighting controls. Demand operated controls would be installed on all mechanical plant.	Photovoltaics	8	Abundance of roof space designed for the future expansion of PV by future tenant. A nominal amount of PV will be installed at base build to meet Part L requirements but a balance to be had in peak demand and actual use.
Air Tightness	9	Important to avoid heat losses which in turn allows heating system to work more efficiently and improve thermal comfort.	Variable Speed Drives (VSD's)	5	Minimal opportunities to adopt VSD's due to the consistent frequency of demand from the electricity and heating of the building. Where possible can help to reduce energy demand on pumps and fans.	Air Source Heat Pumps	9	Favourable solution to generate heating and hot water and could also provide comfort cooling.
Solar Shading / Low G-Value Glass	7	Useful feature to reduce solar gain in summer and therefore reduce the extent of potential cooling required.	Battery Storage	4	Linked to Photovoltaics can improve yield by strong peak demand and utilising renewable energy stored when demand dictates but peak demand will coincide with peak output.	Wind	2	Not suitable for location of health centre.

Suitability rating key:

10 – High 5 - Medium 1 – Low

Description

A health centre will demand a lot of heating and ventilation, to maintain the right environment and good air quality for patients and members of staff alike. For this reason, it is important to maximise natural ventilation as this can meet significant proportion of the building's ventilation demand during hot weather periods and assist with an MVHR unit when required. Where natural ventilation is not adequate to meet the heating or cooling demands, ASHPS's are a favourable method of meeting this demand and the comply with Part L building regulations which is an advantage. High levels of thermal insulation will minimise heat losses from the building and ensure high levels of thermal comfort. LED lighting will also be of high importance as it is an efficient means of lighting. There is an abundance of roof space therefore suitable for PV installation and future expansion will also be considered.


LED Lighting throughout
MVHR for heat recovery
Rooflights for natural daylight
Photovoltaics
Solar shading
Solar shading
Offices
WC's
GP Offices
Low G-value glass
Low G-value glass
Mixed Mode Ventilation
Waiting Room
WC's
GP Offices
Mixed Mode Ventilation
ASHP for heating and cooling
Demand Operated Controls (PIR)

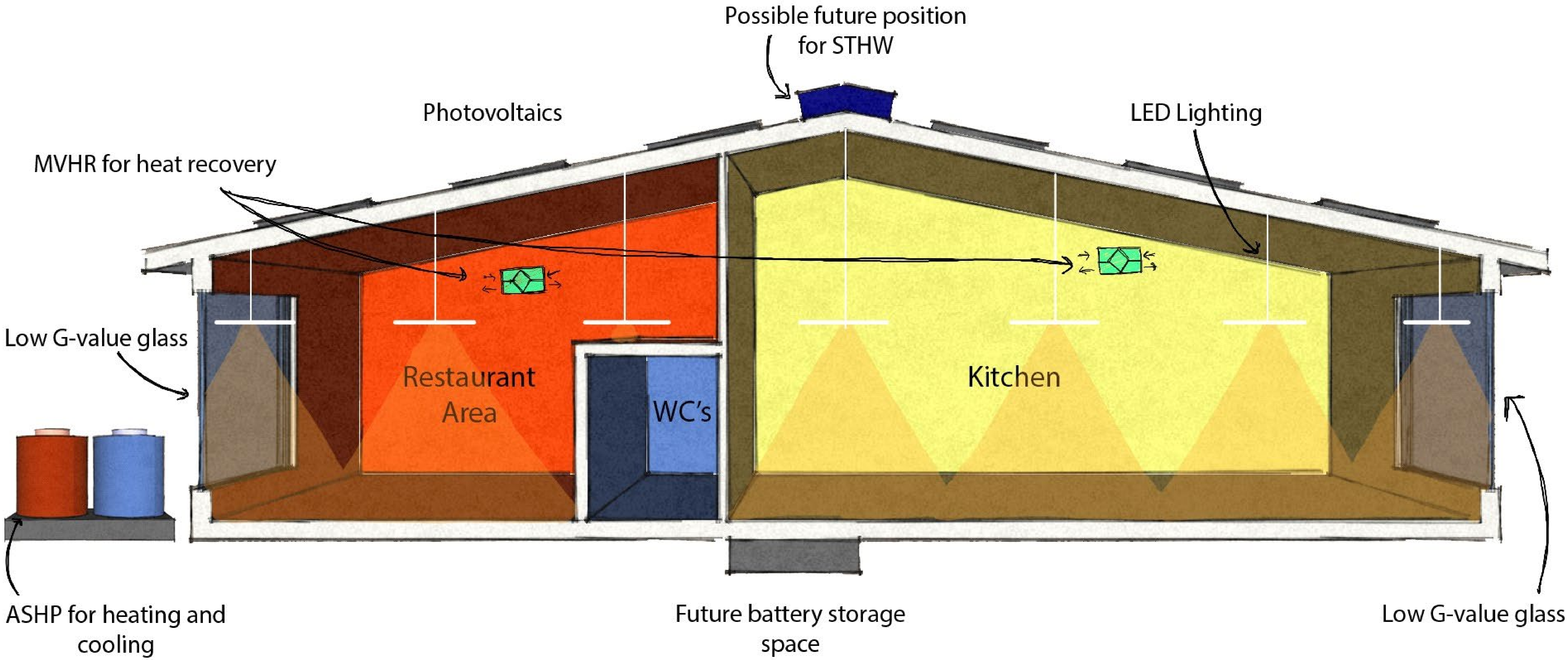
FOOD & BEVERAGE								
PASSIVE DESIGN			ENERGY EFFICIENCY			LOW / ZERO CARBON TECHNOLOGY		
Lean	**Suitability Rating**	**Comments**	**Clean**	**Suitability Rating**	**Comments**	**Green**	Suitability Rating	Comments
Thermal Insulation	8	Essential to achieve Part L 2021 and to reduce the heating demand.	Mechanical Ventilation with Heat Recovery (MVHR)	9	Reduces the amount of energy required to provide heating, thus improving the efficiency of the heating system therefore helping reduce CO_2 emissions.	Combined Heat Power / Tri-Generation	2	The use of natural gas is not conducive with the UK Government Net Carbon targets and decarbonisation of the National Grid. Also, the introduction of Part L 2021 will present a challenge for gas to achieve Part L Betterment.
Natural Ventilation / Mixed Mode	9	Big opportunity to reduce ventilation costs if careful consideration is taken when designing openings.	Mixed Mode Ventilation	6	Ensures space is supplied with the right amount of fresh air, keeping the temperature constant and at a pleasant level.	Solar Thermal Hot Water (STHW)	6	Solar thermal hot water alone will not be sufficient in meeting the hot water demand.
Natural Daylight	3	Artificial lighting will be mainly used with task lighting to create a welcoming environment.	Low Energy Lighting (LED)	8	Essential to reduce the energy use of artificial lighting linked to daylight controls.	Ground Source Heat Pumps A) Open Loop B) Closed Loop	6	Could be adopted by future tenant but high initial capital cost. Soft dig spot to be provided.
Thermal Mass	3	Not economically viable and overheating not an issue due to the potential inclusion of comfort cooling.	Demand Operated Controls	3	The purpose of the building does not lend itself to the extensive use of PIR for lighting controls. Demand operated controls would be installed on all mechanical plant.	Photovoltaics (PV)	8	Abundance of roof space designed for the future expansion of PV by future tenant. A nominal amount of PV will be installed at base build to meet Part L requirements but a balance to be had in peak demand and actual use
Air Tightness	8	Air leakage rates to be minimised to reduce winter heat losses.	Variable Speed Drives (VSD's)	5	Can be an effective solution to reduce the energy demand of pumps and fans.	Air Source Heat Pumps	9	Favourable solution to generate heating and provide comfort cooling.
Solar Shading / Low G-Value Glass	2	Would reduce the amount of cooling required and incorporating solar shading would mitigate excessive glare to occupants directly adjacent to windows.	Battery Storage	7	Linked to Photovoltaics can improve yield by strong peak demand and utilising renewable energy stored when demand dictates.	Wind	3	Subject to analysis and site constraints but would only be small scale per plot and subject to a tenant installation.

Suitability rating key:

10 – High 5 - Medium 1 – Low

Description

In a food and beverage building it is vital to have adequate lighting as this can influence customers moods and appetites this is also the largest energy contributor which is why LED lighting is of high importance. The hot water demands will also be a high energy contributor therefore ASHP's are considered important when designing the building. Solar thermal hot water can also be an efficient means of generating hot water and should be considered, however it may not be able to supply all the needs during high peak demands. Due to the abundance of roof space PV panels would of high importance as they can supply a certain percentage of the building's electricity demand. During periods of high energy production from PV's, battery storage can play a vital role in storing this excess energy for usage during off peak times.


Possible future position
for STHW
Photovoltaics
LED Lighting
MVHR for heat recovery
Low G-value glass
Restaurant
Area
WC's
Kitchen
ASHP for heating and
cooling
Future battery storage
space
Low G-value glass

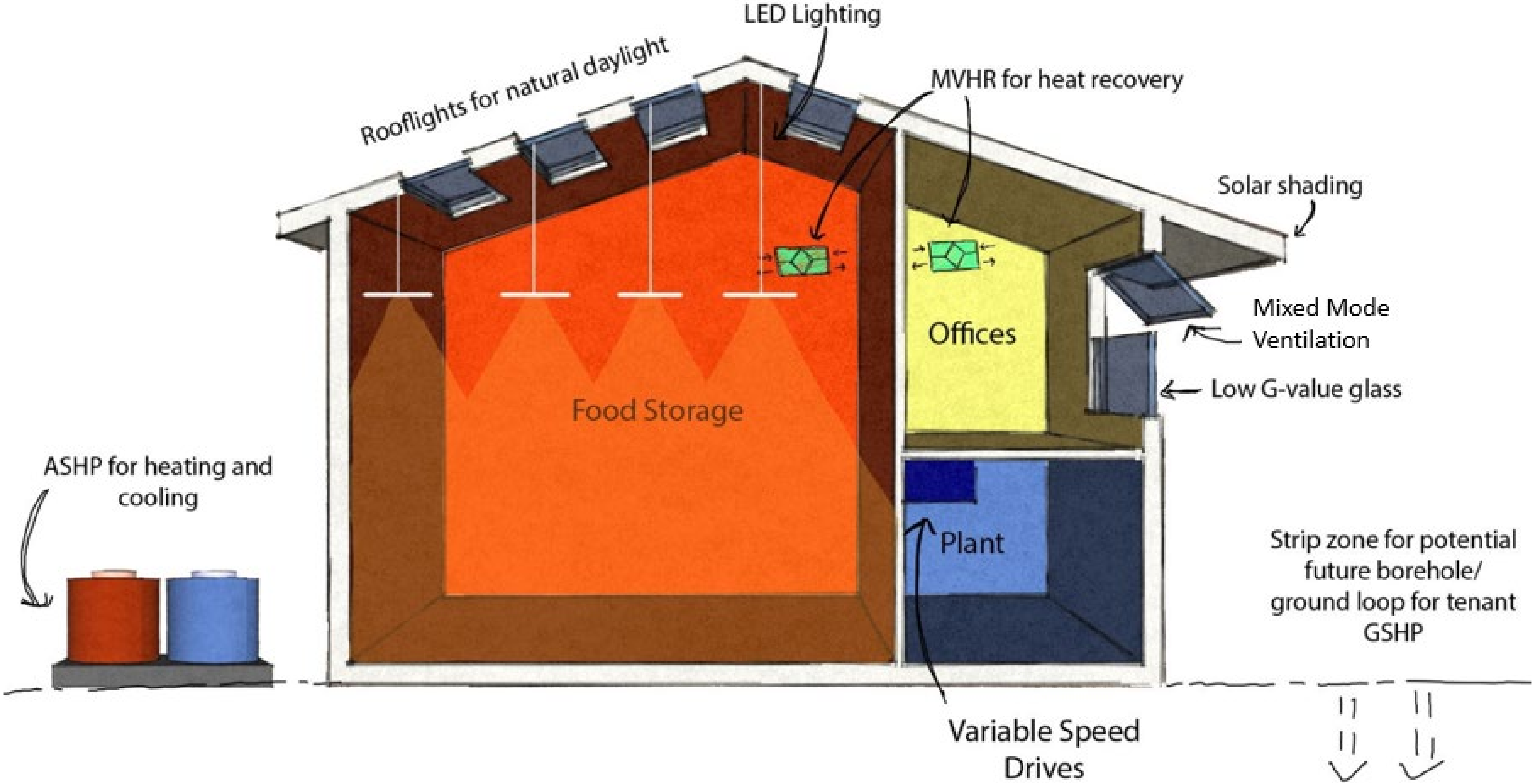
Food Store								
PASSIVE DESIGN			ENERGY EFFICIENCY			LOW / ZERO CARBON TECHNOLOGY		
Lean	**Suitability Rating**	**Comments**	**Clean**	**Suitability Rating**	**Comments**	**Green**	Suitability Rating	Comments
Thermal Insulation	9	Essential to reduce heat losses and ensuring the building is adequately ventilated and heated. The buildings will be insulated to meet the requirements of Part L 2021.	Mechanical Ventilation with Heat Recovery (MVHR)	9	Important to adopt for ventilation requirements and the recovery of heat from the returning air.	Combined Heat Power / Tri-Generation	2	The use of natural gas is not conducive with the UK Government Net Carbon targets and decarbonisation of the National Grid. Also, the introduction of Part L 2021 will present a challenge for gas to achieve Part L Betterment.
Natural Ventilation / Mixed Mode	3	Will not be sufficient to cool the building due to heat gain from refrigeration units.	Mixed Mode Ventilation	3	Won't be as effective as mechanical ventilation which the building requires. Deep plan spaces don't lend themselves to mixed mode.	Solar Thermal Hot Water	2	Not sufficient to meet entire buildings hot water demand
Natural Daylight	8	Fundamental to reduce reliance on artificial lighting. Daylight control required.	Low Energy Lighting (LED)	10	Essential to reduce the energy use of artificial lighting linked to daylight controls.	Ground Source Heat Pumps A) Open Loop B) Closed Loop	6	Could be adopted by future tenant but high initial capital cost. Soft dig spot to be provided.
Thermal Mass	3	Overheating not generally an issue. Also, it is not economical to construct the main building with a heavy mass fabric walls and roof.	Demand Operated Controls	3	The purpose of the building does not lend itself to the extensive use of PIR for lighting controls. Demand operated controls would be installed on all mechanical plant.	Photovoltaics (PV)	6	Abundance of roof space designed for the future expansion of PV by future tenant. A nominal amount of PV will be installed at base build to meet Part L requirements but a balance to be had in peak demand and actual use
Air Tightness	9	Important to avoid winter heat losses which in turn allows heating system to work more efficiently and improve thermal comfort.	Variable Speed Drives (VSD's)	6	Useful feature to reduce energy demand on pumps and fans.	Air Source Heat Pumps	10	Efficient means of supplying heating and hot water cooling to the building without the need to use traditional boilers.
Solar Shading / Low G-Value Glass	6	Useful feature to reduce solar gain in summer and therefore reduce the extent of cooling required.	Battery Storage	3	Linked to Photovoltaics can improve yield by strong peak demand and utilising renewable energy stored when demand dictates.	Wind	3	Subject to analysis and site constraints but would only be small scale per plot and subject to a tenant installation.

Suitability rating key:

10 – High **5 - Medium** **1 - Low**

Description

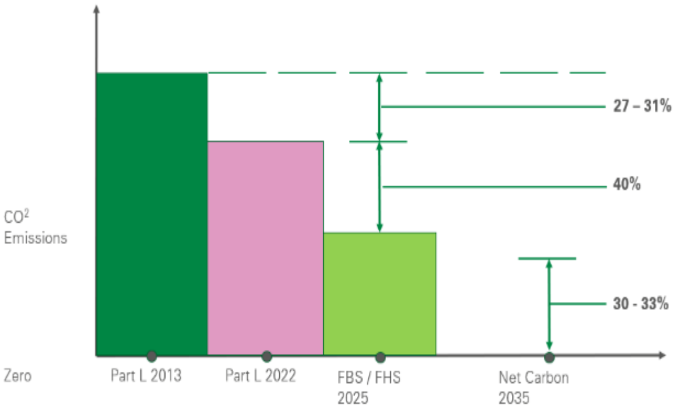
Auxiliary power is the largest energy contributor in a food store as there is a lot of units i.e., fridges and freezers which need power for pumps and fans to ensure the temperature is keep at a suitable level. Lighting is also a large energy contributor; therefore, careful consideration should be taken when designing the building to allow for as much natural daylight as possible and rooflights would be an effective method of doing so. LED lighting will also be of high importance for display stands and also to illuminate the area when natural daylight is not available. Food stores would benefit from high levels of thermal insulation and air tightness as certain temperatures need to be maintained for food etc. ASHP's would be a favourable solution for providing heating and cooling and usage of MVHR units will help to recover waste heat from the return air and make the building more efficient. It is essential to utilise as much roof space as possible for PV as this is a favourable solution for producing electricity and depending on the orientation of the building and the size of the PV array, can help produce a large percentage of renewable energy.


LED Lighting
Rooflights for natural daylight
MVHR for heat recovery
Solar shading
Mixed Mode Ventilation
Offices
Low G-value glass
Food Storage
ASHP for heating and cooling
Plant
Strip zone for potential future borehole/ ground loop for tenant GSHP
Variable Speed Drives

8.0 CHANGES TO PART L AND NEW PART S

- **PART L**

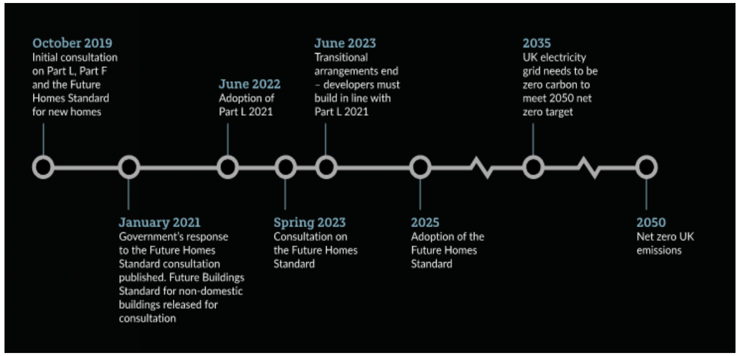
Part L 2021 is due to come into effect in June 2022 with a transitional period of 12 months and will acts as an uplift to help the construction industry adapt to changing regulations and low carbon heating.



The figure above shows the timeline for the new Part L regulations and displats that the new regulations will require a 31% and 27% reduction in CO_2 emissions compared to the previous 2013 regualtioons for domestic buildings and non-domestic buildings respectively.

The future building standards which will come into effect in 2025 will require CO_2 emissions to be futher decreased by 40% in comparision to current figures.

The timeline for the future buildings standards is displayed below:



By 2035 the South Ribble area aims to be net zero carbon.

Part L volume 1 Key Changes (Domestic buildings)

- 31% less CO_2 reduction compared to current regulations.
- No ban on use of gas boilers.
- Local planning authorities will retain powers to set higher energy efficiency targets than building regulations.
- All new builds to be air tightness tested and reducing unwanted air infilration in existing dwellings.
- Improve accuracy of as built energy calculations
- Uplift in the efficiencies of building services in dwellings.
- Maximum flow temperatue of 55°C in wet space heating systems.

Part L volume 2 Key Changes (Non-Domestic buildings)

- New non-domestic buildings to be 27% less CO_2 than current regulations.
- Encourage use of low carbon systems and high levels of buidling fabric.
- Uplift in the efficiencies of buidling services.
- Update to SBEM and NCM modelling guide.
- Uplift to limiting U-values and air permebility.
- Air tightness in existing buildings – reducing unwated air filtration.
- Maximum flow temperature of 55°C in wet space heating systems.

A new performance metric has also been ushered in, primary energy will become the principle measure replacing CO_2 emissions as the main metric. CO_2 emissions will become less effective as a measure of energy performance as the electricity grid becomes de-carbonised. If not addressed, this could result in a dwelling with low CO_2 emissions complying with regulations, despite having excessively high energy consumption. Consequently, the Primary Energy metric has been introduced to ensure that energy efficiency is directly measured rather than assuming it is linked to CO2 emissions. Any plans/notices submitted after June 2022 must adhere to the new part L standards.

- **PART S**

This is a new upcoming building regulation which provides technical guidance regarding the installation and charge point requirements for electric vehicles. This regulation will be introduced on 15th June 2022 and will have an adjustment period of a minimum of 6 months from the regulation coming into force. To comply with this regulation, non-residential buildings with more than ten parking spaces must have a minimum of one charge point along with cable infrastructure for one in five (20%) of the total number of spaces

9.0 DECARBONISING THE NATIONAL GRID & PART L 2021

The UK and Ireland needs to reach Net Zero emissions by 2050 (2045 in Scotland). This means more renewable energy, a shift to zero-emissions vehicles like electric cars, greener gas, and the creation of local energy markets. The energy networks are the backbone of this green revolution.

9.1 Decarbonisation of the electricity grid

The National Grid in the UK is decarbonising rapidly. This permits the electrification of heat and heralds the end to combustion of fossil fuels as the main source of heating. The attractive alternative to combustion is heat transfer using heat pumps linked to ground source energy. The carbon factor of grid electricity was 495 grams of CO^2 for each kWh of electricity generated in 2014 according to Defra. This fell by 6.5% to 462 grams in 2015, and by a further 10.8% to 412 in 2016. BEIS published its Energy and Emissions Projection (EEP) in October 2020 showing the projected Grid Carbon Factor falling dramatically from 156 grams in 2019 to just 67 grams in 2040.

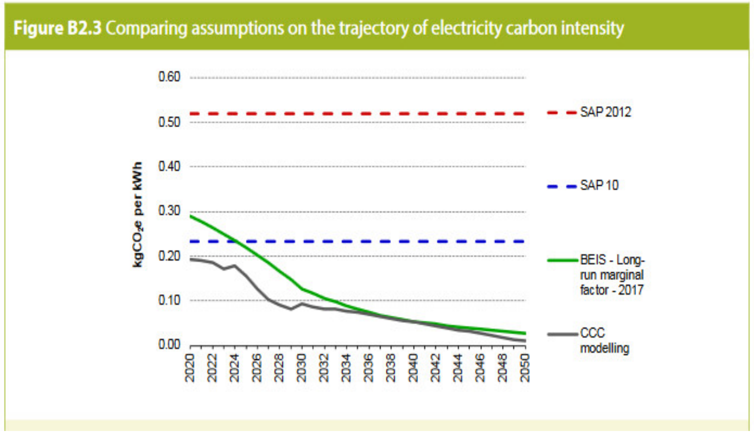
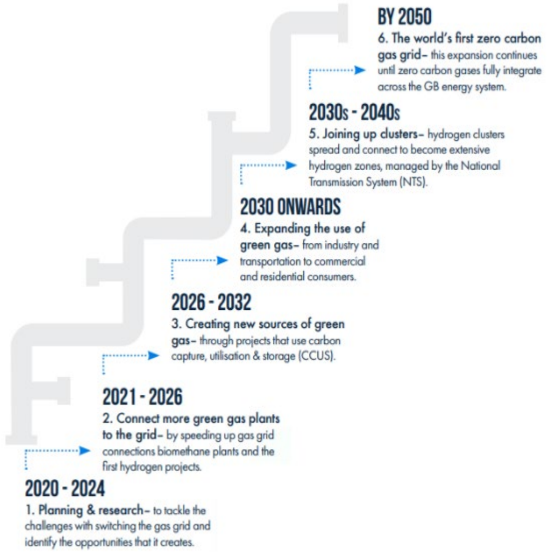


Figure I – Above indicates the predicted reduction in Carbon Emissions per kWhr up to 2050.

Furthermore, the UK Government has passed laws that require the country to reduce all greenhouse gas emissions to net zero by 2050 and have committed to the phasing out of natural gas as a source of heating with gas heating to be banned from 2025. This decarbonisation and phasing out of all fossil fuels is a key factor in deciding the primary fuel for the site

9.2 Greening of the National Grid

Similar to the electricity grid, changes are needed to move Britain's network of 284,000km of gas pipelines from delivering methane-based natural gas to zero carbon hydrogen and biomethane. The timeline for greening the national grid is displayed below:



23 million properties and 85% of Britain's homes are connected to its gas grid, making it one of the most extensive in the world. Research demonstrates that creating a zero-carbon gas grid in the UK is possible and could save bill payers up to £13bn a year compared to the alternative methods of decarbonising heat and transport. Gas network companies have been running trials using hydrogen and other green gas in projects around the country, including at Keele University in Staffordshire, which has the world's first live demonstration of using hydrogen for heating in homes.

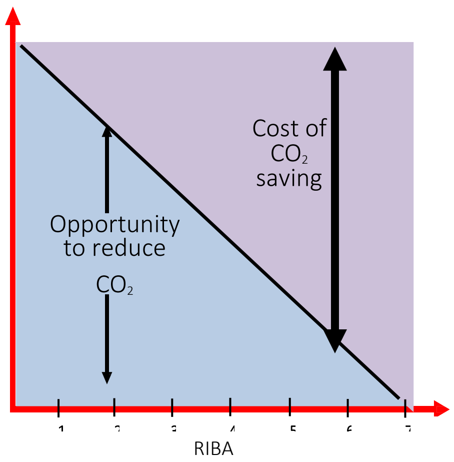
For Britain to meet the challenge of climate change, we need to replace the carbon-emitting natural gas that our building stock rely on for heating, hot water etc.

Currently studies are concluding that the best way to do that is to replace that gas with a combination of hydrogen and biomethane, working in conjunction with an increased use of electricity.

10.0 Carbon Reduction Options

10.1 Approach

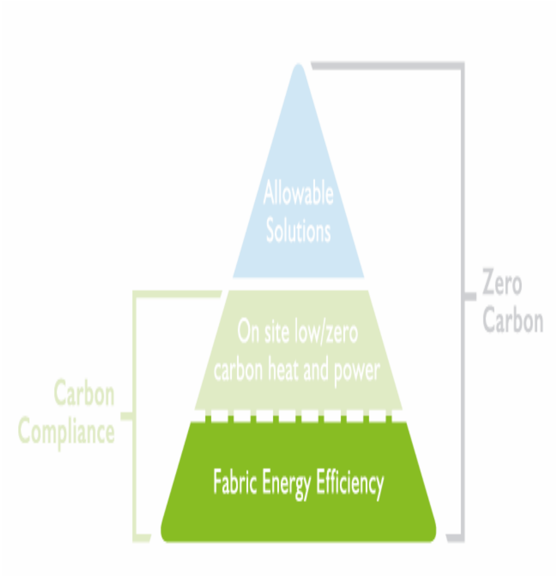
On the whole it becomes more expensive to implement carbon reduction measures, the further along the design process as the opportunities to reduce demand diminish.



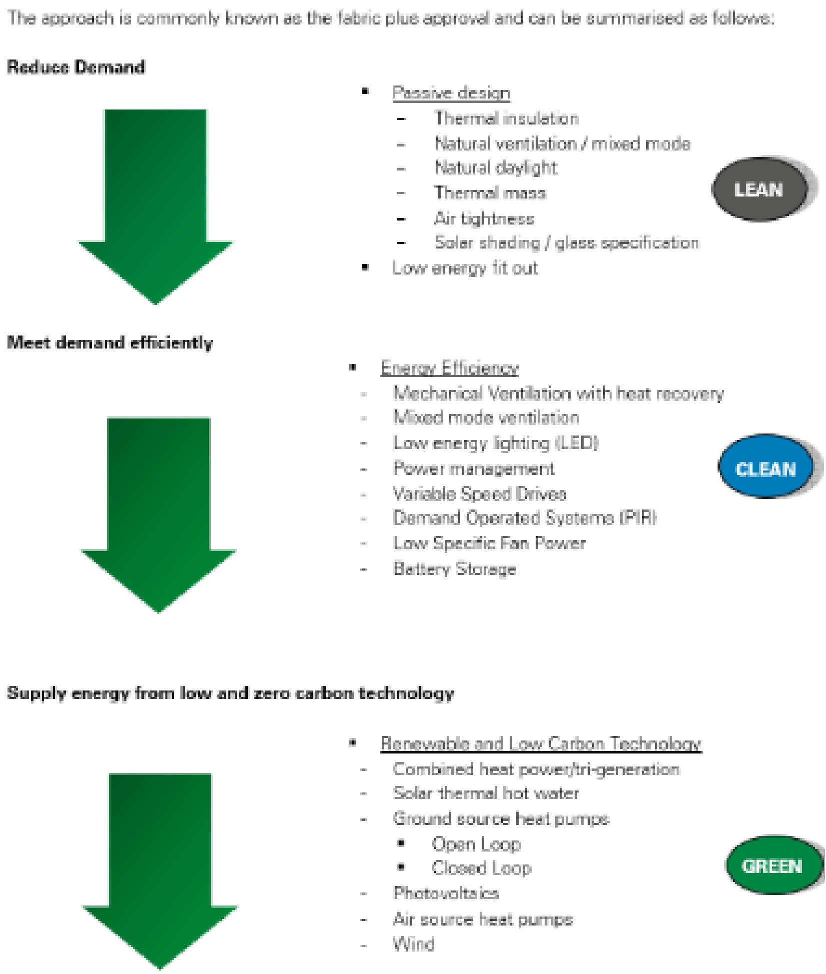
In this first instance it is therefore essential that the buildings 'passive measures' are optimised such as:

- U Values
- Air Leakage
- Natural Daylight

The next stage is to adopt 'efficient technologies' such as a heat recovery methods and variable speed drives etc. to meet the demand efficiency with the final



approach of applying 'renewable and low carbon' technologies accordingly.



The approach is acknowledged by the UK government and classified as the 'fabric first approach,' being a recognized method in the design of building to mitigate carbon emissions at best value.

10.2 Passive Measures

Passive design if the development of the design to reduce the central energy demands of the building by measures such as:

- High levels of Thermal Insulation
- Tight air leakage rates to reduce het losses
- Good natural daylight
- Promotion of Natural Ventilation techniques
- Consideration of building orientation in relation to solar gain.
- Reducing the extent of artificial cooling by limiting unwanted solar gain and promoting thermal mass.

The extent of the passive measures for each of the building types will vary as the demands of each building will vary. For example, the optimization of natural daylight in a storage space will have a significant impact of the energy use of that building but less so in a Food and Beverage type of building.

Conversely promoting thermal mass in a storage facility would not be cost effective but would reduce cooling loads in a Food & Beverage outlet.

The following sections summarise the aspects of passive design consideration for the development.

- **Thermal Insulation and Air Leakage Rates**

Insulation products have developed significantly with technological advances. Legislation has acted as the catalyst for development, from the basic requirements under the Building Regulations Part L, to compliance with Government carbon reduction targets, driven through advanced programmes such as the Code for Sustainable Homes and BREEAM.

Two thermal insultation methods are described below:

- Insulating concrete form or insulated concrete form (ICF) is a system of formwork for reinforced concrete usually made with a rigid thermal insulation that stays in place as a permanent interior and exterior substrate for walls, floors, and roofs. The forms are interlocking modular units that are dry stacked (without mortar) and filled with concrete. The units lock together a bit like Lego bricks and create a form for the structural walls or floors of a building.

- Structural insulated panels (or structural insulating panels), SIP, are a composite building material. They consist of an insulating layer of rigid core sandwiched between two layers of structural board. The board can be sheet metal, plywood, cement, magnesium oxide board (MgO) or oriented strand board (OSB) and the core either expanded polystyrene foam (EPS), extruded polystyrene foam (XPS), polyisocyanurate foam, polyurethane foam, or composite honeycomb (HSC).

Insulation is central to low energy construction, but airtightness and wind tightness must also be central to an energy-efficient design strategy to reduce unnecessary heat loss. In addition, heat that escapes from buildings carries a significant amount of moisture. This can lead to damage to buildings and building materials and may have a severe effect on the air quality of the living space. Airtightness is the control of air leakage, i.e., the elimination of unwanted draughts through the external fabric of the building envelope. This may be achieved by the correct and proper installation of a vapour check or vapour barrier. Consequently condensation, mould, rot, damp, and structural damage are also eliminated. This ensures a more viable structure, an insulation layer that can perform properly as it is now protected against penetrating moisture reducing the amount of energy-in-use in the building and CO_2 emissions. While ventilation is intended, air leakage is not. It is desirable and necessary to have controlled ventilation for healthy, comfortable buildings.

<u>Future Homes Building Standards (FBS)</u>

Below outlines the aims of the FBS:

- From 2025, deliver homes that are ‘zero carbon ready’
- To future proof new homes with low carbon heating and world leading levels of energy efficiency
- Build the supply chains and technology options for low carbon heat that will save carbon through the next decade and put us on a cost-effective pathway to 2050.
- Prevent use of fossil fuel heating

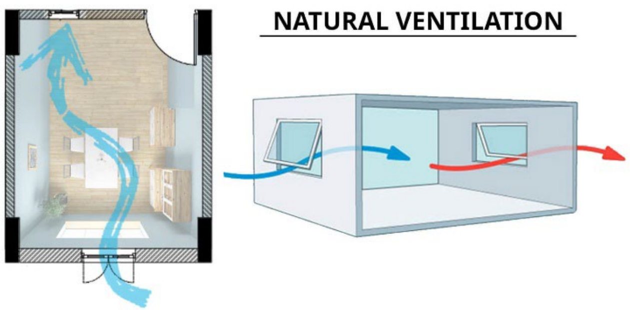
The approach to reach this aim is explained below:

- CO_2 emissions 75% lower than part & 2013
- High level of fabric efficiency
- Low carbon heating system
- Performance standards to be set at a level which means new homes will not be built with fossil fuel heating, such as gas boilers.

A home built to FHS standard will leverage continued decarbonisation of the electricity grid to achieve net zero operational emissions without need for further future material improvements.

- **Natural Ventilation**

The internal planning, building geometry and external topography should be optimised to take advantage of natural ventilation wherever possible.



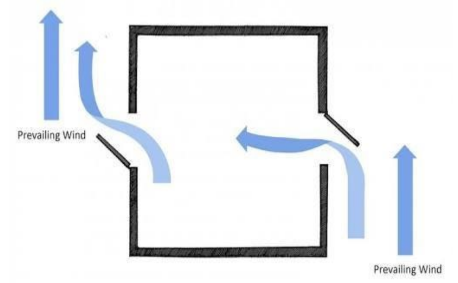
The ability to ventilate a building naturally is a major contributor to reducing on site carbon emissions by the avoidance of operating electrically driven ventilation fans and cooling plant. The feasibility of a room to be adequately naturally ventilated relies on several factors including ventilation opening, height of room, depth of room from window/vent opening, height of the stack above the room, level of internal heat gains and level of solar heat gains.

With the provision of natural ventilation to the building, the potential use of night cooling to pre-cool the building overnight can be implemented. This can be achieved by motorised ventilators providing a controlled ingress of cool night air into the building. The effectiveness of night cooling is dependent on the ability of the building fabric to store the "coolth" overnight so that it is slowly released during the following day, however, even with low thermal mass buildings, night cooling can be beneficial.

Any night cooling scheme will need to consider security of the building to accommodate this.

Careful attention to the placement of openable windows and interior partitions can greatly increase the natural flow of air through a building, by capturing the prevailing winds. In climates with hot days and cool nights, night-time ventilation can be used to cool the thermal mass of a building. A building with good insulation and a high thermal mass may then stay cool during the day.

Cross ventilation is often optimal if a room has three openings on different facades. Unfortunately, this configuration is rare as most rooms have only one external wall. With a single opening, ventilation is mainly due to turbulent fluctuations of the wind, and internal air movement is not significant. Ventilation may improve if two windows can be placed on the facade, as far apart as possible.



Wind fluctuations generate pressure differences between them and often induce air circulation within the space. Where the inlet and outlets are on the same facade you can put a wing wall between them to generate positive and negative pressure zones to stimulate ventilation.

- **Natural Daylight**

Rooflights are most used as a means of giving glare free daylight from the north, (northern hemisphere).

Selection of the exact rooflight area depends on the level of natural daylight desired, the percentage of a working year that lower natural light levels are acceptable, and the level of use of auxiliary lighting is acceptable; these are more subjective and should be determined by the building designer, although it is recognised that rooflight area should not be less than 10% in any daylit space, as specified in Part L2. The research from NCRMA (National Association of Rooflight Manufacturers) provides data on how often during a year rooflights of various area will provide any selected lighting level (and hence how often auxiliary lighting may be required). In general, if relatively small increases in rooflight area result in significant reduction in time that auxiliary lighting is required, they should be seriously considered; conversely, reductions in rooflight area can be justified where they do not result in significant increases in the time that auxiliary lighting is required. The table below taken from this research, provide recommendations for rooflight area to achieve desired lighting levels, on this basis, assuming overall light transmission of 67%; for rooflights with lower or higher light transmission, the figures should be adjusted accordingly.

Selection of the exact rooflight area depends on the level of natural daylight desired, the percentage of a working year that lower natural light levels are acceptable, and the level of use of auxiliary lighting is acceptable; these are more subjective and should be determined by the building designer, although it is recognized that rooflight area should not be less than 10% in any daylit space, as specified in Part L2.

Warehouse Recommended illuminance levels

Recommended Minimum Rooflight Area for Desired Illuminance Level (Horizontal)

ILLUMINANCE LEVEL REQUIRED IN THE HORIZONTAL PLANE (LUX)	RECOMMENDED MIN ROOFLIGHT AREA (% OF FLOOR AREA)
100	10
200	10
300	13
500	15
750	17
1000+	20

Recommended Minimum Rooflight Area for Desired Illuminance Level (Vertical)

ILLUMINANCE LEVEL REQUIRED IN THE VERTICAL PLANE (LUX)	RECOMMENDED MIN ROOFLIGHT AREA (% OF FLOOR AREA)
100	10
200	14
300	17
500+	20

- **Thermal Mass**

Thermal mass describes a materials capacity to absorb, store and release heat. For example, water and concrete have a high capacity to store heat and are referred to as 'high thermal mass' materials. Insulation foam, by contrast, has very little heat storage capacity and is referred to as having 'low thermal mass'. Though thermal mass has always been an aspect of buildings, only in recent years has it evolved as a tool to be deployed in the conservation of energy. However thermal mass does not offer a 'one size fits all' concept.

Locating thermal mass:

- Thermal mass should be exposed ('coupled') to the heated internal space.
- Thermal mass needs to be isolated from the influence of external air temperatures. This is achieved through locating the mass within the insulated building envelope.
- Any heavyweight material will serve as thermal mass. It can form any part of the internal fabric, be it floor, walls, or ceiling.
- Though often desirable, thermal mass does not need to be exposed to direct sunlight for heat to be absorbed. Heat can be conveyed through convection and radiation between other surfaces

- **Solar shading**

Solar shading is a method by which solar radiation in the form of heat and light can be mitigated in a building. While natural heat and light are essential in most buildings and modern architecture uses it more and more there are occasions when the levels are too high. This leads to high temperatures and too much light. Solar shading is a general term for a range of methods used to reduce the amount of solar gain.

Fixed solar shading can be provided by:

1. Canopies.
2. Overhanging eaves or balconies.
3. Trees and other vegetation.
4. External louvres or brise soleil.
5. Light shelves.
6. Canopies and awnings.
7. Solar control glazing.

Dynamic solar shading can be provided by:

1. Internal blinds.
2. Curtains.
3. Internal or external shutters.
4. External roller blinds.
5. Other adjustable shading devices that respond to conditions.

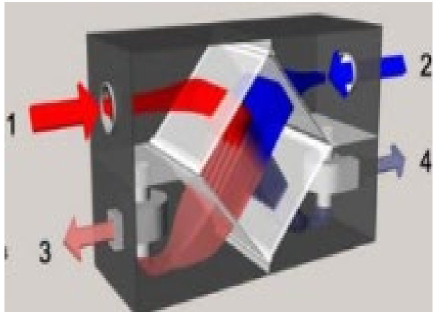
10.3 Energy Efficiency

There are various energy efficiency methods that can be adopted for the development, each having various impact depending on what type of building and functionality. Typical energy efficiency measures:

- Heat Recovery on Ventilation System
- Variable speed drives of fans and motors
- Low Energy Lighting Systems
- Intelligent lighting control systems
- Wastewater Heat Recovery
- Sundry Management Systems & Intelligent Controls
- Metering and out of range monitoring

- **Mechanical Ventilation with heat recovery**

Where natural ventilation is not provided, the buildings will be encouraged to minimise energy consumption using high efficiency ventilation system(s) incorporating heat-recovery on the buildings' air handling units. The re-use of waste heat in the mechanical ventilation systems could provide a significant step towards reducing CO_2 emissions.



- **Mixed Mode Ventilation**

Mixed mode ventilation should be adopted if natural ventilation is not able to fully meet the cooling requirements of the building. This combines elements of both natural and mechanical ventilation. Mixed mode has three modes of operations:

1. Supplementary- when natural ventilation is no longer sufficient, mechanical ventilation via a low energy fan is applied to meet the ventilation need.
2. Complementary – both natural and mechanical ventilation work together to meet the ventilation requirements.
3. Alternate – both natural and mechanical ventilation systems are included separately within the system. The system used is dependent on both the ventilation requirement and the climate conditions.

- **Low Energy Lighting systems**

The use of energy efficient lighting will be encouraged within all building types to limit the energy associated with internal and external lighting. In addition, the use of lighting controls such as occupancy detection and daylight linked control will be encouraged to further reduce the use of artificial lighting.

- **Variable Speed Drives of Fans and Motors**

Variable speed drives and controls allow the system to modulate during periods of low demand. Using variable speed drive pumps therefore uses less energy than traditional pumps, which run at a constant speed. The use of variable speed pumps throughout the building services systems incorporated into energy network and each building will be encouraged

- **Demand Operated Systems (PIR)**

The control of the heating, cooling, ventilation, and lighting systems will be fundamental to the energy efficiency of each building. The use of the following measures will be encouraged: Zoned thermostatic control; Time control; Variable flow control; BMS (Building Management System) automated control; Lighting PIR (Passive Infra-Red Sensor) control; Daylight linked lighting control; CO2 detection; and Energy management control

- **Low Specific Fan Power**

Systems should be carefully designed to minimise pressure losses and therefore energy consumption. Fan and pump motor loads should always be minimised by good system design prior to motor selection with high-efficiency inverter-controlled fan and pump motors selected to ensure accurate commissioning and reduced energy consumption at part load conditions.

This ensures that the plant output characteristics match the system pressure drops. Direct drives rather than belt drives should be used, and the use of Variable Speed Drives should also always be considered for efficient system regulation and variable flow control.

Where fan systems are installed, they shall be designed to limit the specific fan power at the design flow rate to the following minimum values:

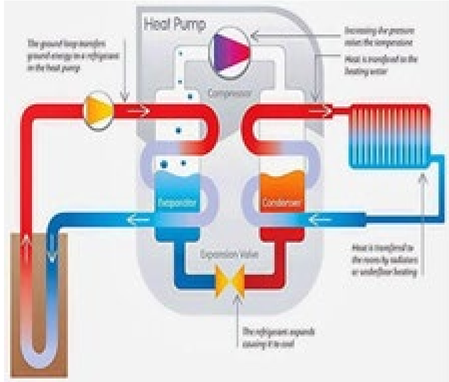
System Type	SFP (W(litre/sec))
Central mechanical ventilation including heating, cooling, and heat recovery	2.5
Central mechanical ventilation including heating and cooling	2.0
All other central systems	1.8
Local ventilation only units within local area such as window/wall/roof units, serving one room or area	0.5
Local ventilation only units remote from the area such as ceiling void or roof mounted units, serving one room or area including VAV units	1.2
Other local units, e.g., fan coil units (rating weighted average)	0.8

Table 4: Specific Fan Powers in New Buildings

10.4 Renewable & Low Carbon

- **Ground Source Heat Pump (GSHP)**

In a Warehouse situation, the GSHP would be sized to carter for the heating and domestic hot water requirement within the office facility. Typically, they are more suited to a centralized system with multiple bore holes to a depth of up to 150-250 metres depending on the ground conditions. GSHP's use a heat exchanger to extract heat from the earth.



If grid electricity is used for the compressor and pump, then there is the opportunity to consider a range of energy suppliers to benefit from the lowest running costs.

- **Air Source Heat Pump (ASHP)**

Air source heat pumps work in a similar way to GSHPs. Air source heat pumps can be fitted on the external façade or in the roof space. An air source heat pump uses small amounts of electricity to take in large quantities of air and extract heat. The efficiency of ASHP is measured by Coefficient of Performance (CoP); this is the ratio of units of heat output for each unit of electricity used to drive the system. Average CoP is around 2-4 depending on operating temperatures.

Air source heat pumps have the following benefits:

1. Renewable, low carbon environmentally friendly heat source.
2. Clean, sustainable, and virtually noise free system.
3. Highly efficient transferring around 3 x more heat energy into a building than it uses to extract heat from the air.
4. Little outdoor space required.
5. Minimum maintenance required.

The GSHP and ASHP systems offer an attractive solution in terms of the de-carbonisation particularly if an electrical supplier is selected whose tariff is based on generating green / carbon neutral electricity.
Both GSHP and ASHP are compatible to serve the office area of the warehouse and in many instances ASHP's are the standard installation in many developments.
The GSHP option is more expensive due to the extent of ground works required but is more efficient and has a longer life span than ASHP.
In many instances, heating will not be installed at base build stage to the Warehouse, then the provision may be put in place for both these technologies.

- **Photovoltaic Panels (PV)**

For businesses, a commercial scale renewable system is one of the most recognisable ways to enhance your company's green credentials as well as reducing your electricity bills. As with solar on homes, the business can then use the power produced on site in it's operations. Because energy can be one of the biggest expenses for an organisation, solar can be a great way to keep costs to a minimum.

There is already two gigawatts of commercial and industrial rooftop solar systems installed within the UK, with many more companies considering solar in order to bring down their energy costs and reduce their carbon footprint.

Photovoltaic panels use cells to convert light into electricity. A PV cell normally consists of 1 or 2 layers of a semi conducting material such as silicon. When light shines on a cell it generates energy causing electricity to flow, the higher the light intensity is, the more electricity flows.

The amount of energy PV cells generate is referred to as Kilowatt Peak (kWp). PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity. Panels can be mounted flat or on A-frames to give the optimum angle. The optimum panel inclination for solar collection is 35°, oriented due south; however, panels that are inclined between 35° and 45° and oriented south of west or east are also generally suitable. If solar collectors are oriented away from due south, then a larger surface area will be required to generate a set amount of energy.

The use of photovoltaic panels is considered attractive as this system offers an effective method of offsetting carbon emissions when compared to grid electricity.

In addition, solar panels can be used to power Electric vehicle charging points which will become increasingly important for business to offer. Under the Workplace Charging Scheme businesses can benefit from a contribution of £250 towards the costs of installing an EV charger which can be used by employees and visitors. Currently businesses can also apply for Enhanced Capital Allowances for installing EV points.

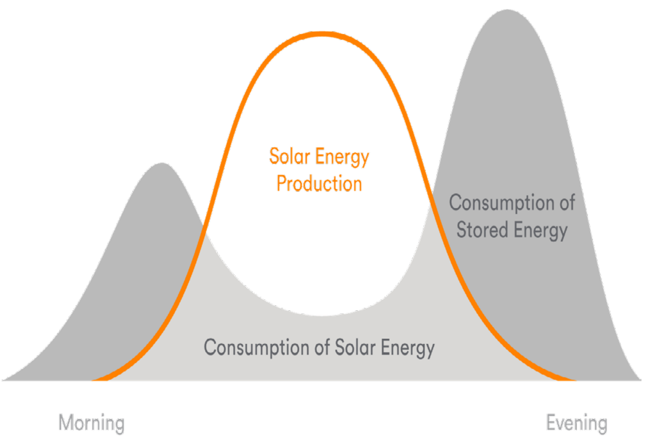
It is also possible to combine PV with Air Source Heat Pumps to generate both heating and hot water to meet a building's needs. However, this may mean that while the solar panels may be able to produce the electricity required to power the air source heat pumps, they may not be able to generate enough electricity to power other electric demands of the building.

- **Battery Storage**

Battery storage allows the low and zero carbon technology that can generate electricity, such as PV panels and wind turbines to charge batteries if there is not sufficient demand from the buildings to utilise the electrical energy.

This is a more efficient way than exporting to the grid as the battery storage can peak lop the peaks in the electrical demand by smoothing out the peaks and troughs, saving the client money as the demand for higher cost and more carbon intense electricity at peak periods will be offset by the stored low cost and low carbon intensive electricity.

Battery storage is a viable option to be adopted, but the required battery size must be assessed in relation to the amount of stored electricity from the proposed PV / Wind system and the daily demand for electricity.



The above image illustrates that incorporating battery storage with PV optimises the yield of the Photovoltaics storage at peak periods, and also enables the storage of off-peak electricity to utilise at peak periods.

The benefits of a battery storage system are as follows: -

- Utilise more of your generated energy onsite.
- Ability to provide backup power in the event of loss of the grid system.
- Less reliant on the supply from your electricity supplier.
- Avoid higher energy bills associated with peak electrical demand offset.
- Further reduce your carbon footprint if off peak renewable energy source is stored.

- **Solar Thermal HW Panels**

Solar panel heating uses the radiant energy from the sun to heat hot water and meet the domestic hot water demand associated with the toilet facilities. There are two types of collectors used for solar water heating – flat plate collectors and evacuated tubes collectors. The systems function successfully in all parts of the UK, as they can work in diffuse light conditions. The collector should be mounted on a 10-60 degrees pitch facing south, although other variations can be used, south is the most efficient.

The cost of installing the system is dependent on the distance between the solar collector and the hot water storage. The closer the collectors are to the hot water storage; the less pipework is required. Annual maintenance checks are recommended. The solar collectors are connected to a condensing boiler via a HW cylinder with twin coil.

- **Wind Power**

Wind power is one of the cleanest and safest methods of generating electricity. As the UK is one of the windiest countries in Europe, wind power is one of the best sources of renewable energy – dependent upon location. The ideal site for wind generation to be successful would be at height with an open aspect i.e., coastal applications. Building mounted turbines can typically produce between 500w and 10kw of power.

Wind turbines have several key challenges when considering suitability for this type of development: -

a) Development is only permitted if the building mounted wind turbine installation complies with

"Microgeneration Certification Scheme Planning Standards".

b) No part of the building mounted turbine should protrude more than 3m above the highest part of the roof (excluding chimney) or exceed an overall height of 15m.

c) An installation is not permitted if any part of the standalone wind turbine (including blades) would be in a position which is less than a distance equivalent to the overall height of the turbine (including blades) plus 10 per cent of its height when measured from any point along the property boundary.

d) In conservation areas an installation is not permitted if the building mounted wind turbine would be on a wall or roof that fronts a highway.

e) The swept area of any standalone wind turbine blade must be no more than 3.8 square metres.

The possibility for a direct relationship with a utility supplier that generates electricity at source using wind farms should be investigated to benefit from a low carbon / green tariff.

- **Biogas**

Biogas is an environmentally friendly, renewable energy source.

It's produced when organic matter, such as food or animal waste, is broken down by microorganisms in the absence of oxygen, in a process called anaerobic digestion. For this to take place, the waste material needs to be enclosed in an environment where there is no oxygen.

It can occur naturally or as part of an industrial process to intentionally create biogas as a fuel.

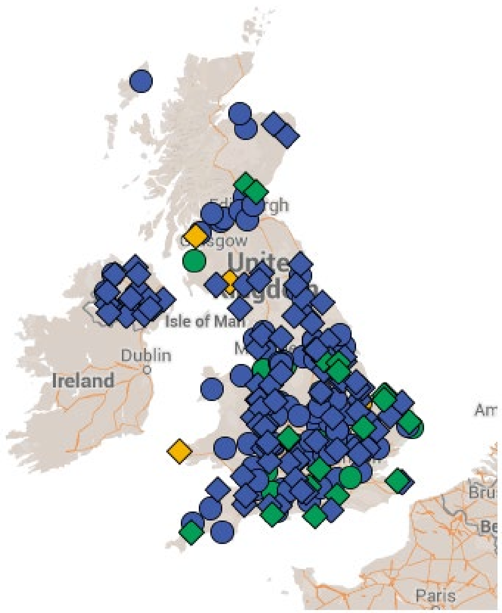
A wide variety of waste material breaks down into biogas, including animal manure, municipal rubbish / waste, plant material, food waste or sewage.

Biogas consists mainly of methane and carbon dioxide. It can also include small amounts of hydrogen sulphide, siloxanes, and some moisture. The relative quantities of these vary depending on the type of waste involved in the production of the resulting biogas.

Biogas can be used for:

- To fuel vehicles – if biogas is compressed it can be used as a vehicle fuel.
- As a replacement for natural gas – if biogas is cleaned up and upgraded to natural gas standards, it's then known as biomethane and can be used in a similar way to methane for cooking and heating.

In the UK there are in the region of 118 Biogas plants currently in operation:



Plants can be filtered by the following categories:

- **Agricultural** – plants that use predominantly agricultural feedstock such as manures, slurries, crops, and crop residues.

- **Waste** – plants that use predominantly municipal, commercial, and industrial waste streams as feedstock.

Each is then further categorised by the end-use of the biogas:

- **Heat and/or Power (CHP)** – an anaerobic digester generating biogas which is burned on-site to generate heat, power, or both

- **Biomethane to Grid (BtG)** – an anaerobic digester generating and upgrading biogas, to derive biomethane for injection into the national gas grid.

The location of these plants is registered on the biogas website www.biogas-info.co.uk which identifies the location and classifications.

Biogas potentially offers an attractive proposition to generate heat and electricity for a warehouse development, but this will be very much dependant on the location of the warehouse in relation to the existing plant.

- **De-Centralised / District Heat Network**

One of the priorities for reducing CO_2 emissions is to reduce the reliance on centralised power stations. This means increasing the use of local, low-carbon energy supplies through de- centralised energy systems.

Decentralised plant generally means any heating and hot water and/or electricity generation provided on a site or district wide basis. District heating is generally provided from Combined Heat and Power equipment (CHP). CHP is an engine which, when running, generates electricity and heats water which can then be distributed around a development.

The table below provides broad guidance on whether

Forecasted annual heat consumption (MWh)	Distance from network where connection may be feasible (metres)
Up to 200	50
201 - 500	175
501 - 1000	375
1001 - 2000	750
2001 - 4000	1500

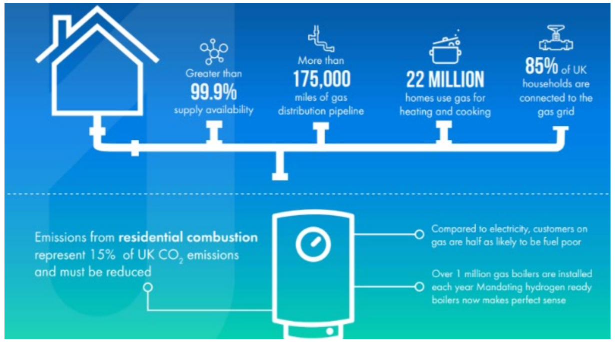
connection is likely to be feasible based on distance from the network and the likely heat consumption.

10.5 Future renewable options

- **Hydrogen**

With fossil fuels required to be phased out by 2050 a significant low-carbon hydrogen economy will be needed to help tackle the challenges of industry, peak power and peak heating. By 2035 regulations enforce that all replacement heating systems for existing homes must be low-carbon or ready for hydrogen, such that the share of low carbon heating increases from 4.5% in 2019 to 90% in 2050.

Hydrogen has the potential to replace fossil fuels in areas where electrification may reach limits of feasibility and cost-effectiveness: industrial heat, and heat for buildings on colder winter days (e.g., as part of a hybrid heating system).



Moving beyond an 80% target changes hydrogen from being an option to an integral part of the strategy. Gas distribution networks will not be able to continue to provide natural gas on a widespread basis by 2050 - they will either need to be decommissioned or, if feasible, repurposed to hydrogen. The UK have been planning for this transition and to date have replaced 60,000 km of iron pipelines with polyethylene since 2002, helping to make the network ready for hydrogen.

Hydrogen proves a great solution for supplying low carbon heat. Even if a 20% hydrogen blend was rolled out across the country it could save around 6 million tonnes of carbon dioxide emissions every year, the equivalent of taking 2.5 million cars off the road.

- **UK Hydrogen Plan**

The UK government has plans to develop 5GW of low carbon hydrogen production capacity by 2030, enough to power around 1.5 million homes. Driving this growth could reap significant benefits – the UK Government estimates hydrogen could deliver a 9% cut in overall carbon emissions by 2032, based on 2018 levels.

11.0 Proposed Approach

At outline planning stages detailed specific solutions cannot be set out for the type buildings and individual plots.

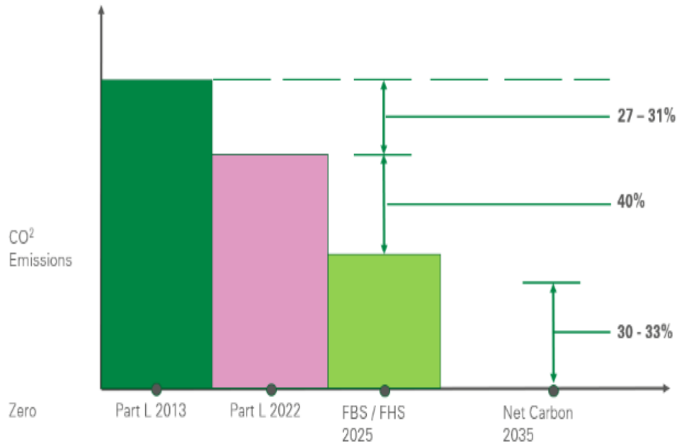
The key reason for this is that the detailed design of the plots will not be progressed, and also different tenants and end users will have differing requirements so flexibility to match those needs is a key requirement.

What can be set out, is a strategy that will be adopted at detailed design stages for the different types of buildings and plots to meet the requirements of both National and Local planning policies and promote the requirements of the Climate Energy that has been declared.

A fundamental driver of this strategy is the decarbonisation of the National Grid and the implementation of the changes to Part L in May 2022 and the Future Building Standards in 2025.

These changes in Regulations will be a fundamental driver in the move away from Fossil Fuels (Natural Gas) and the adoption of Grid Electricity as the main source of the generation of heating and hot water.

Furthermore, these changes in regulations will aim to reduce the predicted Carbon emissions of new buildings by 27% (Part L) and a further 40% (Further Building Standards) on the current Part L 2013 Regulations.

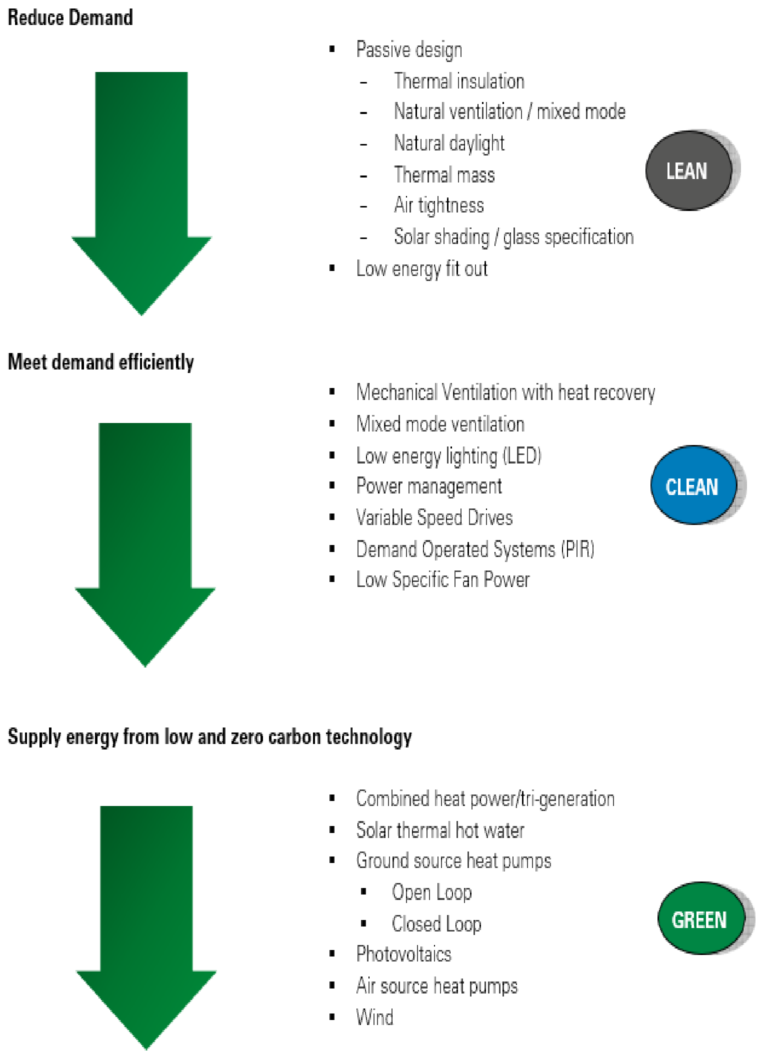


The contribution of these regulation changes will have a combined impact of reducing the predicted carbon emissions of new buildings of circa 60-70% and with the further future reduction in the carbon emissions of the national grid. Then this will deliver a development that is carbon neutral ready.

Notwithstanding the decarbonisation of the National Grid, it is the design intent to install a Natural Gas system to each of the proposed plots to provide flexibility for the future end user tenants. Furthermore, their piped services could be potentially adapted for transporting future advances in the use of hydrogen gas as a clean carbon neutral form of fuel.

Beyond this, the basic fundamental approach of a "Primary Energy" Source will be the fabric first approach as set out previously in this report. A key aspect of this approach will be to adopt suitable technologies and approaches to the types of buildings that are proposed on the site as set out in section 7.0 of this report.

A key aspect of the energy strategy will be to provide flexibility of future proofing of the design. Section 7.0 of the



report set out principals of approaches of all technologies. However, a key aspect of the strategy will be the future proofing of these buildings.

For a distribution and warehouse facility this future proofing will take the form of:

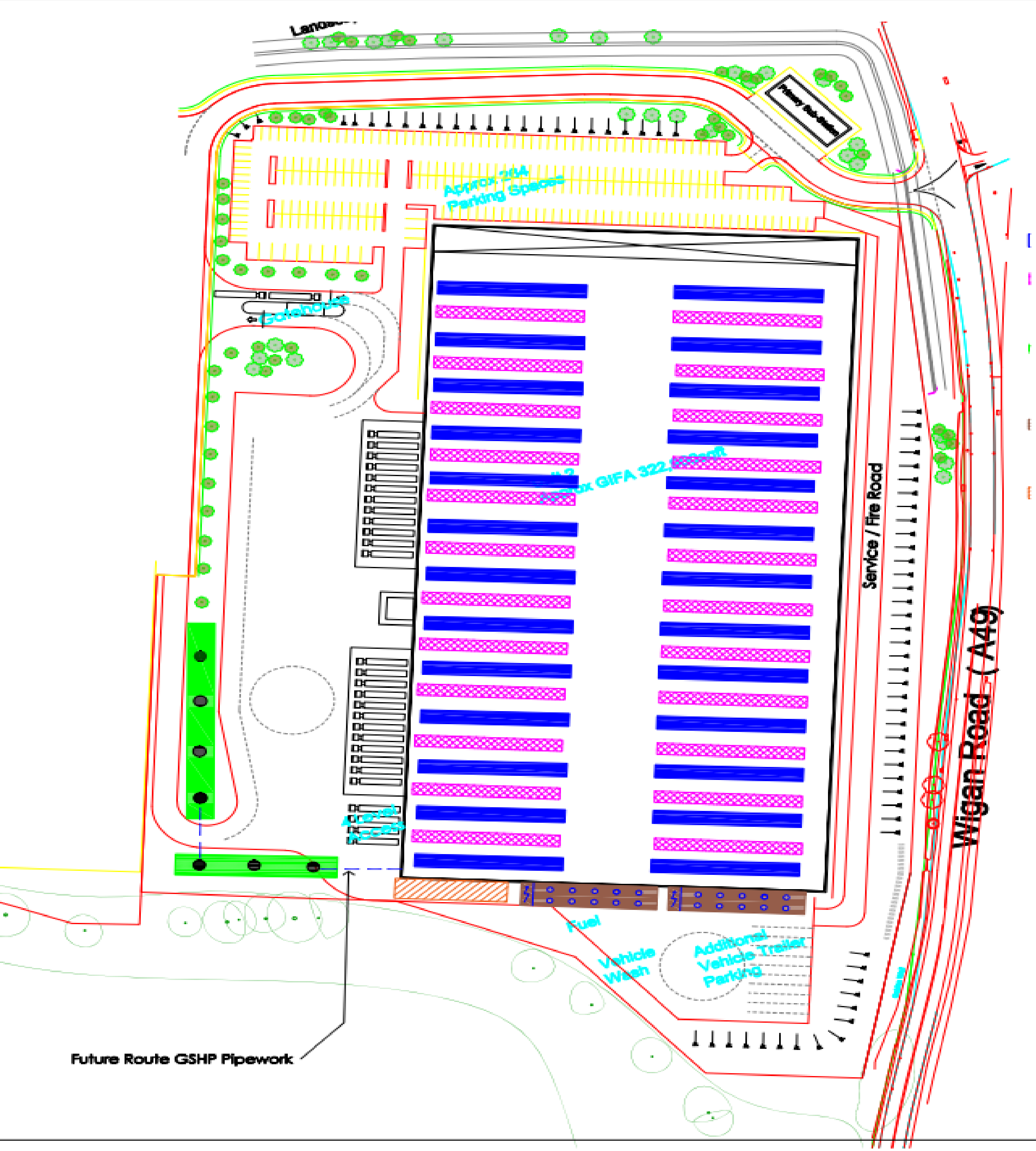
- Roof designed structurally to allow the future expansion of the photovoltaic panels.

- Space provision for the future installation of Air Source Heat Pumps (ASHP) and battery storage.

- Gas pipework taken to each building / plot for future option of hydrogen gas.

- Soft strip areas (Landscape area) for the future installation of Ground Source Heat Pumps (GSHP) and bore holes.

These future proofing aspects will complement the base build features and therefore provide a development that is net carbon ready. An example of a future proofed distribution and warehouse facility for carbon neutrality is displayed on the next page.



LEGEND:

- ROOF LIGHTS PART OF BASE BUILD
- ROOF DESIGN FOR FUTURE EXPANSION OF PHOTOVOLTAIC
- SOFT SPOTS IDENTIFIED FOR POTENTIAL GROUND SOURCE HEAT PUMP (GSHP) BORE FIELDS
- LOCATION IDENTIFIED FOR POTENTIAL AIR SOURCE HEAT PUMP (ASHP)
- SPACE IDENTIFIED FOR FUTURE BATTERY STORAGE

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