Last month we looked at the embodied carbon of the products used in the building of a house. As has become common practice, the word ‘carbon’ is being used here as a shorthand for greenhouse gas emissions. So the embodied carbon of a product is a measure of the greenhouse gases emitted during the varied processes by which Nature’s raw materials are transformed into the product.

Also of interest is operational carbon. This is a measure of the emissions that result from the occupation of a house – both the direct emissions, from the burning of gas or oil, and the indirect emissions, from the use of grid electricity. From 2016, the regulated portion of the operational carbon required for a new house will have to be zero, or negative. (See ‘Zero Carbon’, below.) To achieve this, the house will have to be capable of generating a lot of electricity – usually by means of PV panels.

With the operational carbon so drastically reduced, the embodied carbon of the structure of the house becomes much more significant. Let’s have a look at some examples where an intent to reduce embodied carbon can have design implications.

**Building with bricks**

Most bricks are made of fired clay, as they have been for millennia. Firing requires high temperatures, and results in fairly high embodied carbon. (A table in last month’s article gives the embodied carbon of brick as 400 kgCO$_2$ per cubic metre.) Sandlime bricks are made by a very different process, by heating a mixture of sand and lime under pressure in an autoclave. This results in the formation of calcium silicate – by which name the bricks are also known. These bricks look very different to fired clay bricks, and are usually a uniform, light colour. They have about half the embodied carbon of fired clay bricks.

Two decades ago, there were four plants around the UK making sandlime bricks – unfortunately the last one ceased production last year. The bricks are now imported from the Continent where their use is quite widespread. (See Further Info.)

Concrete bricks are another alternative. They are fairly good imitations of clay bricks, and are popular in some parts of the country. Concrete has a poor image in the eco-world because the production of cement results in 5% of global carbon emissions. But a table in last month’s article showed that aggregates have a tiny amount of embodied carbon, so a mix of cement and aggregates results in a moderate figure for the embodied carbon of concrete. In short, concrete bricks have about half the embodied carbon of fired clay bricks. (Likewise, concrete roof tiles are likely to have about half the embodied carbon of clay roof tiles.)

Fly ash bricks are available in some countries, though not in the UK – these bricks have little embodied carbon. (Fly ash is the fine ash recovered from the flue gases of coal-fired power stations.) In the UK, fly ash is used in the production of some blocks, and in some concrete mixes.

**Building with straw**

Straw is a by-product of growing grain. There is a lot of it about, and it’s cheap. Like timber, it is produced by the extraction of carbon from the atmosphere, so it can be seen as a carbon sink.
For more than a decade, straw bales have been used in the UK for building external walls, thereby making the most of two useful properties of straw bales – they are good insulators and they are quite good load-bearers. Some two storey dwellings have been built with the roof supported solely by bales – though usually a timber frame is incorporated for a two-storey dwelling, and sometimes for a single-storey one, too.

Some commercial builders were building with straw many years earlier. From the Fifties onwards, a company called Stramit turned straw from East Anglia into compressed strawboard (Easiwall) for building internal walls. Nowadays these panels would be seen as having excellent eco credentials, but manufacture of the panels ceased in the mid Eighties. Now the boards have to be imported, currently from France.

But perhaps Stramit will have a resurgence in the UK. Bill Dunster (the architect of the BedZed development in London) offers StramitZED house designs that can attain Code Level 6. And I’ve heard that Stramit production may start again in the UK next year.

**Zero carbon**

“When I use a word,” Humpty Dumpty said in rather a scornful tone, "it means just what I choose it to mean – neither more nor less.”

– Through the Looking Glass, by Lewis Carroll.

In 2007, the Labour government announced that housing built from 2016 onwards would have to be ‘zero carbon’:

“Zero carbon means that, over a year, the net carbon emissions from all the energy use in the home would be zero.”

– Building a Greener Future: policy statement.

At the time, I thought this intention for all new homes was unrealistic, and so it has proved. But it shook up people in the building industry, and has produced in them a different mind-set. Previously, eco-building was seen as a fringe activity for enthusiasts. Nowadays, much of it is main stream.

The present government came to power proclaiming they would be the greenest government ever. As such, they would lose face if they scrapped the Labour government’s commitment to the zero-carbon target. What they have done is to make the target easier to attain by redefining ‘zero carbon’.

Alongside the budget last March, the government launched its ‘Plan for Growth’. This states that the zero-carbon target will now apply only to the carbon emissions currently regulated by the building regulations, ie, to the emissions resulting from space and water heating, ventilation and lighting.

As we saw in the pie chart of last month’s article, more than a third of emissions in a newly built house are unregulated emissions due to electrical appliances and cooking. These emissions are now outside the scope of the ‘zero carbon’ definition.

There is still some uncertainty about the final definition of ‘zero carbon’. The Zero Carbon Hub is a quango set up to facilitate the delivery of zero carbon homes, and it is currently engaged in drawing up a framework for ‘Allowable Solutions’. These off-site measures will be allowed to compensate for on-site emissions.
(Allowable Solutions are likely to be much more relevant to the building of housing estates than to individual selfbuilds.)

Eventually, it is likely that we (the English) will fudge our way through to some sensible, progressive regulation. (The Scots, and perhaps the Welsh and Northern Irish, are developing their own approaches to the issues.)

**Carbon tax**

In the carbon budget announced last May, the government made a commitment that by 2025 the UK would have halved its carbon emissions (compared to 1990 levels). Sooner or later, the UK will follow the lead of other countries and introduce a carbon tax on fossil fuels. Such a tax will result in the polluter paying for carbon emissions. (Most of us are blithely unaware of the emissions that are an implicit consequence of our purchases.) By increasing the price of fossil fuels – the main source of harmful emissions – the tax will help to reduce the consumption of fossil fuels.

Doubtless, a carbon tax will initially be set at a modest level, but rise thereafter. In his book, *Sustainable Energy*, David MacKay suggested a tax of £65 per tonne of CO$_2$e. (David MacKay is now Chief Scientific Advisor to the Department of Energy and Climate Change.) What would be the effect of such a carbon tax on fuel prices?

**Carbon emissions of domestic energy sources**

A helpful table which shows the emissions of various fuels is given on the Carbon Trust website. The following table is based on their figures:

<table>
<thead>
<tr>
<th>Emissions (kgCO$_2$e)</th>
<th>per kWh</th>
<th>per litre</th>
<th>per tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid electricity</td>
<td>0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>0.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>0.21</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Burning oil</td>
<td>0.25</td>
<td>3,160</td>
<td></td>
</tr>
<tr>
<td>Wood pellets</td>
<td>0.04</td>
<td>184</td>
<td></td>
</tr>
</tbody>
</table>

**Carbon emissions for fuels**

Applying a carbon tax at MacKay’s suggested rate of 6.5p per kgCO$_2$e would result in domestic energy being taxed as follows:

<table>
<thead>
<tr>
<th>Carbon tax (Pence per kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid electricity</td>
</tr>
<tr>
<td>Natural gas</td>
</tr>
<tr>
<td>LPG</td>
</tr>
<tr>
<td>Burning oil</td>
</tr>
<tr>
<td>Wood pellets</td>
</tr>
</tbody>
</table>

**Suggested carbon tax on domestic fuels**

ACCOUNTING FOR CARBON 3 NOVEMBER 2011.
At this point, I’ll repeat the exhortation I made last year for another tax rise. I’ll know a government is seriously committing itself, rather than committing unknown future governments, when it abolishes the preferential tax status of domestic fuels, ie, when it raises VAT on gas, heating oil, and electricity from 5% to the standard rate (currently 20%).

**Carbon tax on road fuel**

Readers may also be interested in the effect of the suggested carbon tax on the price of petrol and diesel. From figures on the Carbon Trust website, the following table can be derived:

<table>
<thead>
<tr>
<th>Emissions (KgCO₂e)</th>
<th>Carbon tax (Pence per litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per kWh</td>
<td>Per litre</td>
</tr>
<tr>
<td>Petrol</td>
<td>0.24</td>
</tr>
<tr>
<td>Diesel</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**Suggested carbon tax on road fuels**

However, there is already a hefty tax on road fuels – road fuel duty. This is currently 59p per litre, which over-shadows the suggested carbon tax on road fuels (15p and 18p).

For most people, the introduction of a carbon tax is not necessarily bad news. With a new source of revenue, the Government would be able to reduce other taxes, eg, VAT. In this rebalancing of taxes, there will be some winners and some losers. Selfbuilders who build homes with low or zero carbon energy requirements will be amongst the winners.

**Energy prices to rise?**

Over the next decade, I foresee the following factors affecting the price of energy:

- Increased demand.
  Though the demand for fossil fuels in the Western World may be peaking, all the new consumers taking up Western life styles in newly affluent ‘Third World’ countries will increase global demand.

- Limited supplies of gas and oil.
  Easily accessible reserves are being exhausted, and it will become increasingly difficult and costly to exploit new reserves.

- Raising capital.
  In the UK, the grid is to be progressively decarbonised, and this will require huge investments in off-shore wind power, nuclear power, or whatever, and in the grid itself.

- Taxes.
  A carbon tax is likely to be introduced in the UK, and VAT on domestic energy raised to the standard level.
So the heading of this section requires no question mark. Energy prices will rise. My guess is that they will have doubled in real terms within a decade. Build for the future. Make your new home as energy efficient as you can.

Build yourself a low or zero carbon home!

FURTHER INFO:

Building with Straw Bales: A Practical Guide for the UK and Ireland
By Barbara Jones (Founder of Amazon Nails). Published 2009. £15.

Hye Oak Group Ltd
Importers of calcium silicate bricks. www.hyeoak.co.uk.

PD Edenhall Ltd
Manufacturers of concrete facing bricks. www.pd-edenhall.co.uk.

StramitZED
A partnership between the ZEDfactory and the Stramit Technology Group. They offer designs for affordable Code Level 6 houses. www.stramitzed.co.uk.

Stramit Technology Group
Manufacturers of Stramit Strawboard and Stramit Cassettes. www.stramit.co.uk.

Zero Carbon Hub
www.zerocarbonhub.org.

Carbon Trust
www.carbontrust.co.uk.

Amazon Nails
UK centre for straw-bale building. www.amazonails.org.uk. (NB – single ‘n’.)

Also of interest:

Puzzolana Green Bricks
– in India.

Calstar products
– in USA.
Bricks made from fly ash – 85% less embodied carbon than fired clay bricks. calstarproducts.com.

Words: 1903.

© Copyright article by Robert Matthews in SelfBuild & Design magazine, November, 2011.