GUIDE TO LOW CARBON REFURBISHMENT OF DOMESTIC PROPERTIES

Introduction

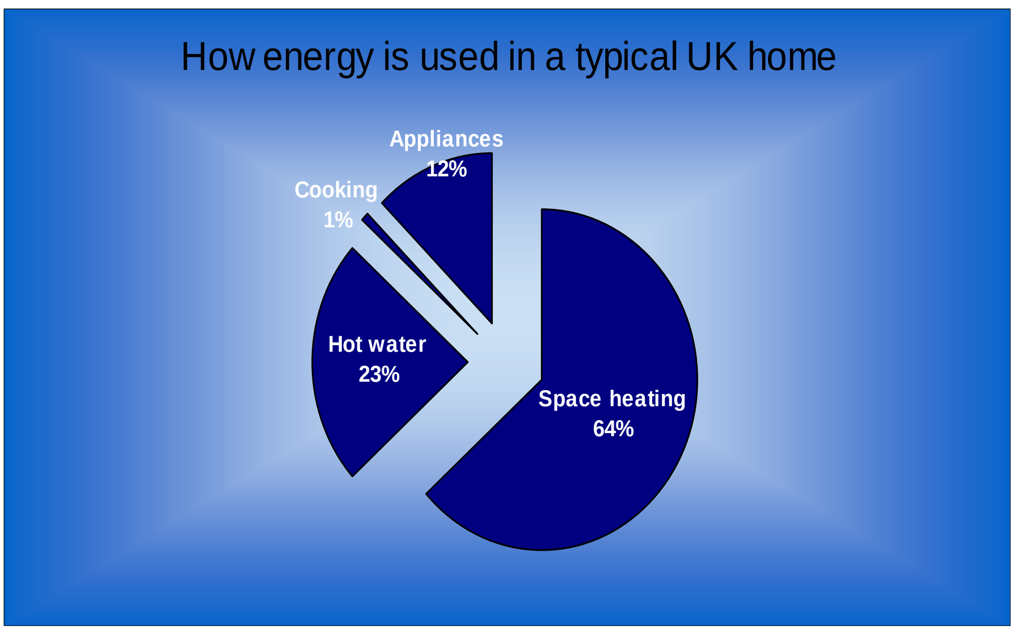
Refurbishing older properties to modern standards of carbon emissions is generally a major project and is often more challenging than building a low carbon home from new.

This is because until 1975 energy performance didn't feature at all in building regulations, and it's only since 2005 that serious attention has been paid to ensuring properties are designed and built with minimising carbon emissions as a high priority.

Before 2005 not only were design rules relatively light, enforcement was also relatively lax. This means that many homes were not even built to the standards then in force. In particular, many properties have higher rates of ventilation than are strictly allowed by regulations: this is typically due to poor detailing (for example gaps around window and door frames) which can be very difficult to correct without wholesale reconstruction.

Prioritising areas to target for action

The main contributor to carbon emissions in most homes is space heating, which accounts for over 50% of emissions in most homes built before 2002 (see diagram).



Emissions from heating will be highest if you use (non-green) electricity or oil, and still substantive if you use gas. They will be relatively low if you use green electricity (although this is expensive) or biomass.

Two approaches to refurbishment

There are two ways to approach a refurbishment project.

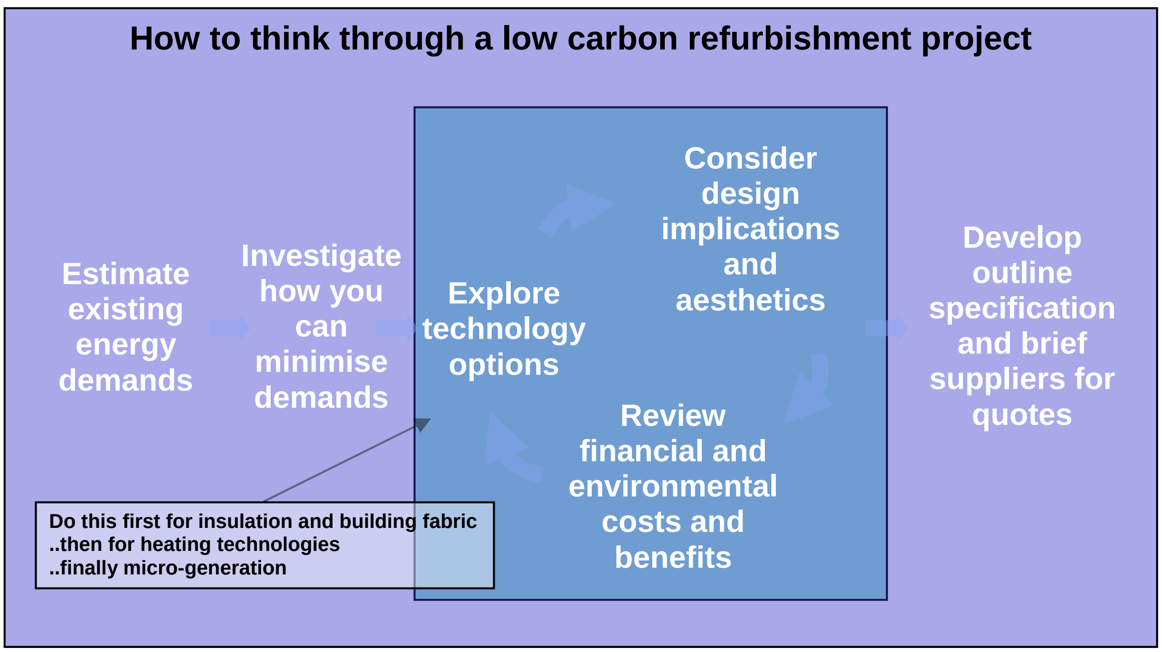
1. Progressively.
2. As a single major project.

A progressive refurbishment might take place over a number of years, and would be paced to minimise disruption and allow you to manage cash flow. A good example of this approach is the Victorian refurbishment project example on the Encraft website at http://www.encraft.co.uk/Homeowner/Examples/Inspiring/Victorian.php.

The disadvantage of the progressive approach is that savings take longer to realise. It may be more expensive overall as you need to bring in multiple contractors and sometimes compromise or repeat parts of the work. On the other hand, you have time to learn and adapt your plans as you go along, and risks are minimised.

A single major project has the advantage of being more efficient and delivering quicker results. It allows you to design and implement an integrated system without having to compromise around existing fittings and infrastructure. The downside is that if you get things wrong you are committed and it is difficult to change mid-stream, so if you go down this route it pays to invest time up front thinking things through.

A logical approach
The diagram below sets out a structured process for approaching refurbishment projects.



As with all energy projects, you should start by making sure you have minimised energy demands and taken all the easy, non-technical steps to reduce consumption of energy. This means thinking seriously about questions such as:

1. What is a comfortable temperature for living rooms?
2. Does this need to be he same throughout the building, or could we maintain some areas at lower temperatures and/or use timer controls?
3. What levels of lighting do we really need?
4. Have we got energy efficient lighting and appliances installed wherever possible?

Once you've defined these parameters, you can begin to look at technical ways to meet your requirements as efficiently as possible.

You should do this in order:

1. **Air leakage**

   Can you reduce air leakage through draught proofing, closing off redundant chimneys etc. You need to heat all the air passing through your house, so the more leakage there is the more expensive your house is to heat and the higher your carbon emissions. There is a trade-off here, as a reasonable level of ventilation is required to maintain air quality. However, modern homes are generally specified with around a third to a quarter of the air leakage of homes built before 1990, so there is plenty of room for improvement in general.

2. **Building insulation.**

   Can you increase wall, roof, floor insulation, or improve glazing specifications?

   By doing this you will reduce the amount of energy you need to put into the building to achieve the same levels of comfort. You will also reduce the size of heating plant you need to heat the building, so you will save twice: one on the capital costs of heating equipment, and then again in the running costs of the building for its lifetime.

3. **Energy and resource efficiency**

   Do you have the most energy efficient appliances fitted? Are you making best use of waste heat? Are there opportunities to recycle water and capture rainwater?

4. **Heating and hot water**

   How are you going to deliver heat into the building? Can you capture heat from the sun and use natural or mechanical ventilation to distribute it through the building? Do you want under floor heating, radiators, warm air systems or stand-alone heaters?

   In general, wet under floor heating will give you more options on the heat source, as it works well with both heat pumps and traditional boilers. Heat pumps can use radiators but generally need about 50% more than a boiler system of the same rating. This is because they work better at lower temperatures and need more surface area to get he same amount of heat into the house.

   The main heating unit can vary from a single boiler or heat pump to supply all your heating and hot water, to a range of technologies working in combination.

For example, in some cases you might use a wood-fired boiler as the main heating plant, supported by a smaller oil or gas-fired boiler and solar thermal systems. The fossil-fuel fired boiler will only be used to meet sudden peaks in demand, and the solar system will provide hot water in summer so you don't nee to use the main boiler at all. This kind of combined system is generally efficient to run as you can use the most suitable technology for the conditions and demands as they vary, but it is inevitably expensive. You would typically include a thermal store so that all the systems supply at to a central point which distributes it to the places that need it.

For larger projects where there is a significant summer heat demand (e.g., a heated swimming pool) you might also consider combined heat and power (CHP). This is an efficient way of using waste heat to generate electricity locally, and can be very economic in some circumstances.

5. Micro generation

On site generation of electricity is possible using wind, solar or water power, as well as CHP systems.

Wind turbines generally don't work well near buildings or trees, where a lot of energy is lost through turbulence. If you have a clear wind site nearby – like the top of a hill or a large field – you can in principle size a turbine to generate as much energy as you want. A typical domestic property will need a turbine of the order of 2.5kW on a good site to offset all its electrical demand – this would go on a 11m pole or mast (telegraph pole height) and be connected to the grid so you can use the national system to smooth out peaks and troughs. A typical 2.5kW turbine has a rotor diameter of 3-4m.

Beware with wind though –performance is highly site specific and can easily reduce by a factor of 3-10 if you get the siting wrong.

Solar systems need to be sited on unshaded sites, ideally sloping at 35-40 degrees in the UK and facing south. Like wind, you would normally connect into the grid to allow you to smooth out peaks and troughs in supply. For all micro-generation systems it is possible to design stand-alone systems with batteries to give you an independent power supply, but this will normally cost around 25-30% more and you will need to think through your design requirements (e.g., how much reserve power you need).

Hydroelectric systems are very economic on the right sites, which are generally in hilly areas where there are streams with good flow rates and reasonable heads (distance through which the water falls through the turbine). A reasonable head would typically be more than 3m except on the larger rivers. Civil engineering costs can be very significant, so if you have an existing millstream, for example, the economics are much improved. Hydro schemes can last 50-100 years. If you suspect this is viable on your property, it is worth exploring first as the benefits of a viable scheme will almost certainly be significant.