

Towards Decarbonisation: A Home Living Lab

- Experiences of an Early Adopter



Property Overview

Property age: 1975
Project timescale: 2003 to present
Type: Semi-Detached
Wall type: Filled cavity wall
Floor area: 119 m² (includes converted garage)
Cost of eco renovations: £30k+
Occupants: 3 adults

Meet your host, Peter:

Since 2003, I've been working to decarbonise our family home through the early adoption of energy efficient building services. Back then, I wanted a low energy home, but also more space to work from home. It now turns out that our family of three all tend to work or study at home for some of the week. The key features of my eco renovations include:

- Topping up loft insulation.
- Replacing all the 30-year-old PVC double glazed windows with new, energy efficient ones in April 2022; the patio doors and back doors were upgraded a few years earlier.
- Installing low energy lighting throughout the house.
- Adding high specification heating controls: the [Tado smart thermostat](#) enables me to control the temperature of each room individually, thus making further energy savings.
- Renewable heat generation: in mid-April 2022, our 30+ year old gas boiler was removed and replaced with a [Tepeo Zero Emissions electric Boiler](#) (ZEB) which is connected to the existing wet radiator system and utilises the cheapest available low carbon electricity to heat the radiators and store the heat until it is required. This means we are now no longer on gas.
- Installing solar thermal panels in 2003, giving us plenty of hot water for appropriately six months of the year during the summer period.



1 of 2 EV chargers

My top tips:

- Take a whole house approach towards decarbonising your home, linking it with any planned improvements & extensions.
- Think "Fabric First" to ensure you have made energy efficiency improvements to the fabric of the property wherever possible.
- Every property is unique, so ask around! Seek expert advice on what might be the most suitable building services (heating, ventilation, solar PV, battery storage) to install in your property.
- Consider different types of energy tariffs, their flexibility & potential standing charge savings to be made if going off mains gas.

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- Renewable electricity generation: a total of three solar PV arrays were installed at the back of the house facing nearly South. The first array (2.6kWp) was installed on the pitched roof in November 2011; the second array (1.2 kWp) was added in February 2012. Each array has a separate inverter and fortunately, I was able to take advantage of the government's feed-in-tariff scheme at the time. The third array was installed in April 2022 above the conservatory roof attached to a wall and is connected to the existing inverter of the 15 kW home battery storage system that I've had since November 2019. This battery storage system is designed to store surplus electricity generated from the Solar PV array for use in the home or sent to the national grid when export prices are high. Alternatively, the battery can also import electricity from the national grid when prices are low for use in the home or stored and later sent back to the national grid when export prices are high again.

- In November 2020, I bought a Nissan Leaf Electric Vehicle (EV) to replace my 13-year-old petrol car. Two EV charging units are now in place: the first, an open source unidirectional charger, was installed as part of the Carbon Co-op Powershaper project to test out its operation with a Home Energy Management System (HEMS) that is accessible via my laptop computer using the "Home Assistant" App; the second, was provided by Wallbox, a Wallbox Quasar bi-directional to beta and field test, and sends stored electricity in the EV battery to the Home (V2H) or back to the national grid (V2G).

Despite all these changes to our home, we have made very few lifestyle changes, including not changing the time that the main meal is cooked on the electric cooker. However, we do try not to use high energy appliances all at once!

Performance

With the exception of the home battery storage system, all our eco renovations have performed well. For example, in the 12 months up to April 2022, my 2 solar PV arrays (totalling 3.8kWp) generated about 3,200kWh of electricity p.a. Since a third solar PV array (2kWp) was added at the end of May 2022, I expect to generate an additional 1,450kWh p.a. of electricity.

Although I sometimes charge the electric car when I am at home, I have also taken advantage of a lot of free public EV charging points, including a local supermarket that offered free 50kW rapid EV charging during this period.

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Key Specifications

Energy Consumption (year to April 2022)	Energy kWh/m ² /pa			Carbon kgCO ₂ e/pa	
	Gas	Electricity	Total	/m ²	/person
Before Renovation	58.8	42	101	18.7	742
After Renovation	None	TBC	TBC	TBC	TBC

Insulation & Glazing

- Loft insulation topped up
- New energy efficient windows

Heating & Energy

- Solar thermal
- 3 solar PV arrays (5.8kW/p) connected to 15kW battery storage system
- Tepeo Zero Emissions electric Boiler (ZEB) connected to wet radiator system
- Tado smart thermostat radiator valves
- 2 EV charging units: 1 with V2H & V2G capability
- Low energy lighting

It is important to remember that every house is different and has to be considered individually. As an early adopter, I have sometimes taken the risk and bought some building services in the hope that they will serve my needs. So far, the main difficulty I have had is with the home battery storage system - the supplier and the manufacturer turned out to be behind in the latest developments and showed a lack of willingness to adapt their system e.g. utilising flexible tariffs.

Future Plans

My focus now is on the software development of the optimisation, interoperability and integration of the various building services.

Key Contacts, Products & Advice:

Additional Loft insulation £200 (2012)
 15kW battery storage system £9,998 (Nov 2019)
 Solar PV array (2kWp) & installation *£2,300 (April 2022)
[Tepeo Electric Zero Emission Boiler \(ZEB\)](#) & installation;
 incl removal of old gas boiler £6,500 (April 2022)
[N&C Glass](#) Double-glazed windows, £6,618 (April 2022)

All costs include VAT, except where *zero rated;
 prices valid at the time.

