

Retrofitting towards our Dream Home - Hills Road, Cambridge



Property Overview

Year built: 1929

Location: Hills Road, Cambridge

Property type: Detached house

Timeline: 2022-2023

Meet your hosts: Stuart & family

I'm Stuart and I'm an engineer by background. I sold materials selection software for many years and then moved onto machine learning software for R&D through which I became familiar with many aspects of home energy, insulation and eco-materials. Inspired by what I had learned, I took the plunge last year and joined the sector at [Midsummer Energy](#), a wholesaler of solar, batteries and air source heat pumps (ASHP), as Head of the Sustainable Heating Division.

My wife and I purchased the house in 2016 for our family of four. Shortly afterwards, I got involved with local groups such as Cambridge Carbon Footprint, [Transition Cambridge](#), and the local [AECB](#). I went to many Open Eco Homes events and local AECB meet ups in order to learn as much as I could. This led me to find a suitable architect and builder for our renovation project. Our dream was to live in a well-insulated, well-ventilated, healthy home with lower bills and no use of fossil fuels. It's been a journey of significant change and upheaval but overall, we're very happy with the result and the house is much nicer to live in. We are pleased to be able to share our experience and learning with others.

The Renovations

We bought the house knowing that we wanted to renovate and extend it to create a warm, comfortable home with improved living spaces and a much better layout, especially for the kids' bedrooms. I also wanted to significantly reduce our heat loss, improve indoor air quality and lower our carbon emissions by getting off gas completely and electrifying our home and car.

A significant part of the work involved extending over a patio and an adjoining garage/workshop to improve the living space. In opting for a full renovation and extension we wanted to go for the [Passive House Enerphit standard](#), with the [AECB standard](#) as a fall back. It took three to four years to develop the initial design through to the final design as my ideas changed and evolved the more I learned.

Due to the house having a good overhang under the eaves, we were able to add 150mm of external wall insulation (EWI) made up of Kingspan Kooltherm PIR layered with an EPS insulation board and then rendered. We removed the existing roof insulation and reused it between the floorboards, which helps with acoustics; in its place, 200mm of glass fibre and PIR insulation was added in between and under the rafters.

We wanted to achieve a high level of airtightness so we used airtightness tape and paint over quite a lot of the joints throughout. We also used Passive Purple (an airtight, liquid, vapour-controlled membrane) in the roof. Triple glazing was added throughout the house. As a result, the airtightness was significantly improved, enabling the insulation to work effectively and Mechanical Ventilation and Heat Recovery (MVHR) to be fitted. In later airtightness tests, we did not quite meet the Enerphit standard, but we did achieve the AECB Retrofit Level 2 standard.



Stuart & family

At a Glance

Challenges

- Finding a builder with experience of Passive House requirements
- Achieving the target airtightness
- Sourcing our desired roof system was not straightforward, leading to late changes in roof material choice & design, delaying other parts of the project

Benefits

- Reduced energy required for heating
- Better indoor air quality
- Upgraded kitchen, bathrooms & bedrooms; improved layout
- No more gas, saving 22,000 kWh pa
- Extremely comfortable home



External wall insulation

Interestingly, as soon as you reduce heat loss and the energy used for heating, you become far more aware of the energy required for hot water, so we added a Showersave wastewater heat recovery system too. Whilst we could maintain the room temperature at 20°C before the retrofit, the floors remained at a stubborn 12°C (hence constant cold feet!) and we suffered from draughts due to poor performing PVC double glazing. We are very glad to have left all this behind.

Performance

The house is now excellent to live in!

- Very comfortable, constant internal temperature; no cold floors
- We are delighted we no longer burn gas
- Our indoor air quality is noticeably better
- The house is much quieter: you can't hear traffic at all
- The performance data shows it has been very good so far.

Energy costs vs savings

Financial considerations were reasonably important in deciding to go ahead. We were looking for good value in whatever we chose to do i.e. not necessarily the cheapest but decent quality at a reasonable price. I didn't calculate the payback period. There's quite a lot of discussion on the payback of retrofit, but few people would consider 'return on investment' when putting in a new kitchen or redecorating – it's done because we want to live in a better and more comfortable home. The fact that you can calculate a payback on retrofit is just an added bonus.

Co-benefits

- The house is much better to live in: my other half is finally warm!
- I expect the house to be worth more should we decide to sell it; in the meantime, my family can benefit from living in a much more comfortable home for many years having made the investment.
- I'm working with [Parity Projects](#) to monitor heating performance over two winters (6 room temperature sensors, flow sensors on the ASHP).
- I'm also working with [Homely](#) (who sell the ASHP controls) to experiment with improved control of the ASHP e.g. by co-ordinating the ASHP with PV production for financial savings.

Conclusions

I'm very happy with the work done. While there are minor bits here and there that could have been better, the project involved significant effort and cost, and overall it's been very worthwhile. I hope the market for eco-materials will grow, bringing down costs and improving availability. Long term, we hope the house can be used as an eco case study to encourage others, just as I have been encouraged and educated by those who have already retrofitted their homes.

Future Plans

I need to switch my focus to monitoring performance and finding ways to optimise energy use, cost, carbon footprint and water usage. I hope to share the data so that others can benefit from my experience.



Back garden & extension

Key features

Complete retrofit & double extension to 1929 home
Extensive insulation to walls, underfloor & roof
8kW [Samsung HT Quiet ASHP](#)
5kW [SolarEdge](#) inverter
5kW [Clearview](#) log burner as backup (unused)
[Zehnder MVHR](#)
[Triple-glazed doors & windows](#)
[Showersave](#) waste water heat recovery system
8.5 kW [Hyundai](#) solar PV system
Full electrification of the home & car

TOP TIPS

- Start with DIY: get an air tightness test, find the leaks & fix them. Insulate your loft, hot water tank, hot & cold water pipes
- Measure things (water usage, gas usage, electricity usage) to work out what to prioritise. Borrow a thermal camera from [Cambridge Carbon Footprint](#) (CCF)
- Get involved with groups who know about retrofit: the [AECB](#), architects, [Grand Designs](#), [National Self Build & Renovation Centre](#) in Swindon, [NESTA's 'Visit a Heat Pump'](#) events, CCF. Attend talks, meet ups, tours & events to learn more.
- If you can, move out of the house during renovation works

Professional Contacts

Architect & Retrofit Coordinator: [Margaret Reynolds](#)
Heat Pump supplier: [Infinite Heating & Energy](#)