

Retrofit strategies

Key Findings: Retrofit project team perspectives

Analysis of a selection of
Retrofit for the Future projects



Institute for Sustainability

Retrofit strategies

The Institute has partnered with the UCL Energy Institute (UCL-Energy) on an independent analysis of the UK's leading domestic retrofit demonstrators: the Technology Strategy Board's £17 million Retrofit for the Future (R4tF) programme. Eight projects consisting of ten houses were selected from 25 R4tF projects in London based on their social and economic diversity.

This summary is one of four based on a series of interviews with Project Teams working on R4tF projects as part of the wider analysis. This summary focuses on the employed retrofit strategies.

In general terms the retrofit strategies used by the sample R4tF Project Teams fell into one of four approaches outlined below. It is fairly well accepted that "fabric first" is the most effective strategy for retrofit and those identified below all followed variations on this approach.



A home undergoing retrofit

Strategies employed within the sample projects

All but one of the consortia identified a high-level strategy with one of the following approaches. In reality, these approaches are not mutually exclusive and some of them are quite similar.

A. The whole-house approach

A whole-house approach (also known as whole-house systems approach) regards the building as an energy system with interdependent parts. The approach was used on one of the eight sample projects (Case A) and considers the interaction between the occupant, building site, climate, and other elements or components of a building. In this approach the features and performance of any one component are strongly affected by the rest, and energy performance is considered a result of the whole system.

B. The "fabric first" approach

The "fabric first" approach was used on three of the eight sample projects discussed here (Cases B, C and G).

- This approach prioritises improvement of the thermal properties of the building fabric through the use of high levels of thermal insulation and airtightness.
- A range of measures is then employed to increase the efficiency of various systems (e.g. heating and hot water, lighting and electrical appliances). System re-sizing may be desirable as a consequence of reduced energy demand, but oversizing (e.g. of heat distribution systems) can significantly improve overall performance.
- Finally, renewables are installed to meet the remainder of the CO₂ and energy reduction requirements.

C. Passivhaus strategies

The Passivhaus standard for energy efficiency for buildings was used in two of the eight sample projects (Cases D and H). The application of this German-developed standard (which can be considered as a high-specification "fabric first" approach with an enhanced Quality Assurance element), reduces the ecological footprint of a building and results in ultra-low-energy buildings that require little energy for space heating or cooling. The Passivhaus standard for central Europe requires that the building fulfils the following requirements:

- The building must be designed to have an annual heating demand, as calculated with the Passivhaus Planning Package, of no more than 15 kWh/m² per year for heating and/or cooling energy, or be designed with a peak heat load of 10 W/m².
- Total primary energy consumption (source energy for heating, hot water and electricity) must not be more than 120 kWh/m² per year.
- The air permeability of the building must not exceed 0.6 air changes per hour at 50 Pa.¹

D. "Insulate then generate" philosophy

This approach, which is very similar to the "fabric first" approach, first aims to reduce energy demand from passive design strategies (building fabric, thermal mass and airtightness, ventilation and heat recovery), and then to meet the remaining demand through the use of microgeneration technologies.

Insulation solutions and thermal bridging

Insulation strategies need to be suited to the property in question and the performance requirements being sought. Issues of insulative value, thermal bridging, disruption to the occupants, aesthetics of the outside of the property and loss of space from the inside of the property all impact on which solution will be most appropriate for a given application.

¹The pascal (symbol: Pa) is the SI derived unit of pressure.



A home being insulated

Key issues

- External wall insulation can impact on poorly constructed extensions, eliminating some thermal bridges while creating others. Handling such issues demands a clearly thought through retrofit strategy, sufficient funding within the project budget and careful engagement with occupants.
- Internal insulation is a more difficult option to install, especially in limited spaces. It is, however, an option that must be used in particular situations where properties are located in conservation areas, in the case of strict planning restrictions and if occupants do not wish to alter the external appearance of their property (e.g. Cases A and E).
- Solid floors are often not insulated due to the disruption involved. While various products currently exist on the market, all involve the complete removal of the floor covering.

Recommendations:

Based on the sample projects, external wall insulation is regarded as a successful solution to insulating “hard-to-treat” properties, as it is considered to be less disruptive and thus a more viable option than internal insulation when undertaking the retrofit of blocks of houses. It also minimises thermal bridging, and can improve the appearance of some properties.

- For internal insulation, manufacturers and suppliers must provide more specifications for a large number of architectural details.
- For external insulation, the following details must be adequately planned for:
 - Eaves: in the case of external insulation, eaves must be extended to accommodate the extended facade. To achieve this, bespoke solutions developed on site were used. For future retrofits “clip-on” eaves extension solutions could enable this to take place more easily (Case B).
 - Windows: positioning of windows needs to be considered to maintain facade appearance and light levels within the internal space. It is important that high-quality and sufficiently informative detailing is provided to ensure that the window–wall–insulation interfaces are correctly handled (Case A).
- Where there are stringent planning constraints, more acceptable external insulation solutions should be developed to allow increased applicability. These should ideally aim to decrease the thickness of current external insulation materials and more closely replicate existing finishes.
- Product development in the area of solid floor insulation is required to develop new technologies, as the issue potentially affects a large number of properties.
- A defective floor makes insulation considerably easier, using straightforward approaches and materials. Project Teams should be alive to such opportunities.

Ventilation and airtightness strategies

There is a complex range of choices in ventilation systems and strategies that can be used when retrofitting properties. The key technologies and strategies that were used in the sample projects were mechanical ventilation with heat recovery (MVHR), continuous mechanical extract ventilation (MEV), positive input ventilation (PIV) and passive stack ventilation (PSV).



MVHR ducts

Key issues

- MVHR can significantly reduce energy consumption; however, it requires a high level of airtight construction (permeability less than about $3 \text{ m}^3/\text{m}^2/\text{h}$), which can be difficult to achieve in retrofit homes.
- A high-quality MVHR installation needs room for generously sized ducts and heat exchangers and for sound attenuation, and to allow for maintenance. In smaller properties there is a risk of energy and acoustic performance being compromised by not having enough space to install the system properly, or the system being disliked by the occupants for taking up sparse storage or floor space. It is also relatively expensive to install, unless used in conjunction with air heating as an alternative to a wet central heating system; this, however, can reduce the realised efficiency of the MVHR installation.
- At intermediate levels of airtightness, simpler strategies such as continuous MEV or PIV may deliver lower CO_2 emissions at lower capital cost than MVHR. PIV, in principle, delivers lower energy use than MEV by recovering heat from attic spaces and using it to help heat the home. But careful attention to insulation and airtightness in retrofits should mean that there is little heat available in the attic spaces to usefully recover, which will reduce the system's effectiveness.
- Both MVHR and PIV filter the air supply; but PIV may be less effective at controlling internal sources of air pollution than MVHR or MEV, unless used with local extractor fans.
- PSV has the advantages of being silently operable and not requiring electricity. However, it may not provide such close control of air change rates, and thus may result in more heat escaping the home and higher heating fuel demand. It may require fan assistance in summer to manage any overheating, and be less effective in controlling external noise than the other strategies.

Recommendation:

Project Teams will need to undertake full feasibility assessments of these technologies in terms of the expected post-retrofit airtightness of the building fabric, and the space requirement and availability, to determine their suitability for individual retrofits.





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