Lark Rise Passivhaus Plus house

by Laura Davila / 2018-06-06 13:53:55 / International / 11240 / EN

New Construction

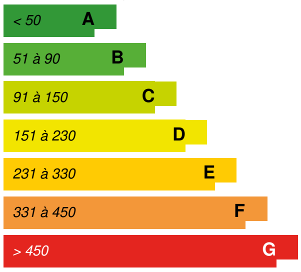
Primary energy need :

80 kWhpe/m².year

(Calculation method : Other)

ENERGY CONSUMPTION

Economical building *Building*



Energy-intensive building

Building Type : Isolated or semi-detached house
Construction Year : 2014
Delivery year : 2015
Address 1 - street : HP17 0XS AYELSBURY, United Kingdom
Climate zone : [Cfb] Marine Mild Winter, warm summer, no dry season.

Net Floor Area : 175 m² Other
Construction/refurbishment cost : 1 200 000 €
Cost/m2 : 6857.14 €/m²

Certifications :

Proposed by :

General informations

Lark Rise, the first Passivhaus Plus building in the UK, was rigurously designed and built by Bere Architecs in 2015 to test the viability of the concept 'house as power station' in a north European climate and to establish the potential for a cluster of similar houses to draw down energy from the National Grid.

Lark Rise is an ultra-low-energy, all-electric, contemporary and healthy certified Passivhaus Plus home. It is a detached two-storey, two-bedroom dwelling of 175m2 located on a North West facing slope on the edge of the Chiltern Hills in Buckinghamshire, England. It is partially prefabricated with heavyweight reinforced concrete retaining construction system to ground floor at garden level and prefabricated timber frame structure to first and floor at entrance level.

The main garden façade faces North West and is entirely glazed, with large windows and a terrace. Solar gains are limited because most of the glazing faces to the North West. Partially underground construction to reduce visual impact on a protected landscape area and northerly orientation certainly help to maintain stable and comfortable temperatures in Summer and Winter and help avoid summer overheating.

The house has been provided with a PV system on the roof designed to generate 12.4 kWp by means of 38 PV panels. The energy consumption and PV production data have been monitored and analysed for 1-year period between Oct-16 and Sep-17 and compared to a UK standard house and other Passivhaus projects achieving outstanding results.

Fully operational (with 13kWh battery storage), Lark Rise is expected to draw from the grid only 2% of the energy a similar sized standard UK house each year, while exporting 10 times this amount back to the grid each year.

See more details about this project

- https://www.bere.co.uk/architecture/lark-rise/
- http://passivhausprojekte.de/index.php?lang=en#d_5535
- https://www.bere.co.uk/research/lark-rise-monitoring-report/
- https://www.bere.co.uk/research/lark-rise-self-consumption-study/

Stakeholders

Contractor

Name : Sandwood Construction Ltd.
Contact : Richard Garland
http://sandwood.co.uk/

Construction Manager

Name : Bere Architects
Contact : Justin Bere (Justin.Bere@bere.co.uk)
https://www.bere.co.uk/

Stakeholders

Function : Certification company

MEAD: ENERGY &ARCHITECTURAL DESIGN

Kym Mead (kym@meadconsulting.co.uk)

http://www.meadconsulting.co.uk/
Passivhaus Plus Certification

Function : Environmental consultancy

Energelio

clement.castel@energelio.fr

http://www.energelio.fr/
Environmental Engineers that carried out the self-consumption analysis

Contracting method

General Contractor

Type of market

Realization

If you had to do it again?

We are doing it again for another client, using low-cost construction on a level site at 1/3rd of the cost.

Building users opinion

Very happy that the house is gaining so much interest around the world as a pioneering example that might one day be the norm.

Energy

Energy consumption

Primary energy need : 80,00 kWhpe/m^2.year

Primary energy need for standard building : 200,00 kWhpe/m^2.year

Calculation method : Other

CEEB : 0.0001

Breakdown for energy consumption : Heating: 22%
DHW: 10%
MVHR: 9%
Power sockets: 25%
Cooking: 5%
Miscellaneous: 9%
Lighting: 19%

Envelope performance

Envelope U-Value : 0,12 W.m^{-2}.K^{-1}

More information :
•Below ground walls: concrete basement retaining structure (250mm), exterior Foamed glass insulation (360mm). U-value= 0.118 W/(m2K)
•Above ground walls: Prefabricated timber frame, with mineral wool insulation (300mm), and larch rain screen cladding. U-value = 0.137 W/(m2K)
•Prefabricated Glulam box-beam ceiling, PIR insulation (280mm) and multi-ply hot-melt membrane, extensive green multi-ply bituminous membrane roof. U-value= 0.074 W/(m2K)
•PUR insulation (50mm) and screed with UFH and floor finishes on top of concrete slab (300mm) and foamed glass insulation below-slab (410mm) U-value= 0.076 W/(m2K)
•Passive House certified, insulated triple-glazed timber-framed windows & doors. Ug= 0.60 W/(m2K), Uf= 0.72 W/(m2K), g-value= 62%
•Entrance door: Bayer Passive House insulated timber-framed door. U-value = 0.81 W/(m2K)

Building Compactness Coefficient : 0,21

Indicator : n50

Air Tightness Value : 0,41

Users' control system opinion : It's an incredibly simple and robust building in use.

More information

Lark Rise consumption was monitored during 2 tenancy periods, user preferences can cause variations in the floating demand seen in the cooking and lighting levels, however, we would expect the miscellaneous circuit to show a relatively constant demand between tenancies because the circuits which are fed by the ‘miscellaneous’ submeter shouldn’t be greatly affected by user preference, however there was an unexpected consumption on the 'miscellaneous' circuit (pumps etc) during the second tenancy period. At present the cause of the variation in miscellaneous power demand is not known. However, the pump within the septic tank burnt out in November 2017, and it is possible that the increased consumption could be due to this.

Real final energy consumption

Final Energy : 42,00 kWhfe/m^2.year

Real final energy consumption/m2 : 42,00 kWhfe/m^2.year

Real final energy consumption/functional unit : 42,00 kWhfe/m^2.year

Year of the real energy consumption : 2 016

Renewables & systems

Systems

Heating system :

- Heat pump

Hot water system :

- Heat pump

Cooling system :

- No cooling system

Ventilation system :

- Natural ventilation
- Nocturnal Over ventilation
- Double flow heat exchanger

Renewable systems :

- Solar photovoltaic
- Heat pump

Renewable energy production : 200,00 %

Other information on HVAC :
Zehnder, Paul Novus 300
eff. specif. HRE: 91%
Maximum flow rate [m³/h] 300
Electric power input [W] 90
Sound power level [dB(A)] 43
Reference flow rate [m³/h] 210
Reference pressure difference [Pa] 50
SPI [W/(m³/h)] 0,22
heat exchanger

12kWp PV installation on the roof with a 13kWh battery store

Solutions enhancing nature free gains :
Since most of the glazing is sub-optimally oriented to face North West, it needed to be made from super-clear glass with a high g-value in order to maximise winter heat gains

Smart Building

BMS :
Very simply that the heat pump will heat the hot water to a few degrees above set temperature if there is excess sun.
The building use, PV production, battery storage and import or export can be seen in real time via the Tesla application on a mobile phone. This information is being used to tune the building and to decide what the next steps might be (e.g demand shifting or change of user habits eg switching off lights and IT and gaming equipment on standby.)

Smartgrid :
not yet applicable, but may follow

Users' opinion on the Smart Building functions : Interested in viewing the information provided by the Tesla app.

Environment

Urban environment

n/a

Products

Product

LIGNO TREND Roof system

Klimaholzhaus

Ralf Harder (R.Harder@lignotrend.de)

https://www.klimaholzhaus.com/construction/

Product category : Structural work / Carpentry, cover, titghtness

Load-bearing insulated CLT ceiling component

Good

Kaufmann Zimmerei und Tischlerei, Reuthe, Austria - first floor timber frame structure and finishes.

Shoeck Isolators for balcony connections

Costs

Health and comfort

Life Cycle Analysis

This is a very interesting topic, but not yet assessed for this building. On another similar project, but with 1/4 the generating capacity, we found that the embodied energy from the building's construction could be paid back in 60 years. This building is

Eco-design material : N/A

Water management

All waste water is processed on site using a low energy septic tank and zero energy natural water polishing system based on natural bacteria in a peat store.

Indoor Air quality

Other similar projects of ours have been independently monitored, tested and assessed with the conclusion that they provide optimal conditions with optimal RH generally around 40% with any peaks being flushed away within an hour by the heat recovery ventilation system. CO2 levels have been found to be optimal, generally between ambient external conditions and an upper level on occasions no greater than 1000ppm. F8 incoming filters have been found to control incoming pollen and particulates. Healthy construction using natural materials has been found in another project to result in a very low VOC count, both from the building construction materials and from household products.

Comfort

Health & comfort : The above indoor air and humidity conditions contribute to very healthy and comfortable conditions. Also both summer and winter temperatures have been found to be very comfortable, with negligible seasonal, daily or hourly fluctuations.

Calculated indoor CO2 concentration :
500-800ppm

Measured indoor CO2 concentration :
500-800ppm

Calculated thermal comfort : 21 degrees centigrade in summer and winter
Measured thermal comfort : approx 21 degrees centigrade in summer and winter

Acoustic comfort : The concrete construction with first floor screed floating on XPS insulation makes for an extremely comfortable acoustic condition.

Carbon

GHG emissions

GHG in use : 16,00 $KgCO_2/m^2/year$

Methodology used :
Indirect emissions from electrical power consumption are estimated in PHPP through the use of electrical emission coefficients in Germany (GEMIS)

Contest

Reasons for participating in the competition(s)

ENERGY CALCULATIONS AND PREDICTIONS (PHPP)
- **Certified Passivhaus Plus in 2017, PHPP values:**Air tightness n50 = 0.41/hAnnual heating demand 15 kWh /(m2a) calculated according to PHPPHeating load 11 W/m2Primary energy requirement 80 kWh /(m2a) on heating installation, domestic hot water, household electricity and auxiliary electricity calculated according to PHPP- **Energy consumption in final use**: 42.1 kwh/m2a**- Distribution of energy consumption: Heating 35%, DHW 30%, Power and lighting 35%- Systems energy efficiency: Thermal insulation, triple glazed windows, no air leaks, no cold bridges. · Below ground walls: concrete basement retaining structure (250mm), exterior Foamed glass insulation (360mm). U-value= 0.118 W/(m2K)**

· Above ground walls: Prefabricated timber frame, with mineral wool insulation (300mm), and larch rain screen cladding. U-value = 0.137 W/(m2K)

· Prefabricated Glulam box-beam ceiling, PIR insulation (280mm) and multi-ply hot-melt membrane, extensive green multi-ply bituminous membrane roof. U-value= 0.074 W/(m^2K)

· PUR insulation (50mm) and screed with UFH and floor finishes on top of concrete slab (300mm) and foamed glass insulation below-slab (410mm) U-

value= 0.076 W/(m2K)

· Passive House certified, insulated triple-glazed timber-framed windows & doors. U_g= 0.60 W/(m2K), U_f= 0.72 W/(m2K), g-value= 62%

· Entrance door: Bayer Passive House insulated timber-framed door. U-value = 0.81 W/(m2K)

- Airtightness: Air permeability at 50Pa, (AP50=Q50/Ae). air result changes per hour ACH@50Pa = 0.41- Heating and DHW System: Viessmann model VITOCAL 242 air-sourced heat pump with 220 litres buffer tank- Renewable Energy System:12kWp by means of 38 solar panel modules made by SunPower and installed at 10-degree angle to the horizontal.- Mechanical ventilation: Zehnder, Paul Novus 300 eff. specif. HRE: 91% Maximum flow rate [m^3/h] 300
Electric power input [W] 90
Sound power level [dB(A)] 43
Reference flow rate [m^3/h] 210
Reference pressure difference [Pa] 50
SPI [W/(m^3/h)] 0,22
heat exchanger
REAL IN-USE MONITORED ENERGY CONSUMPTION (1-year monitored period between Oct-16 and Sep-17)
- Real energy consumption in final use: 32.23 kwh/m2a- Distribution of real energy consumption: Heating 22%, DHW 10%, Power and lighting 68%-Real PV production (with export limit in local grid): 4487 kwh/a *expected PV production with batteries installed and no export limit in local grid: 11000 kwh/aCONCLUSIONS OF ENERGY PERFORMANCE ANALYSIS

F - Lark Rise has delivered 85% reduction in post-occupancy total annual energy consumption compared to a standard UK house.

- Fully operational Lark Rise (with battery store and un-throttled 12.4kWp PV production) is expected to deliver a 97% reduction in post-occupancy grid-load compared to a standard UK house of 85m2 and a 98% reduction on a per square metre basis.

3. - The annual total in-use grid import of Lark Rise (with battery store and un-throttled PV 12.4kWp production) is estimated to cost 592kWh x £0.182 = £107.74 for all uses (Nottingham Energy Partnership, Nov 2017).

4. - The annual total in-use grid export of Lark Rise (with battery store and un-throttled PV 12.4kWp production) is estimated to earn 6069kWh x £0.04/kW = £242.76.

5. - Lark Rise (with battery store and un-throttled PV 12.4kWp production) could potentially be fully autonomous if the indoor temperature was allowed to drop a little in November, December and January, such as might call for a pullover, combined with a big effort to cut lighting and miscellaneous power consumption. It would be interesting to test this hypothesis.

6. - Alternatively, Lark Rise could be fully autonomous if 141kg of seasoned logs were burnt in the living room log burner during November, December and January (an average of 1.5kg per day). (Nottingham Energy Partnership, Nov 2017). To purchase these, according to the same source, would cost £29.31. Alternatively, it would be interesting to consider how much woodland would be needed to sustainably harvest 141kg of seasoned logs per year, returning the ash to the ground to help fertilise the re-growth of timber.

7. - Alternatively, Lark Rise could benefit from a form of renewable energy that could reliably close the small winter gap, such as wind or tidal power.

8. - Once the battery has been installed, we will be able to assess how much excess solar-generated energy is available to power an electric car and when sufficient excess power is available for this, and to assess the potential for an electric car to usefully store energy not just for its own use, but for the benefit of the house and its occupants' needs.

Building candidate in the category

Energy & Temperate Climates

Low Carbon

Health & Comfort

Users' Choice

Date Export : 20230308213508