Lamb Hill, Cornborough, Sheriff Hutton, YO60 6RX

SUSTAINABILITY AND ENVIRONMENTAL PERFORMANCE

July 2021

BRAMHALL
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1.0 Introduction

This document has been prepared by Bramhall Blenkharn Leonard architects and accompanies a planning application for a new dwelling at Lamb Hill, Cornborough, to the west of Sheriff Hutton in North Yorkshire. The purpose of the document is to provide an overview of the sustainability and environmental performance credentials and characteristics of the proposed new dwelling.

There are several aspects to this and the document is divided into subsections focusing on each of these aspects in turn. The main aspects of the proposed dwelling's environmental performance are:

1. Building design and orientation
2. Building fabric and thermal envelope
3. Glazing performance
4. Renewable technologies
5. Design-stage SAP assessment
6. Net zero carbon in operation

2.0 Design Overview

The proposed dwelling is designed as a series of inter-linked single- and two-storey buildings, joined together by a central circulation space under a flat sedum green roof. The key orientation axis of the building is established by existing features of the site, namely the larger of the two existing ponds to the south west corner of the site and the existing land form of Lamb Hill to the south east corner of the site. An axis line is taken between the centre of these two existing features and the proposed dwelling is set out about that axis line.

The landscape design for the proposals has developed and evolved alongside the architectural design and is key to the overall scheme, being integrated with the dwelling and allowing it to sit comfortably within the existing site context. The focus of the landscape proposals has very much been on restoration and enhancement, including; softening of the edges of the existing shelter-belt woodland, restoration of the historic roundel of trees on Lamb Hill, introduction of a green 'wildlife corridor' on the north side of the proposed dwelling, and creation of an additional new pond in the south-east corner of the site. These serve to bring significant enhancement to the site under the proposals, both in terms of biodiversity and wildlife value, but also to setting and context.

The below images provide a visual overview of the proposals, as submitted.

Fig. 2.1 Elevated view of proposals from south east

Fig. 2.2 Elevated view of proposals from north east

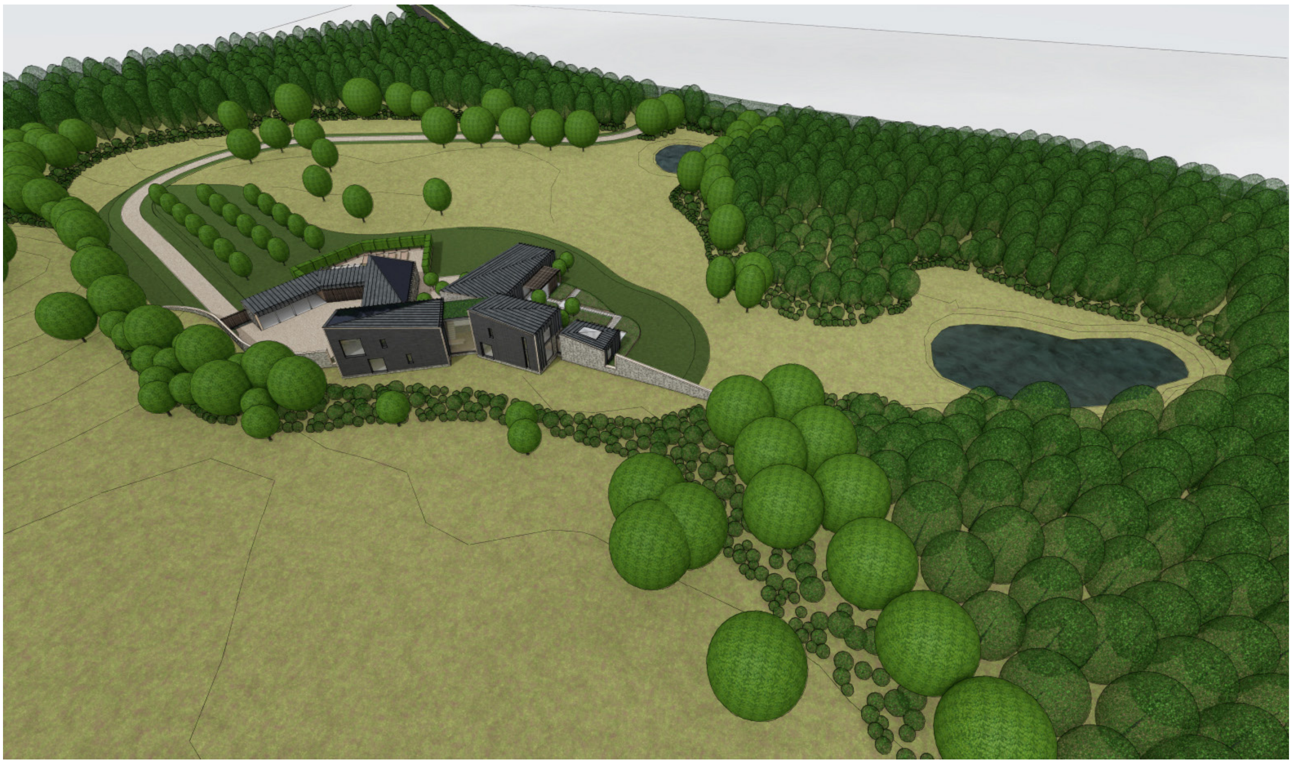

Fig. 2.3 Elevated view of proposals from north west

3.0 Building Design and Orientation

The proposed dwelling has been designed to capitalise on passive energy through solar gain. Much of the larger areas of glazing in the house are south and south-west facing, allowing natural capture of heat energy from the sun through the day. Use of deep reveals and timber fins in front of glazing provides some modulation of solar gain to reduce summertime overheating.

A large number of opening windows and large sliding doors allows flexibility for the building's occupants to provide passive summertime ventilation and cooling, without the need to resort to active cooling, such as air conditioning, and its associated energy use.

Openings on the north side of the building are generally smaller and fewer in number. This helps to maintain the thermal envelope of the building on the colder north side and reduces potential heat loss from glazed areas, which cannot perform as well thermally as areas of solid wall.

4.0 Building Fabric and Thermal Envelope

We generally advocate a 'fabric-first' approach to a building's environmental performance and this is the approach that has been taken at Lamb Hill. Buildings with a high-performing and well-detailed thermal envelope do not need as much heating input as buildings with lower thermal performance. This means ensuring high levels of thermal insulation to the entire building envelope (floors, walls and roof) and making sure that insulation levels are maintained at the junctions between these elements i.e. where the walls meet the roof or the floor. Often it is the junctions between elements, rather than the main elements themselves, that cause heat loss.

The building fabric will also be designed to minimise thermal bridging. This means ensuring that conductive elements or components (such as steel beams and lintels) do not pass continuously from outside to inside, bridging the thermal envelope. 'Cold' elements are located outside of the thermal envelope (outside the insulation) and 'warm' elements are located inside the thermal envelope (inside the insulation) and do not pass through the insulation from one side to the other. Use of 'thermal breaks' can also assist in eliminating potential thermal bridging. This, once again, provides a significant reduction in heat loss from within the building.

The U-values (measure of thermal conductivity) of all proposed building fabric elements (roof, walls and floor) significantly exceed the requirements set out in Part L1A the current Building Regulations:

Building Element	Building Regulations minimum standard U-Values (W/m²K) (Building Regulations Approved Document L1A)	Proposed dwelling U-Values (W/m²K) (As used for design-stage SAP assessment)
Roof	0.20	0.15
Walls	0.30	0.17
Floor	0.25	0.12
Windows	2.00	1.20

Table. 4.1 Comparison of element U-Values of the proposed dwelling compared with Building Regulations Approved Document L1A minimum standard U-Values (Limiting fabric parameters). Numbers closer to 0 represent greater thermal efficiency (lower thermal conductivity through the element).

5.0 Glazing Performance

All glazing used in the proposed dwelling will be high-performance, argon-filled double-glazed units. The cavity between the two glass panes is filled with argon gas, which reduces heat transfer across the cavity between the panes. These glazing units also utilise 'warm edge' spacer bars forming the void / cavity between the two glass panes, which are made from non-conductive materials, further helping to minimise thermal transfer between outside and inside. The glazing units also incorporate a low-emissivity, or 'low-e', coating to the inner pane, which allows thermal energy and light from the sun to enter into the building, but reduces the amount of heat energy that can escape back out from inside. This further assists in minimising heat loss from within the building via the glazing.

Where necessary, solar-control treatments can be applied to the outer pane of the glazing unit to limit solar gain in any spaces that are identified as being at risk of summertime overheating due to excessive heat gain. Generally these would be south-facing rooms that have large areas of glazing with no external shading.

6.0 Renewable Technologies

The proposed dwelling will use a combination of renewable technologies to assist in meeting its annual energy demands. Whilst significant reduction in the energy demand of the dwelling can be achieved through a high-performance thermal envelope, the building will still require energy input to provide space heating, hot water and power.

Renewable technologies can be utilised to provide some of this energy demand from renewable / sustainable sources, rather than from traditional non-renewable sources (primarily fossil-fuels). The proposed renewable technologies to be incorporated into the dwelling are:

- Photovoltaic (PV) roof panels (electrical power generation)
- Battery storage (electrical power storage)
- Ground-source heat pump (GSHP) (space heating and hot water)

6.1 Photovoltaic (PV) Roof Panels

It is proposed to use integrated solar roofs to two of the dwelling's roof slopes. This utilises shaped PV panels to form the visible roof covering of a given roof area, which gives a much neater and more integrated appearance than surface-mounted panels on a supporting frame system, mounted on-top of the roof covering.

Fig. 6.1 Example of integrated solar roof following installation (prior to final completion).

It is proposed that this type of integrated solar roof system would be used on the southeast-facing pitch of the north-eastern bedroom wing of the building, and also on the southwest-facing pitch of the southern garage block, as indicated on the submitted drawings.

Consultation with a solar roof supplier (GB-Sol Ltd.) has indicated that these two roof pitches would provide 13kWp of generation capacity. It is worth noting that the design-stage SAP assessment (Section 7), which assesses the building's energy performance, is based on PV provision totaling 11kW, so it is likely that installed capacity would actually exceed this.

6.2 Battery Storage

It is proposed to utilise battery storage in combination with the above outlined PV, to provide on-site storage of the electricity generated by the solar roofs. One of the recognised limitations of electricity generation from solar PV in domestic applications is the offset between peak generation and peak demand. Peak generation being the middle of the day in summer, and peak demand being the beginning and end of the day in winter. Combining solar PV with battery storage reduces the impact of this generation / demand offset by allowing the electricity generated by the PV system to be stored in the batteries for later use, rather than needing to be used at the time of generation.

Consultation with a battery storage supplier (GoEco Renewables Ltd.) has indicated that the system would comprise a 10kW Solax X3-Hybrid inverter in combination with an 11.6kW Solax Triple Power LFP Battery (2 module system). This would provide adequate storage capacity for electricity generated by the integrated solar roofs, which could then be used to maximum benefit by the building occupants at times of day when the PV system is not at peak generation. The data sheets for the inverter and batteries are included at Appendix A.

Fig. 6.2 Solax X3-Hybrid inverter and single Triple-Power battery (inverter and battery units will be internally mounted in the proposed dwelling and will not be visible externally).

6.3 Ground-source Heat Pump (GSHP)

The proposed dwelling will utilise a Ground-source heat pump (GSHP) to provide its heating and hot water demand. In simple terms, such a system extracts heat energy from the ground and utilises that heat energy to heat water for use in the dwelling and its heating system. The type of GSHP proposed is a 'ground loop' system, with loops of pipework laid horizontally at approximately 1m depth below the ground surface.

Consultation with a GSHP supplier (GoEco Renewables Ltd.) has indicated that the system would comprise an EcoForest ecoGEO 5 22kW Ground Source Heat Pump system, with four 200m ground loops (100m long trenches with loops doubled back). The dwelling's heating system is proposed to be wet underfloor heating to the ground floor spaces and radiators to the first floor spaces. The system will incorporate a 90l cylinder for hot water storage. The data sheets for the GSHP system are included at Appendix B.

The GSHP is powered by electricity, so works well in combination with the proposed solar PV and battery storage, as some of this on-site electricity generation can be used to provide some of the power to the GSHP system.

7.0 Design-stage SAP Assessment

The energy performance of all new dwellings is assessed under the Building Regulations using the Standard Assessment Procedure (SAP). The dwellings energy performance is assessed at two stages; first at design stage (to ensure that the proposed building is capable of achieving the required standard), and then again post-completion of the build (to ensure that the building as constructed meets the standard set out at design stage). The SAP calculation takes into account all of the elements of the proposed building, including its shape, size and orientation; thermal properties; air permeability; heating and ventilation; and use of renewable technologies.

Approved Document L1A of the Building Regulations sets out the requirements for the energy performance of new dwellings. Minimum energy performance requirements are set as a Target CO_2 Emission Rate (TER) and Target Fabric Energy Efficiency (TFEE) rate. TER is expressed as the mass of CO_2 emitted in kilograms per square metre of floor area per year. The TFEE rate is expressed as the amount of energy demand in units of kilowatt-hours per square metre of floor area per year. The TER and TFEE rate are calculated using SAP 2012.

There are several approved software systems that provide the required calculations under SAP 2012. The design-stage SAP assessment for the proposed dwelling has been undertaken by Ryedale Testing using Elmhurst Energy Systems SAP2012 Calculator. This is one of the approved software systems. The Predicted Energy Assessment and Building Regulation Compliance report are included at Appendix C.

The Predicted Energy Assessment gives an Energy Efficiency Rating of 101, which is a high A-rating. It also gives an Environmental Impact (CO_2) Rating of 101, which again is a high A-rating.

The Building Regulation Compliance report provides a calculated TER of 23.63 $kgCO_2/m^2$. The calculated Dwelling CO_2 Emission Rate (DER) is -0.02 $kgCO_2/m^2$. This represents a CO_2 emission rate below zero, and 100.1% lower than the Building Regulations requirement. The calculated TFEE rate is 72.08 $kWh/m^2/yr$, with the Dwelling Fabric Energy Efficiency (DFEE) rate is 56.22 $kWh/m^2/yr$. This represents a Fabric Energy Efficiency that is 22.1% lower than the Building Regulations requirement.

The SAP calculation indicates that the dwelling's annual CO_2 emissions will be -0.03 tons per year (below zero). This demonstrates that the dwelling is net carbon-zero in its energy use over an annual cycle.

8.0 Net Zero Carbon in Operation

Through the combination of factors outlined in the preceding sections of this document, the proposed dwelling has been designed to be net zero carbon in operation over an annual cycle. This means that over a 12 month period of the building being occupied and used, net CO_2 emissions from its operational energy are zero, or below zero.

In its publication 'Net Zero Carbon Buildings: A Framework Definition' (April 2019) the UK Green Building Council defines net zero carbon in operational energy as:

> *"When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset."*

As demonstrated by the design-stage SAP assessment (Appendix C), the proposed dwelling has an annual net CO_2 emissions value of -0.03 tons per year, with a Dwelling CO_2 Emission Rate (DER) of -0.02 $kgCO_2/m^2$. Both are negative values below zero. The dwelling will therefore achieve the definition of 'net zero carbon in operation' as set out above.

APPENDIX A

Solax X3-Hybrid Inverter and Triple Power LFP Battery Data Sheets

Simple.
Reliable.
Efficient

- 3-phase Unbalance Output
- High Efficiency
- IP65 Rated
- Remote Monitoring

5kW 6kW

X3-HYBRID-5.0T / X3-HYBRID-6.0T
X3-HYBRID-8.0T / X3-HYBRID-10.0T

The new X-Hybrid 3-phase inverter from SolaX is the latest incarnation of the market leading range of hybrid inverters, offering a flexible and scalable solution for both domestic and commercial applications. The 3-phase series includes inverters ranging in size from 5 to 10kW, and with the ability to install multiple inverters in parallel, scalable battery storage for commercial applications is now a reality. The Inverter is equipped with EPS (Emergency Power Supply) function only when supported by extra changeover devices, had multiple communication options and can be controlled remotely.

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X3-HYBRID (THREE PHASE)

	X3-HYBRID-5.0T	X3-HYBRID-6.0T	X3-HYBRID-8.0T	X3-HYBRID-10.0T
INPUT (DC)				
Max.PV array power [Wp]	7500	9000	12000	15000
Max.DC voltage [V]	1000	1000	1000	1000
Nominal DC operating voltage [V]	720	720	720	720
Max. input current (input A/input B) [A]	12/12	12/12	24/12	24/12
Max. short circuit current (input A/input B) [A]	14/14	14/14	28/14	28/14
MPPT voltage range[V]	180-950	180-950	180-950	180-950
Start operating voltage[V]	180	180	180	180
No. of MPP trackers	2	2	2	2
Strings per MPPT tracker	1/1	1/1	2/1	2/1
INPUT AC				
Max. apparent AC power[VA]	5000	6000	8000	10000
Max. AC current[A]	8.0	9.6	12.8	15.9
Nominal grid voltage(AC voltage range)[V]	400/230;380/220	400/230;380/220	400/230;380/220	400/230;380/220
Nominal grid Frequency/range[Hz]	50/60	50/60	50/60	50/60
OUTPUT AC				
Nominal AC power [VA]	5000	6000	8000	10000
Max. apparent AC power [VA]	5500	6600	8800	11000
Nominal grid voltage(AC voltage range) [V]	400/230;380/220			
Nominal grid frequency/range [Hz]	50/60			
Nominal AC current [A]	7.2	8.7	11.6	14.5
Max. AC current [A]	8.0	9.6	12.8	15.9
Displacement power factor	0.8 leading ... 0.8 lagging			
THDi, rated power [%]	<3			
OUTPUT DC (BATTERY)				
Battery voltage range [V]	160-800			
Max.continuous charge/discharge current [A]	25			
Communication interfaces	CAN/RS485			
Reverse connect protection	Yes			
OFF-GRID OUTPUT (WITH BATTERY)				
MAX. continuous apparent power [VA]	5000	6000	8000	10000
Rated voltage[V],Frequency [Hz]	400/230VAC;380/220VAC; 50/60			
MAX.continuous current [A]	7.2	8.7	11.6	14.5
Peak apparent power [VA] Duration[s]	<10000 60	<12000 60	<14000 60	<15000 60
Changeover time [s]	<1.5			
THDv, linear Load [%]	<2			
EFFICIENCY				
MPPT efficiency [%]	99.9			
Euro efficiency [%]	97.0			
Max. efficiency [%]	97.8			
Battery charge/discharge efficiency [%]	97.0/96.0	97.0/96.0	97.5/96.5	97.5/96.5
POWER CONSUMPTION				
Standby consumption (Night) [W]	<25 for hot standby, <3 for cold standby			
STANDARD				
Safety	IEC62109-1/-2			
EMC	EN61000-6-1/EN61000-6-2/EN61000-6-3			
Certification	VDE 0126-1-1 A1:2012 / VDE-AR-N 4105 / G98 / AS4777 / EN50549 / CEI 0-21 / and so on			
ENVIRONMENT LIMIT				
Degree of protection(according to IEC60529)	IP65			
Operating temperature range [°C]	-20 ~ +60 (derating at+45)			
Max. operation altitude [m]	<2000			
Humidity [%]	0~100 (condersing)			
Storage temperature [°C]	-20 ~ +60			
Typical noise emission [dB]	40			
DIMENSION AND WEIGHT				
Dimensions(WxHxD) [mm]	457*654*228			
Weight[kg]	45			
Cooling concept	Natural			
Topology	Non-isolated			
Communication interfaces	Ethernet/Meter/Pocket WiFi(optional)/Pocket LAN(optional)/Pocket GPRS(optional)/DRM/USB/ISO alarm/CAN/BMS/NTC			
LCD display	Backlight 20*4 character			
Standard warranty [years]	5-10			

TRIPLE POWER

- Safest $LiFePO_4$ battery
- 90% DOD
- Cycle life>6000 times
- IP55 protection level
- Floor or wall mounting
- Less self consumption
- Quick installation
- No toxic heavy metals or caustic materials

TRIPLE POWER
Global: +86 571-56260011
Email: info@triple-power.com

T-BAT SYS-HV Configuration List

	T-BAT H 5.8
Nominal Voltage [V]	115.2
Operating Voltage [V]	100-131
Battery Type	Li-on (LFP)
Nominal Capacity [kWh]	5.8
Faradic Charge Efficiency [%]	99
Battery Roundtrip Efficiency [%]	95
Standard Power [kW]	2.9
Max Power [kW]	4.0
Recommend Charge/Cischarge Current [A]	25
Max Charge/Discharge Current [A]	35
Cycle Life [90% DOD]	>6000 Cycles
Warranty [Year]	10
Available Operating Temperature Range [℃]	0 to 55
Full-load Operating Temperature Range [℃]	5 to 48
Humidity [%]	4 to 100 (condensing)
Altitude [m]	Below 2000
Protection	IP55
System to Inverter	CAN2.0
Battery to Battery/BMS	RS485
Data Collection Port /FW UPDATE	CAN2.0
Master Control Working Mode Indicator	1 LED
Master Control Capacity Indicator	4LED (25%, 50%, 75%, 100%)
Battery Module LED	2 LED
Reset	Button
Switch ON/OFF	Button*1 + breaker*1
Safety	CE, RCM, TUV(IEC62619) UL1973,ROHS,REACH
UN Number	UN3840
Hazardous Materials Classification	Class 9
Transport Testing Requirement	UN38.3
Dimensions(LxWxH) [mm]	474*193*708 (T-BAT H 5.8) / 474*193*647 (HV11550)
Weight [kg]	72.2 (T-BAT H 5.8) / 68.5 (HV11550)

**The Triple Power battery could be scalable up to 4 modules, for a total of 23.2kWh.*

APPENDIX B

EcoForest ecoGEO 5 Ground Source Heat Pump Data Sheets

HEAT PUMP: ecoGEO 5-22

- **The thermal power control** can modulate within a large range (20-100%) and control the flow of the brine and the production circuit.
- **The compact design** includes the brine and production circulating pumps, the brine and production expansion vessels (8l and 12l for brine and production circuits respectively), brine and production security valves and the three-way valve for the DHW.
- **The High Temperature Recovery system** (HTR) makes the simultaneous production of DHW and heating or cooling possible, as well as DHW production up to 70 ºC without electrical support.
- Integrated management of up to 4 **different distribution temperatures, 2 different buffer tanks** (1 for cooling and 1 for heating), **1 DHW tank, 1 pool** and the **daily schedule of DHW recirculation**.
- **Integrated management of modulating air units**, both for air source systems and for hybrid (air source - ground source) systems.
- **Integrated management of external variable or ON/OFF auxiliary systems** such as boilers or electrical resistances.
- **Integrated management of cascade systems up to 3 units.**
- **Integrated management of simultaneous cooling/heating systems** according to the scheme.
- **Integrated Passive cooling** in models 2 and 4. **Integrated Active cooling** in models 3 and 4.
- **Single-phase and Three-phase** electrical supply availability.
- Compatibility with **e-manager and e-system**
- **Integrated energy meters** to measure the electric consumption, the heating/cooling thermal power, the COP and the monthly and annual SPF.

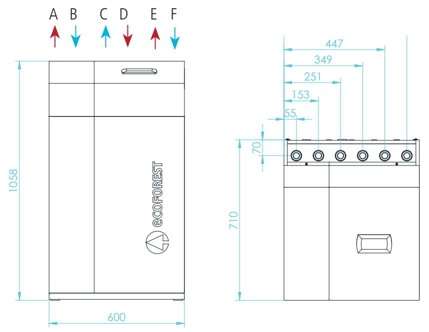
SPECIFICATIONS ecoGEO B/C 5-22		UNITS	B/C 1	B/C 2	B/C 3	B/C 4
APPLICATION	Place of installation	-	Indoors			
	Type of brine system	-	Ground source / Air source / Hybrid			
	Heating	-	✓	✓	✓	✓
	High Temperature Recovery (HTR) system	-	✓	✓	✓ integrated	✓ integrated
	Integrated Active cooling	-	-	-	✓	✓
	Integrated Passive cooling	-	-	✓	-	✓
PERFORMANCE	Modulation range of the compressor	%	20 to 100			
	Heating power², B0W35	kW	5,8 to 25			
	COP², B0W35¹⁰	-	4,9			
	Active cooling power², B35W7	kW	-		6 to 22	
	EER², B35W7	-	-		5	
	Max. DHW temperature without support	ºC	63			
	Max. DHW temperature with support⁵	ºC	70			
	Noise emission level⁶,¹⁰	db	35 to 46			
	Energy label / ηs with average climate control¹⁰	-	A+++ / 187%			
OPERATION LIMITS	Distribution / Set heating outlet temperature range	ºC	10 to 60 / 20 to 60			
	Distribution / Set cooling outlet temperature range	ºC	4 to 35 / 7 to 25			
	Brine inlet temperature range	ºC	-25 to +35			
	Brine outlet temperature in cooling mode range	ºC	10 to 60			
	Refrigerant circuit pressure min / max	bar	2 / 45			
	Production / Pre-load circuit pressure	bar	0,5 to 3 / 1,5			
	Brine / Pre-load circuit pressure	bar	0,5 to 3 / 0,7			
	Maximum DHW storage tank pressure	bar	8 (only for ecoGEO C)			
WORKING FLUIDS	R410A Refrigerant load without HTR / with HTR	kg	1,7 / 2		2	
	Compressor oil type / load	kg	POE / 1,18			
CONTROL ELECTRICAL DATA	1/N/PE 230 V / 50-60 Hz⁸	-	✓			
	Maximum recommended external protection⁹	A	C16A			
	Transformer primary circuit fuse	A	0,5A			
	Transformer secondary circuit fuse	A	2,5			
ELECTRICAL DATA: SINGLE-PHASE	1/N/PE 230 V / 50-60 Hz⁸	-	✓			
	Maximum recommended external protection⁹	A	C50A			
	Maximum consumption², B0W35	kW/A	5,6 / 28,2			
	Maximum consumption², B0W55	kW/A	7,8 / 39,2			
	Starting current min/max⁷	A	6,1 / 15,7			
	Correction of cosine Ø	-	0,96 / 1			
ELECTRICAL DATA: THREE-PHASE	3/N/PE 400 V / 50-60Hz⁸	-	✓			
	Maximum recommended external protection⁹	A	C20A			
	Maximum consumption², B0W35	kW/A	5,6 / 8			
	Maximum consumption², B0W55	kW/A	7,8 / 11,2			
	Starting current min/max⁷	A	2 / 5,2			
	Correction of cosine Ø	-	0,96-1			
DIMENSIONS/WEIGHT	Height x width x depth	mm	ecoGEO B: 1060x600x710 · ecoGEO C: 1804x600x710			
	Empty weight (without assembly)	kg	B 185 · C 247	B 193 · C 255	B 185 · C 247	B 193 · C 255

1. Replacing or combining the geothermal collector with one or more ecoGEO AU12 aerothermal units. Refer to the ecoGEO AU12 aerothermal units manual for more detailed information.
2. In compliance with EN 14511, this includes the consumption of the circulation pumps and the compressor driver.
3. Considering brine and production flows of 2500 l/h.
4. Considering a heat ramp of 20ºC to 50ºC in absence of consumption.
5. Considering support provided by the emergency electrical resistor or the HTR system. Maximum DHW temperature with the HTR system can be limited by the compressor discharge temperature.
6. In compliance with EN 12102, this includes the acoustic insulation kit of the compressor.
7. Starting current depends on working condition of the hydraulic circuits.
8. The admissible voltage range for proper operation of the heat pump is ±10%.
9. Maximum consumption can vary significantly according to working conditions, or if the compressor's range of operation is restricted. Refer to the technical service manual for more detailed information.
10. Certification in process.

ecoFOREST
www.ecoforest.es

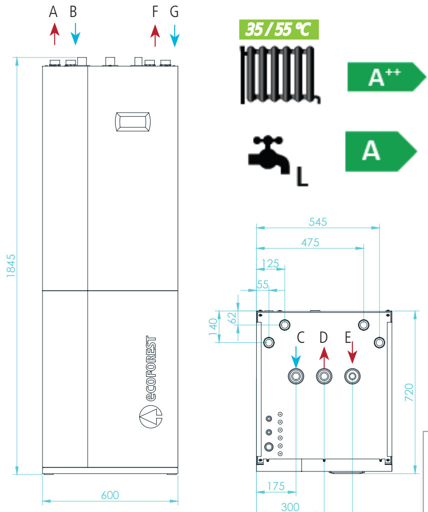
HEAT PUMP: ecoGEO 5-22

ecoGEO Basic

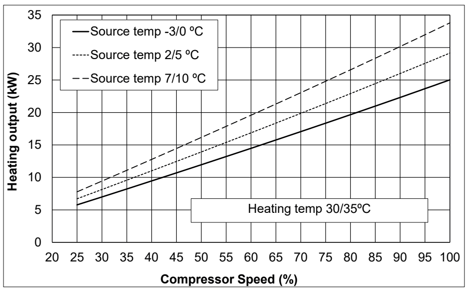


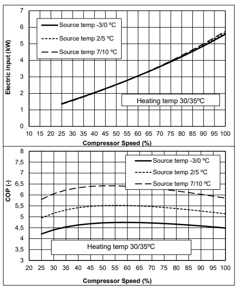
A. Heating/Cooling Outlet/1 1/4 "F
B. Heating/Cooling Inlet/1 1/4 "F
C. Brine Outlet/ 1 1/4 "F
D. Brine Inlet/ 1 1/4 "F
E. DHW Outlet/ 1 1/4 "F
F. DHW Inlet/ 1 1/4 "F

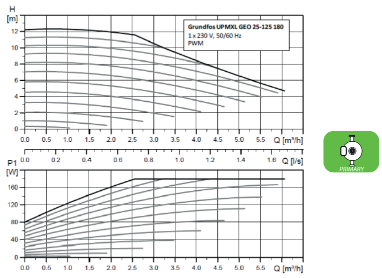
ecoGEO Compact

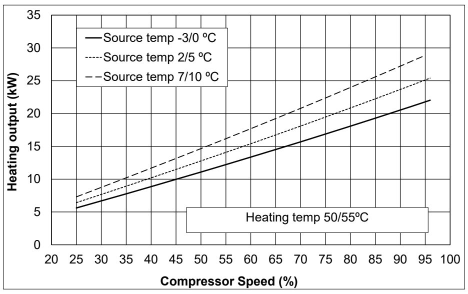


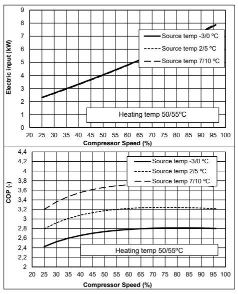
A. Heating/Cooling Outlet/1 1/4 "F
B. Heating/Cooling Inlet/1 1/4 "F
C. DCW Inlet/ 1 "F
D. DHW Outlet/ 1 "F
E. DHW Return/ 3/4 "F
F. Brine Outlet/ 1 1/4 "F
G. Brine Inlet/ 1 1/4 "F

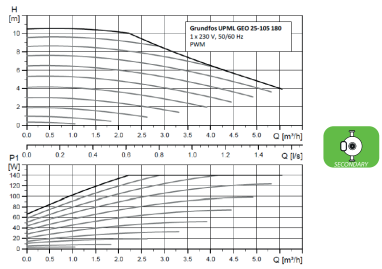


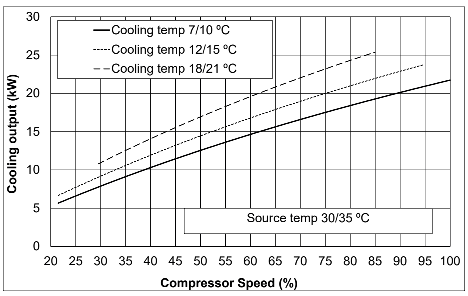


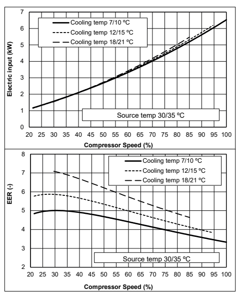


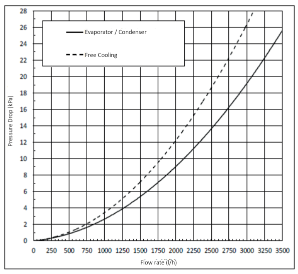












APPENDIX C

Ryedale Testing Design Stage SAP Reports

Note: Reports are automatically issued as 'DRAFT' by the SAP calculation software at design stage. Draft stamps are removed by the software at post-construction stage.

PREDICTED ENERGY ASSESSMENT

ryedale acoustic & air tightness TESTING

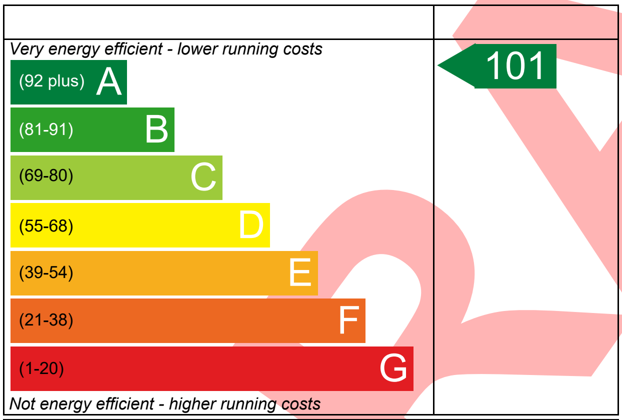
Lamb Hill,
Cornborough,
Sheriff Hutton,
YO60 65X

Dwelling type:	House, Detached
Date of assessment:	02/03/2021
Produced by:	Francesca Greenhalgh
Total floor area:	490.93 m²

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 SAP2012 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 (CO_2) emissions.

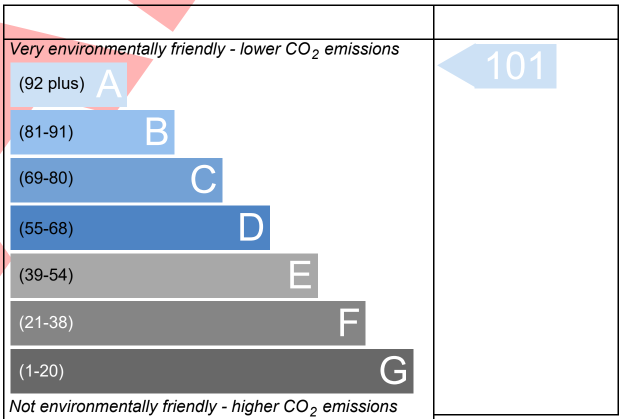
Energy Efficiency Rating



England — EU Directive 2002/91/EC

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



England — EU Directive 2002/91/EC

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.

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

ryedale acoustic & air tightness TESTING

Property Reference	3061	Issued on Date	02/03/2021
Assessment Reference	As Designed	Prop Type Ref	New Build
Property	Lamb Hill, Cornborough, Sheriff Hutton, YO60 65X		

SAP Rating	101 A	DER	-0.02	TER	23.63
Environmental	101 A	% DER<TER	100.08		
CO_2 Emissions (t/year)	-0.03	DFEE	56.22	TFEE	72.08
General Requirements Compliance	Pass	% DFEE<TFEE	22.00		

Assessor Details	Miss Francesca Greenhalgh, Francesca Greenhalgh, Tel: 07392 903643, francesca@ryedaletesting.com	Assessor ID	P130-0001
Client	Arthur Woodhouse		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	23.63	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	-0.02	$kgCO_2/m^2$	Pass
	-23.65 (-100.1%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	72.08	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	56.22	$kWh/m^2/yr$	
	-15.9 (-22.1%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.15 (max. 0.20)	0.15 (max. 0.35)	Pass
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Ground-to-water heat pump	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.