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**Gathering Data**

In their second article on embodied carbon, **Stephen Finnegan** and **Mal Ashall** discuss the true cost of sustainable technologies

# Gathering data

In 2012, RICS developed a methodology to calculate the embodied carbon of construction materials issued as an information paper. A guidance note is due for release later this year, with a Code of Practice and practice statement also likely to be published. This RICS guidance will then become mandatory.

In *Construction Journal* April/May, we considered embodied carbon and carbon accounting. Here we investigate how the existing guidance could be expanded on to assess the true carbon cost of new sustainable technologies.

It is considered that between 85% and 97% of the buildings in existence within the UK in 2006 will remain in use in 2050. To meet the government's demanding carbon reduction targets set for that year, the majority of these buildings will need to consider sustainable refurbishment of some form or other.

In an ideal situation, all buildings would take a 'fabric-first' approach and apply passive design rather than relying on technical solutions. In reality, a large number of buildings will require an 'embodied carbon intensive' technical solution. How significant is this stage, and can the new RICS guidance be expanded on to include all sustainable technologies?

## What is embodied carbon?

For a building, 'embodied carbon' refers to the manufacture, transport, use, construction, maintenance and end of life of materials and products used in it. It therefore represents the supply chain of every component used.

The main sustainable technologies commonly considered for providing so-called renewable or low carbon off-grid electricity, hot water and heat to our buildings are:

- **wind turbines:** wind turns blades linked to a generator to produce electricity
- **solar thermal:** sun's rays heat a transfer fluid and provide hot water
- **solar PV:** sunlight is captured by photovoltaic cells and converted into electricity
- **micro-hydro:** relies on a water flow to turn blades or turbines to produce electricity
- **biomass:** the burning of organic material to produce heat

- **ground source heat pump:** extracts heat from underground to provide low grade heat
- **air source heat pump:** converts ambient outside air into useful heat.

Many of these technologies are approved by the government via the Carbon Trust Energy Technology List for Green Deal and Energy Companies Obligation funding. But are they truly low carbon over their lifetime use?

### Example 1: solar PV

When considering the life cycle carbon impact of manufacture, transport, construction, use maintenance and end of life of solar PV, results are highly variable. On average, the UK receives around 700kWh-1,000kWh of solar energy per $m^2$ per year. At this level of intensity, projections are that a solar PV system would take five to seven years before the energy lost in the embodied stage is 'repaid'. This is more commonly referred to as carbon payback.

However, solar PV can last for more than 25 years, and as more panels are manufactured and more efficient photovoltaic systems produced, the energy payback is expected to be reduced. Solar PV therefore looks like a low carbon solution. But what happens if parts of the PV cells become inactive over time or are inadequately maintained or serviced? Is a 25 year plus operational cycle likely?

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### Example 2: ground source heat pump

This solution requires considerable groundworks because pipes are buried to extract heat from the ground. Some studies indicate that the carbon paybacks of ground source heat pumps are two to five years. Industry examples demonstrate that this is completely unrealistic, and in reality much longer paybacks are likely. There are a large number of variables that can change the payback calculations, and there is no universally accepted method of life cycle assessment.

As can be seen by these two examples, there is a need to develop a standard form of assessment and to consider both the embodied and operational carbon impact of all common sustainable technologies approved by the government as low carbon solutions.

## RICS guidance

RICS is at the forefront of this initiative, and its guidance is the first stage in developing a framework, methodology and assessment. There are a large number of variables, and each sustainable technology will face a different set of bespoke challenges.

However, we believe that this guidance can be used as a precursor to a new approach. A mandatory RICS practice statement will encourage all new developers to disclose information on the full embodied carbon of materials used in the construction process. By providing an additional set of benchmarked conversion factors for the common types of sustainable technologies, users of the practice statement can also report on the embodied carbon of technologies they are considering. This provides a more holistic review.

If embodied carbon for sustainable technologies is not considered, then we are not able to assess the true embodied carbon of a building. More advanced low carbon technologies with increasingly sophisticated systems are under development in the form of ground source heat pump aquifers or solar panel tiles and slates. What is the embodied carbon impact of new manufacturing processes? Where are these products manufactured? How are they transported? Are they providing a truly low carbon solution?

## Recommendations

Our first recommendation is to include a new set of benchmarked conversion factors for all of the common sustainable technologies. There are numerous methods for the calculation of embodied carbon for construction materials, which with the introduction of certified figures could be expanded on to compare sustainable technologies. The European Standards Technical Committee or Building Research Establishment may be willing to undertake this task, and certify the process. This would provide some level of standardisation and a means of appraisal.

Leading on from this, our second recommendation is to develop a simple life cycle assessment of the most frequently deployed sustainable technologies, with transparent data based on worked examples. This would provide the industry with a common set of reference points. Something similar to the BRE *Green Guide to specification* or the University of Batch ICE database would be a good starting point.

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