

RIDGE

ENERGY STRATEGY REPORT
THE WORKS, ACREFAIR
WREXHAM
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THE WORKS, ACREFAIR RESIDENTIAL DEVELOPMENT CLWYDALYN

DRAFT

Prepared for

ClwydAlyn
St Asaph Business Park,
72 Ffordd William Morgan,
Saint Asaph
LL17 0JD

Prepared by

Ridge and Partners LLP
Belvedere House
5th Floor
12 Booth Street
Manchester
M2 4AW
Tel: 01618339579

Contact

Cain McGilloway
Building Services Engineer
cainmcgilloway@ridge.co.uk
07810031326

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1. INTRODUCTION

As Low Carbon Design Consultants, Ridge and Partners have been appointed by ClwydAlyn to provide a statement for the purposes of submitting a full planning application, on a residential development consisting of 159 dwellings at the Former Air Products Site, Llangollen Road, Acrefair, Wrexham.

The purpose of this statement is to summarise the National and Local Energy Policies and demonstrate the ways Ridge & Partners have reviewed various options to promote those policies.

The document presented outlines a preliminary low carbon design philosophy, which allows an energy strategy for the proposed works to be developed. The "Energy Hierarchy" methodology provides the design framework used to develop the proposed low carbon energy strategy. The approach described by this methodology provides a staged process: LEAN, CLEAN and GREEN (Illustrated below, Figure 1) to assess design measures.

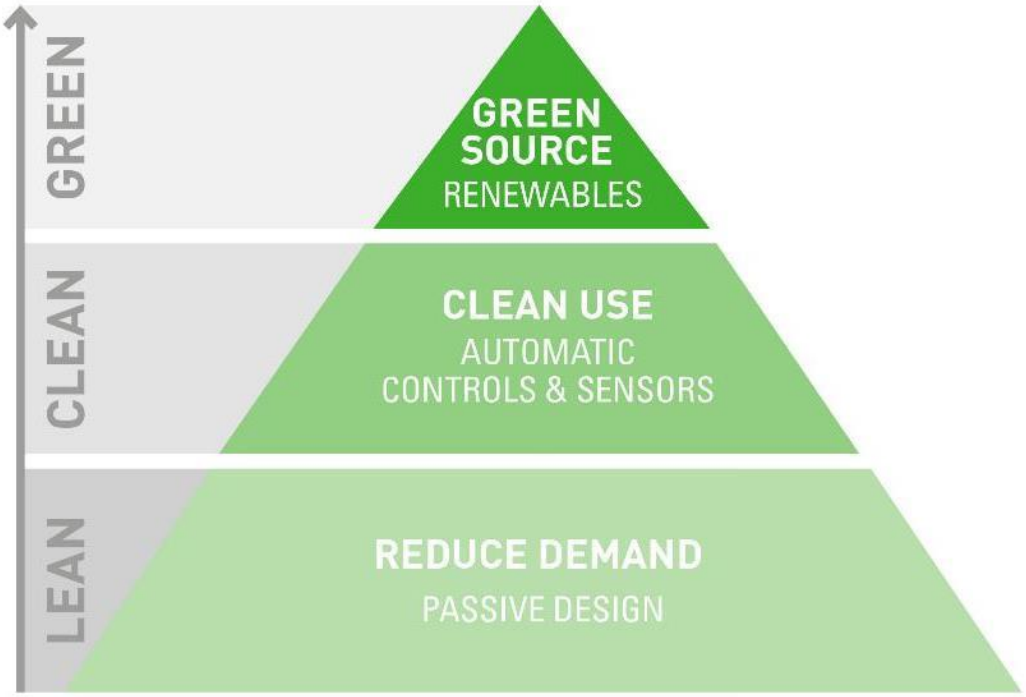


Figure 1 - Lean, Mean, Green Approach

Each design stage would focus on the following:

- Lean – The main aim is to reduce the buildings energy demand through "passive measures".
- Clean – Meeting the reduced energy demand in the most efficient way possible using "active measures".
- Green – Assess the technical feasibility of incorporating a low or zero carbon technologies to further reduce the CO_2 emissions.

2. DEVELOPMENT PROPOSALS

2.1 Description of Development Site

The Site known as The Works, Acrefair is located in Wrexham and is the Former Air Products Site, Llangollen Road, Acrefair, LL14 3HP.

The approximate area of the site is: 71,802m^2



Figure 2 – View of the proposed site development and the surrounding area

2.2 Development Proposal

ClwydAlyn intends to develop 159 dwellings consisting of the following house types:

- 3 person 2 bedroom wheelchair bungalow: 1
- 3 person 2 bedroom bungalow: 6
- 2 person 1 bedroom walk-up apartment: 26
- 4 person 2 bedroom house: 58
- 5 person 3 bedroom house: 34
- 5 person 3 bedroom house: 13
- 6 person 4 bedroom house: 16
- 7 person 4 bedroom house: 5

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3. GOVERNMENT POLICY REVIEW

3.1. National Policy Framework

The Welsh Government declared a climate emergency in 2019 and set a target to reduce 95% of greenhouse gas emissions by 2050 relative to 1990. Achieving this target will require substantial transformation of the Welsh energy system and will result in radical changes in the technologies the country uses to heat its homes, to travel and to generate electricity.

Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes (TANs), Welsh Government Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales.

The primary objective of PPW is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental, and cultural well-being of Wales, as required by the Planning (Wales) Act 2015, the Well-being of Future Generations (Wales) Act 2015 and other key legislation and resultant duties such as the Socio-economic Duty.

This planning policy framework states the purpose of sustainable development:

> *'Sustainable Development" means the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals. Acting in accordance with the sustainable development principle means that a body must act in a manner which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs'*

A plan led approach is the most effective way to secure sustainable development through the planning system and it is essential that plans are adopted and kept under review. Legislation secures a presumption in favour of sustainable development in accordance with the development plan unless material considerations indicate otherwise to ensure that social, economic, cultural and environmental issues are balanced and integrated.

The planning policies states that The Welsh Government's highest priority is to reduce demand wherever it is both possible and affordable. Low carbon electricity must become the main source of energy in Wales. Renewable electricity will be used to provide both heating and transport in addition to power. The future energy supply mix will depend on a range of established and emerging low carbon technologies, including biomethane and green hydrogen.

The Welsh Government has set targets for the generation of renewable energy:

- for Wales to generate 70% of its electricity consumption from renewable energy by 2030;
- for one Gigawatt of renewable energy capacity in Wales to be locally owned by 2030; and
- for new energy projects to have at least an element of local ownership.

The Welsh Government's policy is to secure zero carbon buildings while continuing to promote a range of low and zero carbon technologies as a means to achieve this.

Sustainable building design principles should be integral to the design of new development. Development proposals should:

- mitigate the causes of climate change, by minimising carbon and other greenhouse gas emissions associated with the development's location, design, construction, use and eventual demolition; and
- include features that provide effective adaptation to, and resilience against, the current and predicted future effects of climate change.

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3.2. North Wales Energy Strategy



The North Wales Energy Strategy seeks to provide a strategic direction for the future of a decarbonised energy system including heat, power and transport within North Wales. It will define steps to begin to overcome the challenges faced. Furthermore, while the energy transition has the potential to bring benefits to our communities, maximising this benefit requires reflection on past experience and would also benefit from an increased strategic focus.

Scenario modelling has been undertaken to create a 2035 North Wales Energy Vision scenario that could deliver against the level of ambition set out in the Energy Vision statement. The modelling outcomes are unique to the region, taking advantage of local resources and opportunities, and input from local stakeholders. The overall aim of the scenario is to set out a potential decarbonisation route that will put the region on track to achieve a net zero energy system by 2050. The scenario is not intended to be prescriptive. There are a number of potential pathways to achieve energy system transformation, including new opportunities from technological innovation and changes to energy demand that will certainly emerge as the transformation takes place.

The Committee on Climate Change recommended in its 2019 report, "Net Zero: The UK's contribution to stopping global warming", that Wales adopt an overall decarbonisation target reduction of 95%, against a 1990 baseline, by 2050. This target, which is lower than the equivalent UK 2050 net zero decarbonisation target, recognises that Wales faces several additional challenges including higher greenhouse gas emissions from its agriculture and parts of its heavy industry. However, Welsh Government has expressed an ambition to exceed this target and aim for 100% decarbonisation.

To achieve the energy vision for North Wales, to meet Welsh Government targets, and to be on track for net zero by 2050, North Wales needs to reduce emissions from its energy system by 55% by 2035, split by sector in the pathway modelled as follows:

- 57% reduction in domestic heat and power emissions
- 54% reduction in commercial and industrial emissions;
- 55% reduction in transport emissions.

The energy vision scenario modelling assumes a significant shift away from business as usual across these three sectors by 2035. The assumptions of the modelled future vision include:



Figure 3 - Summary of the Energy Vision's emission reductions by sector

Domestic:

- 35% of all homes improved from EPC bands G, F and E to bands D, C and B;
- 65,500 heat pumps installed;
- 30,000 houses fitted with internal or external wall insulation;
- 67,000 homes currently heated by fossil fuels to move to low carbon heating;
- No new gas connections for homes from 2025

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North Wales currently consumes around 23% of all energy consumed in Wales, which is slightly higher, on a pro-rata basis, than its 22% share of the Welsh population. The domestic sector household heat and power use consuming 30%.

Box 1: Assumptions regarding the decarbonisation of domestic heating in North Wales[13]

The North Wales energy strategy modelling assumptions for domestic heating are based on input from regional stakeholders and the 2019 Wales & West Utilities Distribution Future Energy Scenario (DFES) project which explored potential future scenarios for the gas network in North Wales in 2035. Some of the key scenario highlights from the 2019 DFES included:

- Around 20% of homes could be heated by a heat pump by 2035, predominantly air source or ground source heat pumps replacing more expensive oil, LPG or solid fuel heating.
- Hydrogen offers a number of significant opportunities for Wales, particularly through the development of industrial clusters in North Wales and extending into the Wirral, and in South Wales in Pembrokeshire, Port Talbot and industrial zones around Cardiff and Newport. A number of hydrogen projects are planned and there is a high likelihood that hydrogen for industrial and transport applications will be become an important fuel over the next decade. There is the potential that some hydrogen from these trial projects could be used to supply heat to adjacent homes and commercial buildings, however hydrogen is not expected to become economically viable or widely available for network distribution as a heating fuel before 2035.
- Biomethane from food waste and sewage in populous areas, alongside farm waste in more rural areas, could provide up to 5.1% of energy supplied by the gas distribution network in North Wales by 2035. The proportion of biomethane that is injected into the mains gas network will depend on the availability of feedstocks and level of demand from other biomethane uses such as power generation.
- Consumption of natural gas energy in Wales could fall by over 20% between now and 2035.
- Projections on the uptake of heat pumps, including the proportion of hybrid heat pumps, were based on FES 2019 scenarios. Since then, the FES 2020 study has been published and includes a higher proportion of hybrid gas heat pumps, particularly under the Leading the Way scenario.

These findings have been built on in developing the North Wales Energy Vision scenario.

Wales and West Utilities' outlook regarding the potential for biomethane and hydrogen has evolved since the modelling was undertaken following the UK government evolution to a net zero target last year. Net zero scenario shows higher potential for biomethane and hydrogen. For example, biomethane levels can exceed in some parts of the WWU network will reach over 20% by 2021. This would facilitate the decarbonisation of homes using smart hybrid heating systems.

Figure 4 - Assumptions regarding the decarbonisation of domestic heating in North Wales

Table 2: Scenario summary: domestic

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Domestic heat and energy efficiency	30,000 houses fitted with internal or external wall insulation Over 120,000 other insulation measures in homes Over 65,500 heat pumps Replacing heating systems in oil, LPG and solid fuel heated homes prioritised No gas in new homes from 2025, to avoid retrofitting at a later date	17% reduction in gross thermal energy demand 32% net decrease in domestic heating energy consumption, taking into account demand reduction and improved heat technology efficiencies, including the impact of heat pump performance.	499 kt CO_2 (57% reduction)

Table 1 - Scenario Summary: domestic

3.3. Approved Document Part L Volume 1 2022 – Dwelling – Wales

Approved Document Part L 2022 took effect on 23rd November 2022 with a 12 month transition period if building work has already commended or is started within 12 months of the Regulations coming into force. In this instance, the application will be in respect of the number of buildings on a site and it is only those individual buildings for which work has commenced which can take advantage of the transitional provisions.

Following the release of the new approved the below bullet points highlight the significant changes that will be introduced.

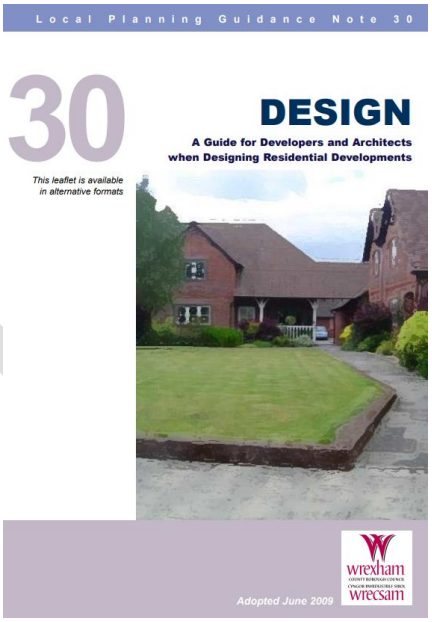


- There will be a 37% reduction in carbon emissions in new homes compared with Part L 2014 standards
- A Primary Energy compliance metric has been introduced alongside the existing carbon emissions standard
- A new minimum energy efficiency standard has been introduced for new builds set at a minimum EPC rating of 81 (B)
- Tightened limiting fabric standards for thermal elements
- Mandatory airtightness testing will be introduced for all new homes
- Air tightness testers will be able to choose between either Pulse or blower door testing as methods to determine airtightness in dwellings
- The SAP 10 methodology will be adopted.
- Low temperature hot water systems are to be designed with a temperature of 55°C.

3.4. Local Planning Guidance Note 30 – Design - A Guide for Developers and Architects when Designing Residential Developments

This guidance note amplifies development plan policies on encouraging good design (in particular policies PS2 and GDP1 of the adopted Wrexham UDP) and outlines the Council's requirements for sustainable buildings. It will form a material consideration in the determination of all relevant planning applications.

The Local Development Plan, in accordance with guidance and policy from the Welsh Assembly Government, requires sustainable building principles to be adopted in order to reduce the impact upon the natural environment and reduce reliance on non-renewable energy sources.



Sustainable development is a key objective of planning. All residential schemes must be environmentally sustainable. The Council's Development Plan, in accordance with guidance and policy from the Welsh Assembly Government, requires sustainable building principles to be adopted in order to reduce the impact upon the natural environment emissions and reduce reliance on non-renewable energy sources. Sustainable development is an integral part of the design process, and these aspects must be considered at the earliest stage

In achieving an environmentally sustainable design solution it is important new development incorporates measures to ensure an efficient use of land, energy and water; minimises waste and encourages and belonging recycling of materials; maximises least harmful forms of movement and transport and protects and enhances the natural and built environment. The design process should also ensure that development contributes to tackling the causes of climate change and is designed to meet zero-reduce fuel bills carbon standards from the outset.

4.5.1 Renewable Energy

In addition to ensuring that the building itself is constructed in a sustainable manner the Council requires that 10% of the future energy production of the development be sourced from renewable energy sources. The Council does not seek to impose specific types of renewable energy sources on developers and will accept a mixture of technology including schemes on individual houses and community schemes providing that the 10% target is achieved. The Council will require a renewable energy statement to be submitted with the application which indicates the sources from which the renewable energy is to be obtained.

The Council will ensure sustainability features are incorporated into the Design Solution by the use of nationally recognised and quality assured standards. All new residential development must meet a minimum of Level 3 of the Code for Sustainable Homes or recognised equivalent scheme and provide 10% of the future energy requirements of the building through renewable energy sources.

Figure 5 – Future Renewable Energy Requirements of Residential Buildings

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4. REGULATORY FRAMEWORK

4.1. Building Regulations

Part L 2021 came into effect in June 2022 with a transitional period of 12 months and will act as an uplift to help the construction industry adapt to changing regulations and low carbon heating. The new regulations will require a minimum EPC rating of B for all new homes in Part L 2021 and a 37% reduction in CO_2 emissions over Part L 2013. The table below shows the worst acceptable U-values acceptable in new dwelling for the new Part L 2021. The SAP results shown in appendix 1 and 2 of this report show a betterment over the worst acceptable u-values for each house type.

Element type	Maximum U-Value W/(m².K)[1]
Roofs	0.13
Wall – Dwelling Houses	0.18
Walls – Flats	0.15
Floor	0.15
Party Wall	0.20
Window or roof windows	1.4
Doors	1.4

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 decarbonised. 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 CO_2 emissions. Any plans/notices submitted after June 2022 must adhere to the new Part L standards. The primary energy and carbon emissions rate, calculated using SAP 10, from the proposal should be no greater than that of a fully compliant benchmark. Appendices 1 and 2 show that the SAPS produced are complying with this target.

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5. ENERGY HIERARCHY

In line with the draft definition of zero carbon an energy hierarchy has been created (see figure 7 below). Under the polices discussed in section 3, developers will initially be expected to secure high levels of energy efficiency and low energy demand. This is followed by the incorporation of on-site measures where these exist, such as low or zero carbon energy technologies and directly connected heat (not necessarily on-site).

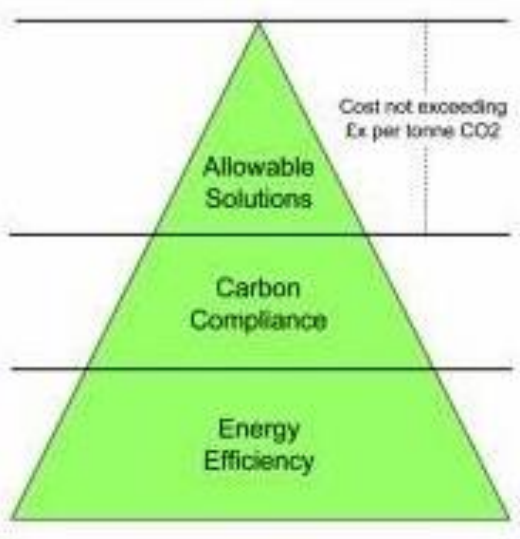


Figure 6 – Energy Hierarchy

However, in order to achieve the highest level of carbon reductions, it is intended that developers will be able to contribute to or co-ordinate investment in near or off-site infrastructure. This could include, for example, the connection of buildings to district heating networks and investment in low or zero carbon technologies on buildings owned by the city or by public and community institutions. Further guidance on these 'allowable solutions', possibly in the form of a Supplementary Planning Document (SPD), will be given following further national guidance on this matter expected from the Local Planning Authority.

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6. APPRAISAL OF SOLUTIONS

6.1. Summary

The strategic approach follows a specific appraisal of technologies at each stage of design and to achieve the overall goal of CO_2 reduction.

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.

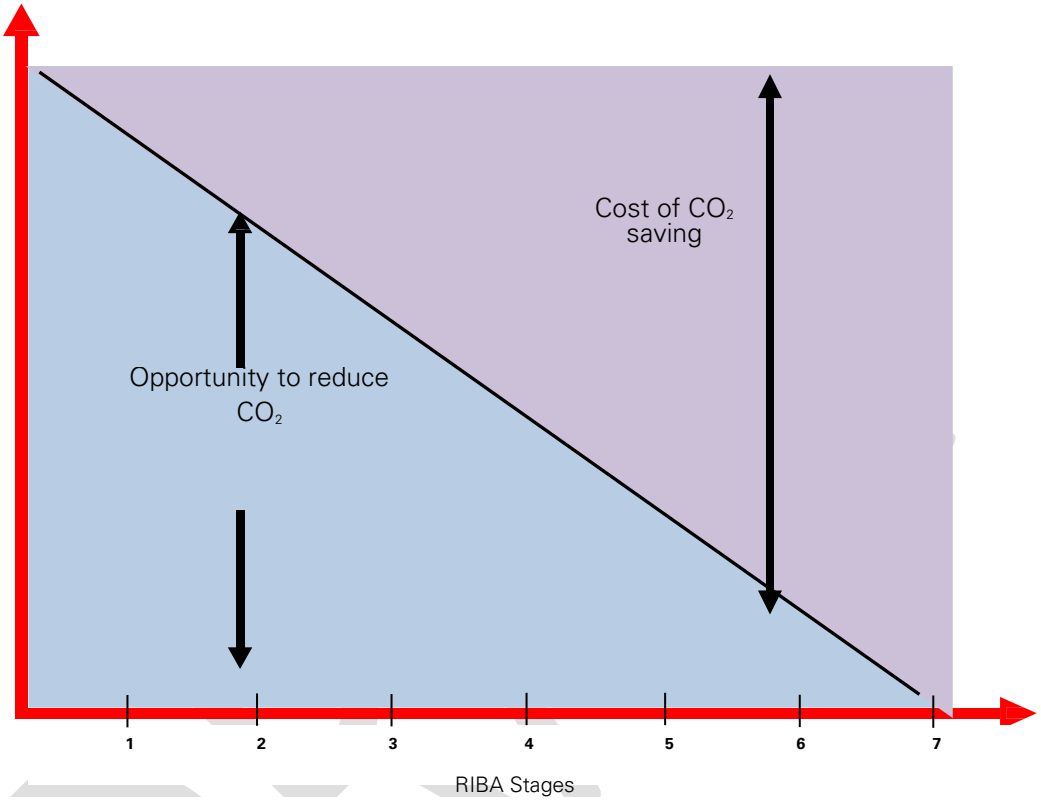


Figure 7 - Costs of implementing design measures at each RIBA Stage

In this first instance it is therefore essential that the buildings 'passive measures' are optimised and the design team work in close collaboration with the user team to consider the future fit out demands.

The next stage is to adopt 'efficient technologies' such as heat recovery and variable speed drives etc. to meet the demand efficiency with the final approach of applying 'renewable and low carbon' technologies accordingly.

Our approach has followed the following route:

Reduce Demand



Passive Design

- Thermal insulation
- Natural ventilation / mixed mode
- Natural daylight
- Thermal mass
- Air tightness
- Solar shading / glass specification

- Low energy fit out

LEAN

Meet demand efficiently



Energy Efficiency

- Mechanical Ventilation with heat recovery
- Mixed mode ventilation
- Low energy lighting (LED)
- Power management
- Variable Speed Drives
- Demand Operated Systems (PIR)
- Low Specific Fan Power

CLEAN

Supply energy from low and zero carbon technology



Renewable and Low Zero Carbon Technologies

- Combined heat power/tri-generation
- Biomass/biofuels
- Solar thermal hot water
- Ground source heat pumps
  - Open Loop
  - Closed Loop
- Photovoltaics
- Fuel cells
- Air source heat pumps
- Wind
- Hydro

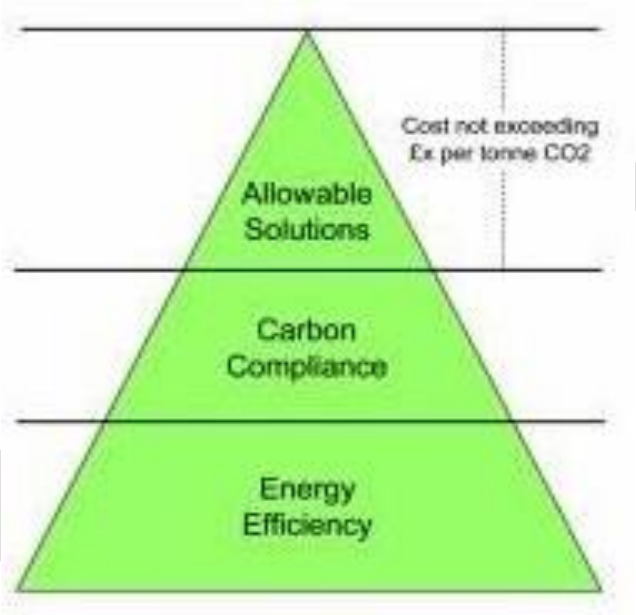
GREEN

6.2. Passive Design Measures - (Reduce Demand – Be Lean)

This section looks at the proposed measures that will ensure the initial demand for energy in the building is low from the outset using passive measures.

The following measures are to be incorporated in the design:

- Passive Design
  - Thermal Insulation and Thermal Bridging
  - Natural Ventilation / Mixed mode
  - Natural Daylight
  - Thermal Mass
  - Air tightness
  - Solar Shading



These measures promote the reduction of Energy use and carbon emission in the first instance. The passive design features on the proposed residential development mean that the buildings are is well adapted to these risks. Firstly, the energy demand has been reduced and therefore the buildings will be less affected by the decreased availability of energy. Secondly, the buildings will have a lower carbon footprint helping to stop the effects of climate change from increasing any further. The expected increase in external temperatures could result in future overheating problems. Whilst the buildings cannot be relocated or re-orientated, by having low G-value glass, there is less solar heat gain entering the rooms thus reducing any cooling requirements.

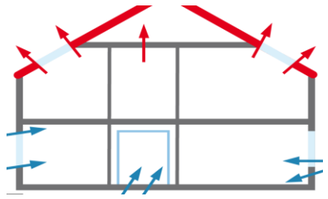
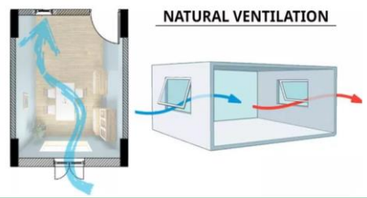
The demand for cooling has also been reduced through the adoption of efficient building services and by exceeding the u-values stated in the Building Regulations. This combination of passive design measures act to stabilise the temperatures within the building and enable it to adapt to the likely extremes of both high and low temperatures.

Key:

Y – Yes could be incorporated
P – Possible
N – Not appropriate

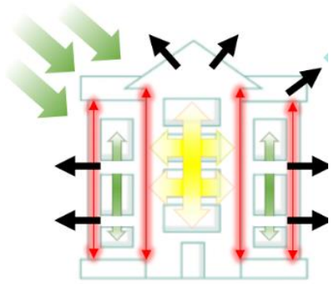
<table>
<tr><th>Measure</th><th>Description</th><th>Suitable For Consideration</th><th>Commentary</th></tr>
<tr><td>Thermal Insulation
</td><td>Thermal insulation is the reduction of heat transfer (i.e., the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radiative influence.</td><td>Y</td><td>Insulation is central to low energy construction to reduce unnecessary heat loss.

The dwellings will adopt a high level of thermal insulation to reduce heat loss and thus reduce overall energy demand.

Thermal insulation is essential to minimise heat losses and worst acceptable U-values shown in the table will be matched or exceeded.
<table>
<tr><th>Element type</th><th colspan="2">Maximum U-value W/(m².K)[1]</th></tr>
<tr><th></th><th>In new dwellings</th><th>In existing dwellings</th></tr>
<tr><td>Roofs[2]</td><td>0.13</td><td>0.13[13]</td></tr>
<tr><td>Wall – Dwelling Houses</td><td>0.18</td><td>0.18</td></tr>
<tr><td>Wall – Flats</td><td>0.21</td><td>0.21</td></tr>
<tr><td>Floor</td><td>0.15</td><td>0.15[10,14]</td></tr>
<tr><td>Party wall</td><td>0.20</td><td>0.20</td></tr>
<tr><td>Swimming pool basin[3]</td><td>0.25</td><td>0.25</td></tr>
<tr><td>Window or roof window [4,5]</td><td>1.4</td><td>1.4[11] or minimum WER[8] Band B</td></tr>
<tr><td>Roof-light [6,7]</td><td>2.2</td><td>2.2</td></tr>
<tr><td>Doors:
>60% internal face glazed
All other doors</td><td>
1.4
1.4</td><td>
1.4[12] or minimum DER[8] Band C
1.4[9,12] or minimum DER[8] Band B</td></tr>
<tr><td>Air Permeability</td><td>8.0 m³/ (h·m2)@50Pa
OR
1.57m³/(h·m2)@4Pa</td><td>N/A</td></tr>
</table></td></tr>
<tr><td>Air Tightness
</td><td>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.</td><td>Y</td><td>The dwellings of the development will target an air tightness that exceed the minimum requirements of the building regulations which is 8m³/(h.m²) at 50 Pa. This will help to reduce air infiltration and unwanted draughts through the external fabric of the building envelope and so heating and cooling energy demand will be lowered. The air permeability rating for the targeted dwellings is 4m³/(h.m²) at 50 Pa.</td></tr>
<tr><td>Natural Ventilation
</td><td>Natural ventilation is a method of supplying fresh air to a building or room by means of passive forces, typically by wind speed or differences in pressure internally and externally. During design, natural ventilation is first considered before mechanical ventilation because this reduces carbon emissions.</td><td>Y</td><td>Natural ventilation to be used to counter space overheating. This will help to reduce on site carbon emissions by the avoidance of operating electrically driven ventilation fans and cooling plant. The internal space planning, dwelling geometry and external topography will be optimised to take full advantage of natural ventilation.</td></tr>
<tr><td>Natural Daylight
</td><td>Natural light is light that is generated naturally, the common source of which is the Sun. This is as opposed to artificial light, which is typically produced by electrical appliances such as lamps.</td><td>Y</td><td>To reduce the energy used for artificial lighting the natural daylight entering occupied spaces will be maximised by optimising window size and orientation.

The dwelling of the development orientation and fenestration strategy will take advantage of passive solar gains and natural daylight to reduce heating energy and the need for artificial lighting.</td></tr>
<tr><td>Solar Shading
</td><td>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 overheating and too much light.</td><td>P</td><td>Whilst maximising daylight care must be taken to ensure that direct sunlight does not cause glare in the dwellings and does not cause excessive solar gains in summer which will cause spaces to overheat. This is managed by solar shading on affected windows. Some examples of solar shading are: canopies, solar control glazing, balconies, internal blinds and curtains which could be adopted on this development.

Solar shading will be determined when a part O overheating assessment is undertaken.</td></tr>
</table>

	Solar shading is a general term for a range of methods used to reduce the amount of solar gain.		
Thermal Mass 	Thermal mass is a material capacity to absorb, store and release heat. For example, bricks 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'. A common analogy is thermal mass as a kind of thermal battery. 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.	**P**	Thermal mass such as brick can absorb large amounts of heat energy which prevents spaces from overheating. The thermal mass can be cooled overnight when the space is not occupied to further reduce energy needed for cooling when the space is occupied. Although the roof will have a lightweight structure, the walls will be of heavyweight structure and offer thermal mass.

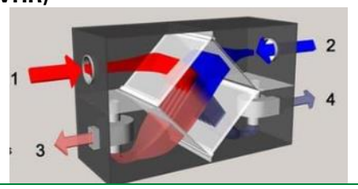
6.3. Meeting Demand Efficiently - (Be Clean)

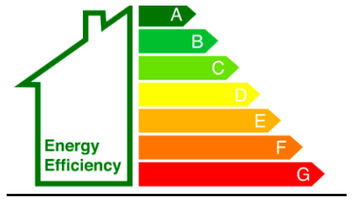
This section looks at technologies that will be used to ensure that energy demand is further reduced and met efficiently

- Ventilation Heat recovery
- Smart Controls
- Variable Speed Drives on fans and pumps
- LED Lighting
- Low Energy Fit-out
- Smart Meters

Key:

Y – Yes could be incorporated
P – Possible
N – Not appropriate

Technology	Description	Suitable For Consideration	Commentary
Mechanical Ventilation Heat Recovery (MVHR) 	MVHR provides fresh filtered air into a building whilst retaining most of the energy that has already been used in heating the building. Heat Recovery Ventilation is one solution to the ventilation needs of energy efficient buildings.	**N**	Where fresh air is supplied, and stale warm air extracted by mechanical ventilation, heat recovery will be used to recycle up to 85% of the heat from the extracted air to warm the incoming fresh air. The re-use of waste heat in the mechanical ventilation systems can provide a significant step towards reducing CO_2 emissions. Local Mechanical Ventilation Heat Recovery (MVHR) units are not proposed as it understood that the site does not have acoustic constraints. Low energy extract fans to wet rooms will be accepted.
Smart Controls 	Smart controls allow a building occupier to control the heating, appliances, thermostats and lighting systems within the homes. Smart controls link to smartphones from which the occupier can control functions of their home remotely.	**P**	Smart controls are important to the energy efficiency of a modern dwelling. This can will shut down the systems i.e. heating serving the spaces when they are not required and turn them back on instantly when they are required. The use of the smart controls will be encouraged.
Variable Speed Drives 	Variable speed drives and controls allow an energy 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.	**Y**	These can be used in conjunction with the demand operated systems to reduce the speed of pumps and fan motors to a minimum to conserve energy. Variable speed drives are potential adopted on the air source heat pumps of this development.

LED Lighting 	LED lighting is an electric light that produces light using light emitting diodes and are significantly more energy efficient than incandescent and fluorescent lights	**Y**	Extensively adopted LED fittings will be used throughout the dwellings to limit the energy associated with internal and external lighting.
Low Energy Fit Out 	A low energy fit out is an interior development of a building that is low carbon in its design, operation, and entire lifecycle.	**Y**	Energy efficient goods and appliances would be promoted.
Smart Meters 	A smart meter is a meter within your building or facility for specific energy measurements.	**Y**	Each dwelling will have a smart meter which allow energy consumption to be pinpointed and reviewed if it is excessive. Baselines and targets will also be set to help reduce energy use.

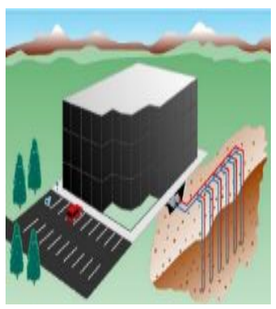
6.4. LZC Technology - (Be Green)

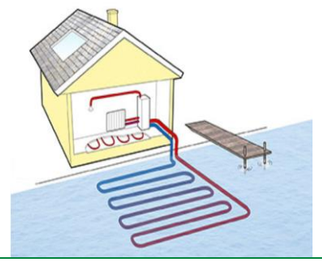
The following Low Zero Carbon (LZC) technologies have been identified and reviewed against their suitability on the dwellings of the development in Wrexham:

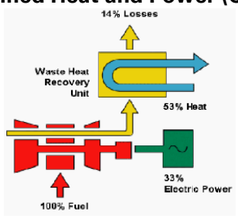
- Solar Water Heating
- Ground Source Heat Pumps
- Water Source Heat Pumps
- District Heating
- Biomass
- Wind Power
- Photovoltaic Electricity Generation
- Combined Heat and Power
- Air Source Heat Pumps
- Battery Storage

These services are described in more detail below and their suitability discussed.

Key:
Y – Yes could be incorporated
P – Possible
N – Not appropriate

Technology	Description	Suitable For Consideration	Commentary
Solar Thermal Water Heating 	Solar thermal water heating systems use heat from the sun to pre-heat domestic hot water. Solar thermal water heating systems are generally composed of solar thermal collectors and a fluid system to move the heat from the collector to a storage tank to store the heat for subsequent use. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders.	**P**	The solar energy collection and pipework distribution strategy would centre on collecting and storing thermal energy in cylinders or tanks in plant rooms. The roof space would be better utilised for PV panels and plant equipment as such there would be limited space to utilise this technology therefore not proposed for this development.
Ground Source Heat Pumps 	Ground Source Heat Pumps (GSHP) can be used to extract heat from the ground by circulating a fluid through a system of pipes buried underground to a heat exchanger which transfers the energy to the distribution network. This can provide space heating and/or domestic hot water. Ground source heat pumps have the advantage that they can act as a source of both heating and cooling for the buildings. Ground source heat pumps are either open-loop (abstracting and rejecting water to the aquifer below the site) or closed-loop. aquifer below the site) or closed-loop using boreholes and energy piles.	**N**	GSHP's have an average COP of 4.6 meaning that for every unit of electricity used to pump heat, 4-6 units of heat are produced making it an effective way of heating a building. However, the efficiency of the system is dependent on the low distribution temperatures from the low grade heat. There is extensive land available for boreholes/pipework therefore this system could be implemented. But is not cost effective for a development of this size.

Water Source Heat Pumps 	Water Source Heat Pumps (WSHP) work in a similar way to GSHP, with the exception that the pipes are submerged into a river, stream, lake or the sea. The fluid is pumped through the system and absorbs energy from the surrounding water. WSHP can be either an open-loop or closed-loop system.	**N**	No suitable water courses nearby with enough volume.
District Heating 	Energy sources include heat from CHP and to a lesser extent, geothermal. District heating offers low carbon emission factors and is potentially able to achieve renewable targets without other technologies. This system also reduces plant space requirements within building.	**N**	It is understood that there is no district heating network in close proximity to the site, therefore discounted.
Biomass 	Biomass heating systems burn biomass material in a biomass boiler in order to heat water in the same way that gas boilers burn gas. Biomass materials include all land and water based vegetation, e.g. wood chips, wood pellets, wood waste and fast growing coppice trees such as willow. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a low carbon process. Biomass boilers require fuel storage for the fuel source.	**N**	Could be adopted to offset heating and hot water but high NO_X and air quality levels are a concern. Also sourcing of materials and transporting large volumes into the site can be an issue Wood chips require a large storage area, usually equivalent to the plant room size, therefore biomass is discounted.
Wind Power 	Wind power is one of the cleanest and safest methods of generating electricity. Wind turbines use the wind's forces to turn a rotor which in turn generates electricity. Wind power is used in large scale wind farms for national electrical grids as well as in small individual turbines or building integrated turbine. 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.	**N**	Wind Power is not deemed suitable on the roofs of the residential area.
Photovoltaic Electricity Generation 	Photovoltaic (PV) modules are devices or banks of devices that use the photovoltaic effect to generate electricity directly from sunlight. Until recently, their use has been limited due to high manufacturing costs. In buildings current applications include PV on the roof, PV curtain walling systems and PV louvred external shading devices. Typically, photovoltaics would be installed on a south facing roof.	**Y**	The dwellings will have a significant electricity demand over a 24 hour period, therefore, no potential issues with utilisation, i.e. availability will match demand. The PV panels are used to generate electricity reducing CO_2 emissions. As the capital cost has dropped significantly in recent years PV panels are considered attractive to the dwellings

			PV can contribute to the 10% of the future energy requirements of the building through renewable energy sources that is described in section 4.5.1.
Combined Heat and Power (CHP) 	A CHP unit provides heating as well as electrical power. The electricity generated by the CHP plant can be distributed around a development and into the electrical network if needed. The use of this co-generation improves the overall efficiency of the primary energy delivered to the site with a corresponding reduction in the development's CO_2 emissions. The amount of thermal energy provided by the CHP unit will be dependent on the calculated thermal base load for the buildings.	**N**	Not considered as is not compatible with future de-carbonisation of the grid and reduction of use of fossil fuels
Air Source Heat Pump 	Air source heat pumps work in a similar way to GSHPs but extract thermal energy from the surrounding air and transfer it into water. Air source heat pumps can be fitted on the façade or on the roof but care should be taken when mounting the units to avoid any acoustic problems associated with operating the fans as the outdoor units typically operate with sound levels in the range 55 - 60dB(A). 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 although some systems may produce a greater rate of efficiency.	**Y**	The ASHP systemdoes offer an attractive solution in terms of the de-carbonisation of the grid and the omission of the requirement for natural gas to the site. This technology is feasible to generate hot water & heating and is the favoured solution for the dwellings.

7. PREDICTED CARBON EMISSIONS

A sample of initial SAP assessments have been undertaken, based on the Approved Document Part L 2021, using proprietary SAP modelling software, *Array*.

- House Type A1 (Bungalow, Detached)
- House Type B1 (Bungalow, Semi-Detached)
- House Type C1 (Flat, Semi-Detached)
- House Type D1 (House, Semi-Detached)
- House Type E1 (House, Semi-Detached
- House Type F1 (House, End-Terrace)
- House Type G1 (House, Detached)
- House Type G1 (House, Detached

Note that for the purposes of this report the results from one of these SAPs (House Type A1 – Bungalow, Detached) has been presented, the output results are tabulated below. The results from the SAP calculations of House Type A1 are displayed in Appendix 1, The rest of the SAP calculations for the different house types are available in Appendix 2.

The specific inputs used in the SAPS are as follows

Building Fabric Element	Maximum permitted average U-Value [W/m2K]	Target dwelling average U-Value [W/m2K]
External walls	0.26	0.16
Party walls	0.2	N/A
Curtain walls	1.6	N/A
Floors	0.18	0.1
Roof	0.16	0.1
Windows, doors, and roof windows	1.6	1.29

Target air permeability value:

Air Permeability	Worst acceptable standard	This building (target)
$m^3/(h.m^2)$ at 50 Pa	8	4

The subsequent carbon emissions saving identified are as follows:

Target 1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	9.07 kgCO2/m^2	
Dwelling carbon dioxide emission rate	3.21 kgCO2/m^2	OK

The proposed option provides a 64.6% improvement on Part L baseline calculation.

This proposed option also achieves an Energy Efficiency Rating of B and an Environmental impact (CO_2) rating of A.

8. CONCLUSION

This report has set out the methodology in which the design team have approached the design of the proposed residential development and how the strategies of Wrexham County Borough Council and the Government guidelines have been adopted.

Note that for the purposes of this report the tabulated results below are from one of the House Types (House Type A1 (Bungalow, Detached)) with SAP 10 results shown in Appendix 1. The rest of the SAP calculations for the different house types are available in Appendix 2.

9.2.1 Passive Measures – Lean

In the first instance, the team have looked to maximise passive measures to reduce the initial load of the building in terms of heating and anticipated lighting loads with the following measures: -

- Target U-values that exceed minimum Building Regulation Standards as below

Building Fabric Element	Maximum permitted average U-Value [W/m2K]	Target dwelling average U-Value [W/m2K]
External walls	0.26	0.16
Party walls	0.2	N/A
Curtain walls	1.6	N/A
Floors	0.18	0.1
Roof	0.16	0.1
Windows, doors, and roof windows	1.6	1.29

- Target Air leakage rates that exceed minimum Building Regulations

Air Permeability	Worst acceptable standard	This building (target)
$M_3/(h.m_2)$ at 50 Pa	8	4

9.2.2 Energy Efficiency Measures – Mean

The next stage of the design development was to establish energy efficiency measures to meet the demand of the building, these being:

- High efficiency LED lighting throughout
- Demand operated lighting where appropriate
- Variable speed drives for air source heat pump units.

9.2.3 Renewable and Low Carbon Technologies – Green

The final aspect of the design has been to establish what renewable and low carbon technologies can be adopted. Following the appraisal of the building and site, air source heat pumps will be used to generate low carbon heating and hot water for the development. PV panels are also proposed on the dwellings of this element to offset a percentage of the dwelling's electricity demand.





9.2.4 Summary

Note that for the purposes of this report the tabulated results below are from one of the House Types (House Type A1 (Bungalow, Detached)) with SAP 10 results shown in Appendix 1. The rest of the SAP calculations for the different house types are available in Appendix 2.

In summary, the residential buildings emission rate is lower than the target emissions rate using block compliance and the design fabric energy efficiency is better than the target fabric energy efficiency.

Target 1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	9.07 kgCO2/m^2	
Dwelling carbon dioxide emission rate	3.21 kgCO2/m^2	OK

The proposed option provides a 64.6% improvement on Part L baseline calculation.

The SAPs for the results are shown in appendix 1 of this report.

9. OVERALL SUMMARY

This report has discussed the energy strategy for the Former Air Products Site, Llangollen Road, Acrefair, LL14 3HP, Wrexham. It has reviewed and proposed low and zero carbon technologies and presented the results from an initial SAP assessment.

Our strategy has sought to reduce the carbon emissions for the building using a lean, mean green approach and these findings have been applied to the building.

The proposals presented also support the government's and local authorities' policy on phasing out fossil fuels and as the grid decarbonises further and will offer more carbon reduction towards net zero carbon.

10. APPENDIX 1

House Type A1 (Bungalow, Detached)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:45:32

Project Information			
Assessed By	Adrian Farnell	Building Type	Bungalow, Detached
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	85 m^2
Site Reference	House Types	Plot Reference	House Type A1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.07 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	3.21 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*48.76 kWh_{PE}/m^2*	
Dwelling primary energy	37.27 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*44.2 kWh/m^2*	
Dwelling fabric energy efficiency	42.5 kWh/m^2	OK

2a Fabric U-values				
Element	*Maximum permitted average U-Value [W/m^2K]*	Dwelling average U-Value [W/m^2K]	Element with highest individual U-Value	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	N/A	N/A	N/A
Curtain walls	*1.6*	N/A	N/A	N/A
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.29	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	N/A

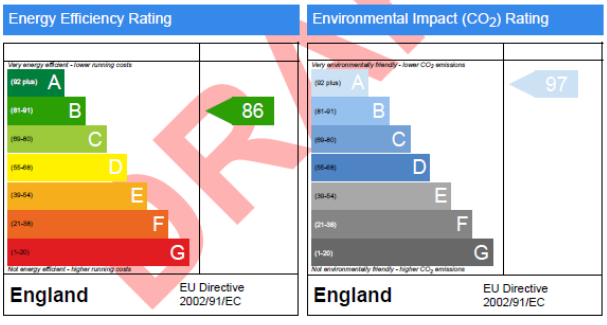
Predicted Energy Assessment

elmhurst energy

Dwelling type: Bungalow, Detached
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 85.06 m²
DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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11. APPENDIX 2

House Type B1 (Bungalow, Semi-Detached)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:39:37

Project Information			
Assessed By	Adrian Farnell	Building Type	Bungalow, Semi-detached
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	68 m^2
Site Reference	House Types	Plot Reference	House Type B1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.62 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	3.22 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*51.5 kWh$_{PE}$/m^2*	
Dwelling primary energy	32.81 kWh$_{PE}$/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.2 kWh/m^2*	
Dwelling fabric energy efficiency	36.0 kWh/m^2	OK

2a Fabric U-values				
Element	*Maximum permitted average U-Value [W/m^2K]*	Dwelling average U-Value [W/m^2K]	Element with highest individual U-Value	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	N/A
Curtain walls	*1.6*	0	N/A	N/A
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.28	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	N/A

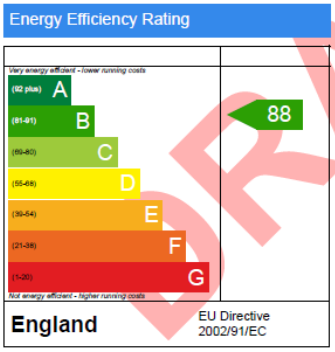
Predicted Energy Assessment

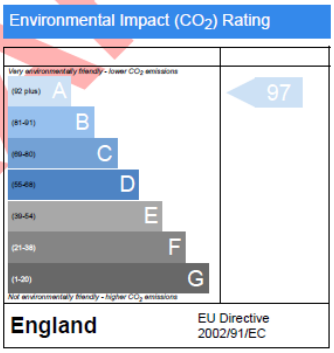
elmhurst energy

Dwelling type: Bungalow, Semi-Detached
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 68.4 m²
DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.





The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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House Type C1 (Flat, Semi-Detached)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:40:00

Project Information			
Assessed By	Adrian Farnell	Building Type	Flat, Semi-detached
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	52 m^2
Site Reference	House Types	Plot Reference	House Type C1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*13.28 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	4.07 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*69.76 kWh_{PE}/m^2*	
Dwelling primary energy	42.11 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*36.7 kWh/m^2*	
Dwelling fabric energy efficiency	36.6 kWh/m^2	OK

2a Fabric U-values				
Element	*Maximum permitted average U-Value [W/m^2K]*	Dwelling average U-Value [W/m^2K]	Element with highest individual U-Value	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	N/A	N/A	N/A
Curtain walls	*1.6*	N/A	N/A	N/A
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	N/A	N/A	N/A
Windows, doors, and roof windows	*1.6*	1.3	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	N/A

Predicted Energy Assessment

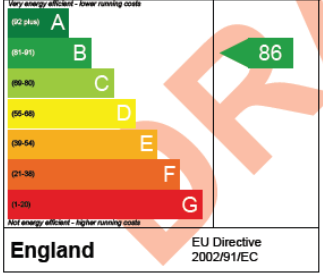
elmhurst energy

Dwelling type: Flat, Semi-Detached
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 52.02 m²
DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

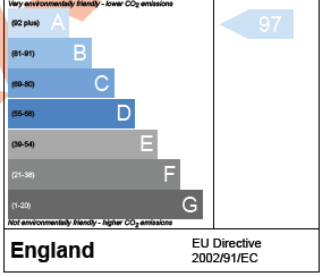
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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House Type D1 (House, Semi-Detached)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:40:24

Project Information			
Assessed By	Adrian Farnell	Building Type	House, Semi-detached
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	93 m^2
Site Reference	House Types	Plot Reference	House Type D1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.17 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	3.09 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.02 kWh_{PE}/m^2*	
Dwelling primary energy	31.66 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*34.1 kWh/m^2*	
Dwelling fabric energy efficiency	32.9 kWh/m^2	OK

2a Fabric U-values				
Element	*Maximum permitted average U-Value [W/m^2K]*	Dwelling average U-Value [W/m^2K]	Element with highest individual U-Value	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	N/A
Curtain walls	*1.6*	0	N/A	N/A
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.28	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	N/A

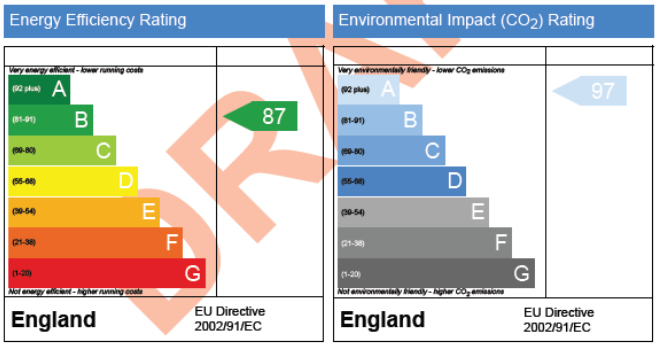
Predicted Energy Assessment

elmhurst energy

Dwelling type: House, Semi-Detached
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 92.66 m²
DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

DRAFT

House Type E1 (House, Semi-Detached)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:40:57

Project Information			
Assessed By	Adrian Farnell	Building Type	House, Semi-detached
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	99 m^2
Site Reference	House Types	Plot Reference	House Type E1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.91 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.82 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*51.65 kWh_{PE}/m^2*	
Dwelling primary energy	28.83 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*34.4 kWh/m^2*	
Dwelling fabric energy efficiency	32.4 kWh/m^2	OK

2a Fabric U-values				
Element	*Maximum permitted average U-Value [W/m^2K]*	Dwelling average U-Value [W/m^2K]	Element with highest individual U-Value	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	N/A
Curtain walls	*1.6*	0	N/A	N/A
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.29	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	N/A

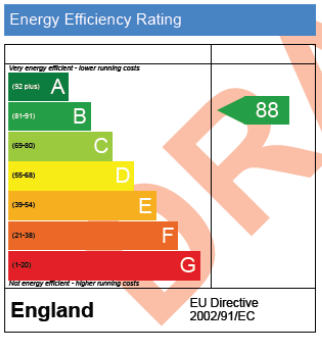
Predicted Energy Assessment

elmhurst energy

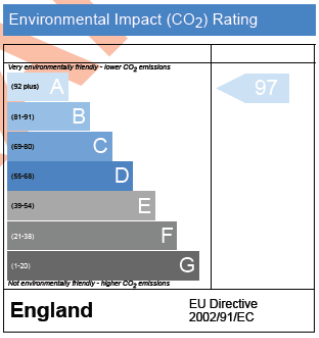
Dwelling type: House, Semi-Detached
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 98.6 m²
DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

DRAFT

House Type F1 (House, End-Terrace)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:41:16

Project Information			
Assessed By	Adrian Farnell	Building Type	House, End-terrace
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	104 m^2
Site Reference	House Types	Plot Reference	House Type F1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.72 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	4.41 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*55.98 kWh$_{PE}$/m^2*	
Dwelling primary energy	46.34 kWh$_{PE}$/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*39.4 kWh/m^2*	
Dwelling fabric energy efficiency	37.8 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.3	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

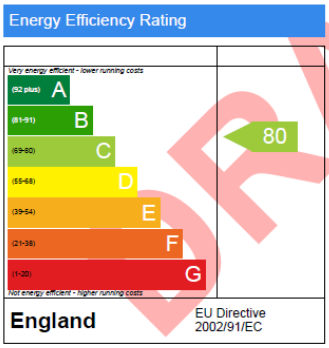
Predicted Energy Assessment

elmhurst energy

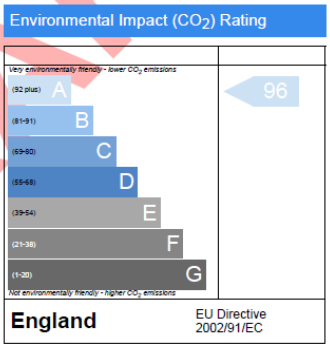
Dwelling type: House, End-Terrace
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 104.34 m²
DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

DRAFT

House Type G1 (House, Detached)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:41:40

Project Information			
Assessed By	Adrian Farnell	Building Type	House, Detached
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	120 m^2
Site Reference	House Types	Plot Reference	House Type G1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.63 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	2.93 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*50.28 kWh_{PE}/m^2*	
Dwelling primary energy	29.94 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.7 kWh/m^2*	
Dwelling fabric energy efficiency	36.3 kWh/m^2	OK

2a Fabric U-values				
Element	*Maximum permitted average U-Value [W/m^2K]*	Dwelling average U-Value [W/m^2K]	Element with highest individual U-Value	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	N/A	N/A	N/A
Curtain walls	*1.6*	N/A	N/A	N/A
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.35	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	N/A

Predicted Energy Assessment

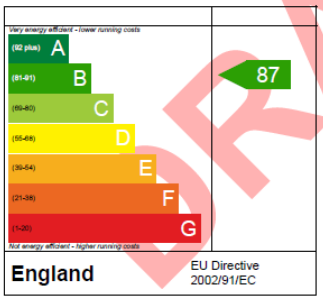
elmhurst energy

Dwelling type: House, Detached
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 120 m²
DRRN:

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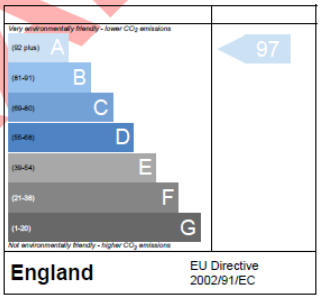
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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House Type H1 (House, Detached)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 22 Feb 2023 11:42:01

Project Information			
Assessed By	Adrian Farnell	Building Type	House, Detached
OCDEA Registration	EES/019609	Assessment Date	2023-02-22

Dwelling Details			
Assessment Type	As designed	Total Floor Area	118 m^2
Site Reference	House Types	Plot Reference	House Type H1
Address			

Client Details	
Name	Ridge
Company	Ridge
Address	Work, England, England

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.81 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	2.6 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*51.48 kWh$_{PE}/m^2$*	
Dwelling primary energy	26.23 kWh$_{PE}/m^2$	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.5 kWh/m^2*	
Dwelling fabric energy efficiency	39.6 kWh/m^2	OK

2a Fabric U-values				
Element	*Maximum permitted average U-Value [W/m^2K]*	Dwelling average U-Value [W/m^2K]	Element with highest individual U-Value	
External walls	*0.26*	0.16	Walls (1) (0.16)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.1	External Floor (0.1)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.3	Front Windows (1.4)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

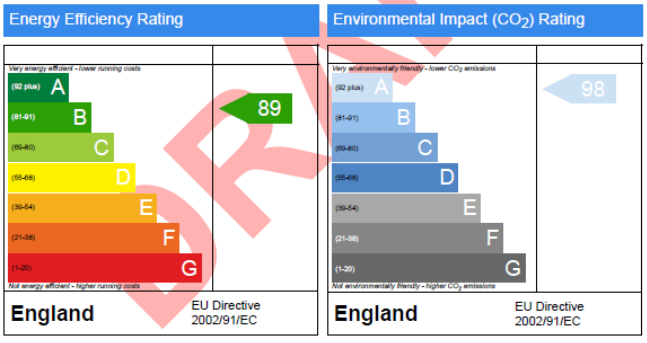
Predicted Energy Assessment

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Dwelling type: House, Detached
Date of assessment: 22/02/2023
Produced by: Charlie Ball
Total floor area: 118.12 m²
DRRN:

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