# EPC Case Study

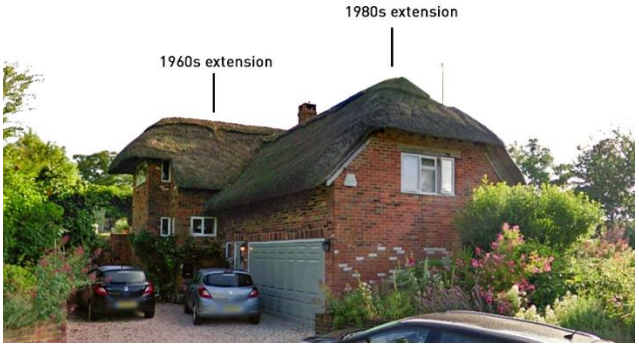
Last year a major renovation of a four-bedroom house in Hampshire was competed, and a new EPC rating obtained to see whether the works done impacted the rating. During the course of the assessment, the assessor was interviewed about the ratings process.

This exposed some major flaws in the EPC process: the condition of buildings is ignored; improvements to the structure that cannot be seen by the assessor are assumed not to have been done; electric heating is severely penalised and some of the recommendations made are unsuitable and possibly even illegal.

## Background

The house is a four-bedroom detached house in rural Hampshire built into a sloping site meaning there are four separate levels to what is essentially a two-storey home. The oldest parts of the house date to at least the early 1800s if not before and have solid exterior walls which were at one time timber-framed.


The house was modernised and extended in 1966, and in 1986 a significant gable extension was added creating a bedroom, double garage and small utility room. The 20th century extensions were all standard cavity-wall construction except for a small timber-clad, flat roofed dormer-style extension which housed the bathroom (prior to 1966 there were no indoor bathroom facilities).




The house has a thatched roof and is supplied by mains gas and electricity. Water is supplied from a local borehole and there is a septic tank for waste. In the early 2000s, uPVC double glazed windows were installed as well as a set of French doors (which for some reason lacked a lintel).

The most recent renovations included:

- Conversion of the integrated garage into usable living space (larger utility room, cloakroom and study);
- The replacement of the bathroom dormer extension with a new single-storey first floor bedroom extension which is timber-framed and thatched with external tile cladding;
- Some internal re-modelling to combine rooms;
- Full replacement of the thatch and replacement of roof timbers on the oldest parts of the house;
- New flooring downstairs including electric underfloor heating and insulation (the lack of foundations in the older parts of the house precluded the installation of a wet system);
- A new gas-fired boiler, new hot water tank and new radiators were installed to provide hot water and heating for the upstairs of the house;
- An air-conditioning system with heating capabilities were installed in all major rooms excluding the kitchen and study;

- All windows and doors were replaced. The new windows are double-glazed and external "stable" style doors have been replaced with either double-glazed French doors or engineered oak doors with appropriate draught exclusion;
- The open fire in the living room was replaced with a large wood-burning stove, the unsafe stove in the snug was replaced and a new stove was added in one of the bedrooms which has a fireplace;
- The gas-fired Aga was retained and a new gas-fired range added to increase cooking capacity. The Aga is connected to the hot water tank and provides continuous hot water. In the summer, all the hot water needs are met by the Aga;
- The entire house was re-wired and all lighting replaced with LED lighting.

Timber frame extension under construction (left) and completed (right)

## Previous rating and report

Previously the house had an EPC rating of D with a potential rating of C, based on an assessment carried out in 2015. The main recommendations were the introduction of internal or external wall insulation (which has not been done); the addition of floor insulation on both suspended and solid floors (the solid floors have been insulated and underfloor heating installed); replacement of lights with LED lights (done, although interestingly only one of the bedrooms had lights, lamps were the only source of artificial light in the other three bedrooms), the addition of heating controls and thermostatic radiator valves (individual thermostats have been installed in each room with underfloor heating but there is only a single thermostat for the radiators); and the installation of a wind turbine (this has not been done and there are no plans to ever do so).

| Recommended measures | Indicative cost | Typical savings per year | Rating after improvement |
|---|---|---|---|
| Internal or external wall insulation | £4,000 - £14,000 | £ 123 | D63 |
| Floor insulation (suspended floor) | £800 - £1,200 | £ 56 | D65 |
| Floor insulation (solid floor) | £4,000 - £6,000 | £ 132 | D67 |
| Low energy lighting for all fixed outlets | £115 | £ 71 | C69 |
| Heating controls (thermostatic radiator valves) | £350 - £450 | £ 64 | C70 |
| Wind turbine | £15,000 - £25,000 | £ 530 | B81 |

The suggestion that a wind turbine should be installed is inappropriate for this property. The house is located in a conservation area within the South Downs National Park – the installation of wind turbines is not a permitted development in national parks, and as no other house in the region has one, it seems unlikely that permission would be granted.

Also, given the size of the plot and the position of the house within the plot, the only place a free-standing wind turbine could be cited and meet the distance-to-boundary regulations is right in the middle of the back lawn! Finally, the report cited the cost of such a wind turbine to be £15,000-£25,000 - a very wide range - with a potential energy saving of just £530 per year. On that basis it would take between 28 and 47 years to repay the capital cost!

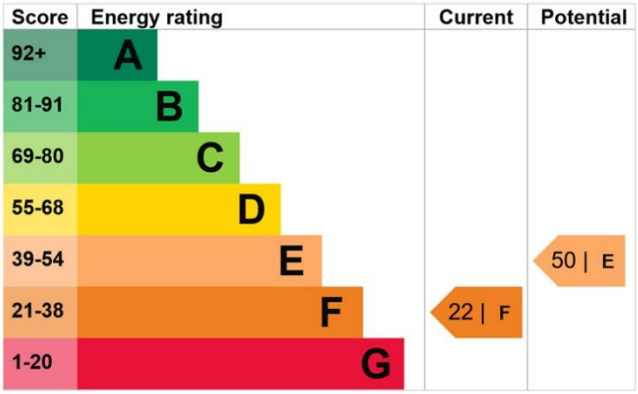
The inclusion of such an unrealistic recommendation that might not even be allowed for this particular house undermines the credibility of the process and also the accuracy of the potential rating.

The same planning issues apply to the recommendation to install wall insulation – being in a conservation area, external cladding requires planning permission, and internal cladding might create condensation issues since the old part of the house was built using methods that envisaged a degree of breathability that would be impeded by the addition of cladding.

Even the recommendation to install floor insulation is somewhat dubious. The rooms do not have generous headroom, but the absence of foundations means excavating to make room for insulation is structurally undesirable. A small amount of headroom was sacrificed in order to install insulating mats beneath the underfloor heating, with limestone tiles or engineered wood flooring on to finish.

## New rating and report

Amazingly, the new rating is an F!




The report indicates that the estimated annual energy cost for the property is £3,256 and implementation of the recommendations would result in a potential saving of £820.

What the report fails to mention explicitly is that a capital outlay of **£23,500 - £46,000** would be required, which would take between **28 and 56 years** to pay back.

**Recommendation 1: Cavity wall insulation**

Cavity wall insulation

| | |
|---|---|
| **Typical installation cost** | £500 - £1,500 |
| **Typical yearly saving** | £105 |
| **Potential rating after carrying out recommendation 1** | 23 \| F |

**Recommendation 2: Internal or external wall insulation**

Internal or external wall insulation

| | |
|---|---|
| **Typical installation cost** | £4,000 - £14,000 |
| **Typical yearly saving** | £348 |
| **Potential rating after carrying out recommendations 1 and 2** | 29 \| F |

**Recommendation 3: Floor insulation (solid floor)**

Floor insulation (solid floor)

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|---|---|
| **Typical installation cost** | £4,000 - £6,000 |
| **Typical yearly saving** | £366 |
| **Potential rating after carrying out recommendations 1 to 3** | 36 \| F |

**Recommendation 4: Wind turbine**

Wind turbine

| | |
|---|---|
| **Typical installation cost** | £15,000 - £25,000 |
| **Typical yearly saving** | £676 |
| **Potential rating after carrying out recommendations 1 to 4** | 50 \| E |

According to the assessor, the methodology penalises electric heating significantly, the only exceptions being certain models of air-source heat pumps that feature on an approved list, and the very top-of-the-range storage heaters. This is because the EPC is fundamentally a cost assessment and not an emissions assessment, and electric heating is more expensive than gas heating.

The addition of flooring insulation could not be included as it could not be seen by the assessor, although the receipts from its purchase were available for inspection. According to the assessor, this would only improve the EPC score by an insignificant 2 points, although the report suggests a 7 point difference, and the replacement of the lighting to fully LED (previously only 4% of the lights were LED) also made little difference.

After the report was made available, the assessor was contacted for further discussions on the floor insulation after it appeared as a new recommendation. According to the assessor, he has only had two occasions in six years where floor insulation was able to be credited retrospectively, and in each case the home-owner was able to lift up floorboards so it could be inspected. In the test house, the assesspr was subsequently showed photographs of the insulation being installed, and offered to get the builder and architect to confirm the installation. Whether the rating can be updated remains to be seen as this may trigger an audit.

Apparently the same applies with cavity wall insulation, where filling the cavity with insulation will only be credited if it can be directly inspected by drilling a hole in the wall, or by providing the installer's guarantee.

The recommendations still include exterior cladding and a wind turbine. According to the assessor, this is due to the classification of the property: houses are categorised as heavy urban, urban or rural, and the software makes these recommendations by default for rural properties irrespective of any listed building status (which this house does not have) or being located in a conservation area or national park, which this house is.

According to the assessor, it is rare for such properties to obtain planning permission for these types of improvements, and he added that very few people install interior cladding – in his experience only people on low incomes with poorly rated houses who qualify for grants that cover the entire cost of the work ever install internal wall insulation.

It is worth noting that under the Planning (Listed Buildings and Conservation Areas) Act 1990, it is a criminal offence to carry out or cause to be carried out any works to alter or extend a listed building in any manner which would affect its character as a building of special architectural or historic interest. This means that installing external cladding to a listed building without having permission to do so is illegal.

The assessor photographed the dated labels on the inside of the window frames in case the U-values were better than the default, and measured the wall thicknesses, but otherwise the only measurements taken were of the floor area.

Even if all of the recommendations were followed, the best potential rating is only E, the minimum at which a property could be rented out. According to the Government:

> "The cost cap: you will never be required to spend more than £3,500 (including VAT) on energy efficiency improvements. If you cannot improve your property to EPC E for £3,500 or less, you should make all the improvements which can be made up to that amount, then register an 'all improvements made' exemption."

This would not even fund the first two recommendations, and in reality, it might be more cost-effective to simply install new radiators connected to the gas boiler and disconnect the underfloor heating. This would most likely cause the rating to revert back to its previous level of D, but is the opposite of the current direction of travel on energy policy away from gas central heating.

### A system open to "dreadful abuse"

During the assessment, the assessor was asked a number of questions about the process:

**The previous EPC report states that physical condition is not taken into account. Is that still the case and how far does that go?**

That's still the case…we don't check condition at all. You could have a pane missing from the window and still get the points for double glazing. We also don't look at gaps round the windows or anything like that.

**Other than measuring the floor area and wall thickness, do you take any other measurements for example air-pressurisation tests?**

No, we never do pressurisation tests.

**Does the presence of register plates in chimneys make any difference?**

Chimneys are considered "open" if there is an opening of 100cm$^2$ or more, which tends to be the case for open fires even if there's a register plate and fire hood. We sometimes see old fireplaces in the bedrooms of older houses and each one has to be included in the calculation separately.

**Apart from double glazing, do you consider the style of doors, for example are solid doors better than hollow doors, and are stable doors treated differently?**

Insulated doors with a U-value sticker on the side are given credit, but otherwise doors are treated the same. You can have an old warped stable door with a huge gap in the middle and it's treated the same as a new glazed door. Also, a door might only be one of 20 doors and windows so although a new front door might make a noticeable difference in terms of draught reduction it would only be about 5% of the score for windows and doors so wouldn't even show up as a recommendation.

**How do you look at the different heating systems?**

The primary heating source is the one which is most used, so in this house it is electric underfloor heating, in 60% of the property and gas for 40% or so. The secondary heating would be from the wood-burners and I just note the presence of air-conditioning on the report. Normally I look at whether there are obvious signs of use with wood-burners for example ash in the bottom.

Because most of the hot water comes from the Aga, that is the primary source of hot water.

**What do you think of the quality of the recommendations? Is the capital cost taken into account?**

Some of the recommendations are really unsuitable like the wind turbine and external cladding, and you can also get condensation issues if you're not careful with cladding on older houses. The upfront cost isn't taken into account. The new reports are not as detailed as the previous one for this house, but I thought they were listed in order of cost, but it doesn't look like it.

**What do you think about the EPC system overall?**

I think it's open to dreadful abuse. Back in around 2016 I was doing a lot of ECO work where installers were paid based in tonnes of $CO_2$ saved by installing insulation. I went to a block of flats to do a new EPC but didn't think they needed one since that flats were quite new, but they told me what they had was all wrong. Their EPC said they had electric heaters because that showed a bigger $CO_2$ saving but actually they had a boiler and all gas heating. It was filled out wrong so the installer could make a fraudulent claim.

I also see mistakes, so in one house the rating went from E to G because the previous assessment had said it was on mains gas when actually if used LPG, which pretty much automatically put it to the bottom of the scale.

The size and type of property makes a huge difference so any post 1960s mid-terrace with a decent boiler and loft insulation will automatically be a C because having two party walls there's a smaller heat-loss perimeter. Having solar panels also makes a huge difference, probably ¾ of a grade.

Age is also important. Houses build between 1983 - 1990 are assumed to have partial wall insulation and houses built between 1990 – 2002 are assumed to all have wall insulation, but there were loads of houses built in the 1990s with no wall insulation at all.

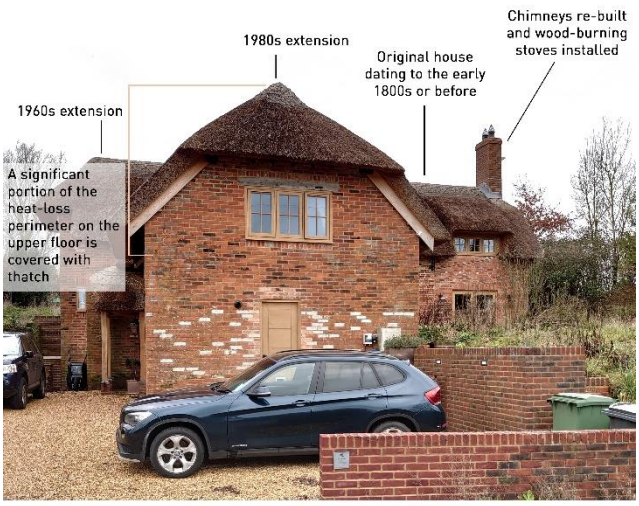
I'm quite surprised by how much the rating for this house has gone down, but the calculation really punishes electric heating. It can be really off though – people with thick cobb walls say their houses are really warm but the calculations suggest otherwise, and I know of one house where the guy's only heat source was a wood-pellet boiler. The house was freezing but his score was really good because basically the Government loves anything with wood because the carbon savings are so high.

## EPC is unfit for purpose and should be reformed

The EPC appears to be a very blunt tool. The test house is significantly warmer and less draughty than it was before the renovations, primarily due to improvements in its condition, but no credit is given at all to this in the EPC methodology. A broken window is as good as an unbroken window in the EPC method when clearly in real life that is not the case.

The specifics of the structure also matter. The test house has a thatched roof, and, in common with many thatched properties, a large portion of the heat-loss perimeter on the upper level is made of thatch since bedrooms are within the eves. This means that a good portion of these walls has a significant amount of insulation that is completely ignored by the calculation.

Penalising electric heating is a major flaw against a backdrop of policy drivers away from gas heating. In fact, if the EPC methodology is not changed, the Government will be unable to both promote electric heating and achieve EPC ratings of C or better for the majority of houses unless they are forced to install air-source-heat pumps from the approved list.





Impractical recommendations undermine consumer confidence in the ratings system. Recommendations should be realistic, so suggesting improvements that require planning permission which is unlikely to be obtained because a building is listed, or located within a national park or conservation area is unhelpful. The recommendations should also make economic sense – suggesting capital-intensive projects with pay-back periods spanning several decades are unlikely to be adopted.

A wider range of properties should be examined, but based on this very limited case study, the following improvements to the process can be proposed:

- Take the condition of buildings into account so that improvements to the condition which reduce energy use are credited;
- Carry out an air-pressurisation test, a thermal imaging survey and thermometric analyses on buildings to identify the actual thermal properties of the structure and identify areas of heat loss (while façade U-values cannot be measured directly, they can be derived from thermal imaging and thermometric testing which involves measuring internal and external air and surface temperatures);
- Re-calibrate the calculation methodology so electric heating is not penalised in order to align with de-carbonisation targets;
- Ensure recommendations are realistic and cost-effective, and that acceptable proof that the works have been carried out is identified in the report, so that all improvement works are credited and to avoid undermining public confidence.