Forever green

A pair of Victorian townhouses has been renovated to meet the Enerphit Plus standard, set by the Passivhaus Institute, renowned for its exacting demands for energy efficiency.

Two period townhouses in Manchester are the first in Europe to achieve the toughest performance standards set by the renowned German Passivhaus Institute. Featuring graphene and a host of world-first technologies, the 125-year-old properties have achieved the Enerphit Plus standard, and outperform nearly all new builds - providing a template for renovating period buildings to a green agenda.

Renovated by eco consultants Ecospheric, the exemplar homes are designed to remain comfortable and warm year round without a central heating system, whilst maintaining good air quality. The properties combine the best of traditional British architecture with cutting-edge environmentally-friendly materials, saving their owners around £50,000 over the next 10 years with zero energy bills and minimal maintenance.

Photovoltaic panels on the roof power lighting and electrical appliances and heat the hot water tank - the first in the world with a thermocline control. Since the homes generate more power than they use, excess electricity can be sold back to the grid.

More than 100 pallets of insulation, predominantly made of recycled newspaper, help to maintain an even temperature year round, while for long hot summers like the one just gone, a thermostatically controlled roof light with rain sensor provides effective passive cooling.

Hidden in the roof build up, the vapour control membrane provides an airtight barrier while cactus-inspired technology keeps the fabric dry. Water used for hand washing is recycled to flush the toilets, and outside a sustainable urban drainage system (SUDS) made from recycled car tyres not only relieves pressure on land drains but keeps the drive weed free as well.

The properties have been specified with durable materials throughout. Graphene, the toughest material known to science and 200 times stronger than structural steel, has been formulated into the interior paints, while the wooden external cladding is 'pre-fossilised', making it resistant to rot and ultraviolet degradation. The copper guttering and downpipes are expected to last more than 100 years.

A discreet, central mechanical ventilation with heat recovery system (MVHR) cleanses airborne germs and particulates such as pollen and controls humidity, while breathable materials including lime plaster control humidity and minimise mould.

Ecospheric has exceeded the Passivhaus Institute's requirements by aiming for a petrochemical-free building fabric, focusing on natural, breathable materials that avoid harmful off-gassing.

> "Sustainable retrofit is critical to meeting the government's greenhouse gas emission targets."

Copper light switches and hand-brushed brass surfaces help to stop the spread of bacteria within the household while the electrical wiring in the homes minimise electromagnetic fields.

The rear living area has four-metre-high ceilings, with a wood-burning stove as the centre piece. While not required in a passive house it adds a little winter luxury, and by drawing its air from outside, avoids the drafts typically caused by chimneys and exacerbated by lighting fires.

The handcrafted kitchen is made from locally-grown timber and complemented by hand-brushed brass splashbacks, Welsh slate worktops and A+++ rated appliances. Other features include elaborate plaster cornicing and ceiling roses displaying refurbished LED chandeliers, gold-plated taps, cast iron roll top baths and marble floors.

"Ecospheric has achieved a pristine period finish, even incorporating stained glass in a passive house, which is a world first," says Martina Harrison from Fishwick Estate Agents which is marketing the properties. "From the street the building looks classically Victorian with its decorative path, cast stone steps and ornate porch. The only hint of the wealth of technology within is a subtle copper strip that blends into the traditional Victorian brickwork to disguise a super-insulated sidewall."

The houses have been renovated to a high standard.

GREEN FEATURES

- 11kW photovoltaics to produce more energy than the properties consume, supplied by Environmental Building Services.
- Airtight, mould free, solid lime plaster interiors capable of mopping up dangerous VOCs, setting down excess CO_2 and buffering moisture.
- Bespoke solid timber and brass kitchen with Welsh slate worktops and A+++ rated appliances, supplied by John George Fine Cabinetry.
- Unlacquered antibacterial copper electrical switches throughout.
- Graphene paints to prevent cracking. Supplied by Graphenstone.
- Copper rainwater goods with 120-year life.
- DibT wood-burning stove drawing air from outside the thermal envelope.
- Grey water recycling toilets from Sanlamere.
- Electromagnetic field-free design and LED lighting throughout.
- Windows angled towards the sun to maximise solar gains.
- Thermostatically controlled roof light with rain sensor for passive cooling supplied by Fakro.
- Breathable roof featuring intelligent membrane by Siga.
- Sustainable Urban Drainage featuring recycled tyres and stone by Sudstech.

The luxury homes have high levels of insulation so that central heating isn't required. Water is heated by solar power, and waste water used to flush the toilets.

"What really struck me is the meticulous attention to detail and the simple fact that so many of the property's features work better than what we consider 'normal'. All that coupled with no maintenance or bills is a very exciting step forward in technology and we look forward to seeing more properties heading in this direction."

Ecospheric MD Kit Knowles adds: "Period semi-detached properties represent a huge portion of the UK's housing stock, yet they are one of the trickiest formats to upgrade. It's critical that planners, architects and builders explore and define appropriate methods to tackle them. The UK housing stock of today will account for over 80 percent of the stock in 2050. New build solutions do not tackle this; sustainable retrofit is critical to meeting the Government's 2050 greenhouse gas emission targets."

Passivhaus Trust chief executive Jon Bootland said: "The properties combine the beauty and character of a period property with the world's highest standards of energy efficiency and are a great addition to the UK's Passivhaus portfolio."

THE SPEC

FRONT WALLS 110mm Victorian facing brick; 38mm cavity; 13mm Fermacel; 145mm Steico I-joists with Steico Floc blown cellulose in between; 80mm Steico Protect Dry; 10mm Thermalime plaster. **U-value: 0.175 W/(m²K)**

SIDE WALLS 14mm Therma lime render; 80mm Steico Protect Dry; 240mm Steico I-joists with Steico Floc blown cellulose in between; 250mm double layer of Victorian wire-cut bricks with finger cavity; 10mm Thermalime plaster. **U-value: 0.116 W/(m²K)**

OUTRIGGER WALLS Organowood cladding; Facade membrane; 300mm Steico I-joists with Steico Floc blown cellulose in between; Proclima Intello Membrane; 15mm gypsum plasterboard and skim. **U-values: 0.132 and 0.116**

BASEMENT FLOOR/FLOOR SLAB Pine chevron or tiles with grout; 18mm Magply magnesium board; Proclima Intello Membrane; Steico I-joists/original floor joists with Steico Floc blown cellulose in between; 80mm Steico Protect Dry. **U-value: 0.133 - 0.165**

ROOF Hook fixed slate on battens; Siga Majcoat; 60mm Steico Special Dry; 145mm - 300mm Steico I-joists mounted on 75mm original rafters with Steico Floc blown cellulose in between; Siga Majrex membrane; 15mm gypsum plasterboard and skim. **U-value: 0.108 – 0.148**

FRAME Viking Windows by Ecospheric. Triple-glazed timber windows with Uw-value 0.68-0.72. Features stained glass, curved units and traditional door conservation profiles. **Uw-value = 0.68 W**

GLAZING Saint Gobain Ug ranges: 0.45-0/62. **g-value = 1 %**

ENTRANCE DOOR Viking Windows supplied by Ecospheric Windows & Doors Ltd. Triple-glazed timber doors 0.68 - 0.8. Features stained glass, traditional mouldings and french doors. **Ud-value = 0.8**

MVHR Paul Novus 300 system (93-94 per cent heat recovery).

HEATING 2kW electric post heater on Paul Novus 300 MVHR system. 5kW DiBT accredited 78 per cent efficient log-burning Stove for backup (heat input not included in PHPP calculations).

DOMESTIC HOT WATER Mixergy 300L tank with smart controls. Electricity fed from PV on roof via Solar i-Boost.