

## Book review

### Embodied Carbon: The Inventory of Carbon and Energy (ICE). A BSRIA Guide

Professor Geoff Hammond and Craig Jones (edited by Fiona Lowrie and Peter Tse). University of Bath with BSRIA, Bracknell, UK, 2011, ISBN 978 0 86022 703 8, £60, 136 pp.

Professor Geoff Hammond and Craig Jones, from the Sustainable Energy Research Team (SERT) at the University of Bath, are the team behind the Inventory of Carbon and Energy (ICE), which has been providing an online source of data for embodied energy and carbon of construction materials since 2006. Three characteristics of the Inventory of Carbon and Energy have led to it becoming the most widely quoted information source in embodied energy and carbon studies in the UK.

- The data are rigorously researched by individuals who took the time to understand the subtleties and complex issues of 'lifecycle analysis' (LCA), a luxury that many practising engineers cannot afford.
- It comes from an independent source (in contrast to most trade association publications, desperate to show that their products are 'the greenest').
- Perhaps most importantly, it has always been freely available to download from the University of Bath website, unlike other datasets that are only available on a commercial basis.

The release of the online Inventory of Carbon and Energy V2.0 in January 2011 was accompanied by the publication of this book, complete with case studies and other useful guidance notes to accompany the hard data, and can be compared with the decision to publish on paper the free internet book *Sustainable Energy – Without Hot Air* by Professor David MacKay: it builds on the reputation it has already made on the internet by those interested in the subject, and brings it to a wider audience. This book further cements the Inventory of Carbon and Energy's reputation as 'the' seminal reference for embodied energy and carbon of construction materials, something that the industry has bemoaned the lack of for many years, in a subject of growing importance in the ever more challenging quest to meet carbon reduction targets.

The information is succinct, but well explained for the uninitiated in the subject. However, even those who have used the data already would benefit from spending 30 minutes or so reading the explanatory guide to the material profiles, section 3.2, and the FAQs, section 10, to ensure the most suitable data are being used. It is all too tempting to dive in and grab a number at first glance, but by doing so, one is at risk of grossly misusing the data, and wasting the effort of the authors to give us embodied energy and carbon data as close to the 'true' values as possible.

The information is very user-friendly – for example, the data for concrete are complete with embodied carbon and energy coefficients for every 100 kg of reinforcing steel per cubic metre of concrete, numbers that should be familiar to structural engineers. The book contains only nine of the 34 material profiles that are available on the University of Bath website, concentrating on those of most interest to construction professionals.

In addition to the hard data, there are many helpful snippets of information on issues that the authors realise will be of particular interest

to 'typical' readers. For example, the vast majority of the data are defined as 'cradle-to-gate', that is – counting the energy and carbon emissions from the extraction of raw materials from the earth (the 'cradle') and all the manufacturing processes up until when it leaves the factory (the 'gate'), therefore excluding energy and emissions caused by transport from factory to the site of the building where it will be used. The authors remind readers that although this transport stage may be negligible for very energy-intensive materials, for those with low MJ/kg or kg carbon dioxide/kg values, or very dense materials such as aggregate or sand, transport emissions may be significant. Under the concrete section, they inform readers that the average delivery distance of concrete from a readymix plant is 8.3 km by road.

The book highlights two issues in particular that are often hotly debated in industry: first, the treatment of recycling and recyclability, particularly for metals (section 7), but also general end-of-life scenarios for all materials, and second, the 'sequestration' of carbon in timber construction products (section 8), including an excellent case study to illustrate the effect of the latter. The authors explain the alternative methods of dealing with both of these in an objective manner, which given the interests of the lobby groups from trade organisations, is extremely valuable. The glossary is itself a very helpful section for understanding terms such as 'primary energy' and 'feedstock energy', which have a very important meaning in this kind of analysis.

This book goes a long way in bridging the gap between LCA and the calculation of embodied energy and carbon, for which many civil and structural engineers, eager to make a contribution to low carbon construction, will be very grateful. LCA specialists may not be impressed by the lack of referencing in the data tables to the long list of sources, making cross-checking the data with the methodologies used difficult. It is important to remember that the Inventory of Carbon and Energy database and this book contain no original LCA results, being simply a collection of a huge literature search of information that is already out there in the public domain, arranged and collated in such a way that makes this a must-have book for any civil engineer with aspirations of contributing to a revolution in low carbon construction.

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