Transparency in the carbon labels for construction materials – a comparison of three carbon labelling schemes

P.Wu[1], *Y.Zhong*[2], *Y.B. Feng*[3] *and X.H.Jin*[3]

[1]School of Engineering and Technology, Central Queensland University, Rockhampton, QLD 4701, Australia.

[2]Department of Building, National University of Singapore, 4 Architecture Drive, Singapore 117566.

School of Computing, Mathematics and Engineering, University of Western Sydney, Penrith NSW 2751, Australia.

p.wu@cqu.edu.au

ABSTRACT

The construction industry is one of the largest sources of carbon emissions. Manufacturing of raw materials, such as cement, steel and aluminium, is energy intensive and has considerable impact on the carbon emissions level. Due to the rising recognition of global climate change, the industry is under pressing stresses to reduce carbon emissions. Carbon labelling schemes are therefore developed as a meaningful yardstick to measure and compare carbon emissions. The design of current carbon labels have some transparency issues relating but not limited to the use of a single sign to represent the comprehensiveness of the carbon footprint. These transparency issues are partly caused by the life cycle assessment (LCA) methodology to measure carbon emissions. Transparency in carbon labels is very important and it is highlighted in the new PAS 2050: Specification for the assessment of the life cycle greenhouse gas emissions of goods and services and ISO14067: Carbon footprint of products – requirements and guidelines for quantification and communication. A comparison of the Singapore Green Labelling Scheme, the CarbonFree (the U.S.) and the Carbon Label (UK) is therefore conducted to identify and investigate the transparency issues. Based on transparent carbon labels, consumers can choose truly environment-friendly materials and the construction industry can then move closer towards being a "green" industry.

Keywords: Carbon labels, Carbon emissions, Construction materials, Transparency.

INTRODUCTION

The building and construction sector is one of the largest sources of carbon emissions. According to Klotz et al. (2007), buildings consume 36 percent of the total energy used, 30 percent of the raw materials used and 12 percent of potable water consumed in the USA. The manufacturing process of building materials (e.g. cement and steel) and chemicals have considerable impact on CO_2 emissions level (Worrell et al., 2011A). For example, the cement section alone accounts for 5% of global man-made CO_2 emissions (Worell et al., 2001B). Due to the rising recognition of global climate change, many sectors, including the building and construction sector, are under pressure to reduce carbon emissions. A central issue in striving towards reduced carbon emissions is the need for a practicable and meaningful yardstick for measuring and comparing carbon emissions (Crawley and Aho, 1999).

Life Cycle Assessment (LCA) has been widely adopted to evaluate the environmental impacts, including carbon emissions, in both the manufacturing industrial and construction sectors (Petersen and Solberg, 2002). It assigns elementary flow and potential environmental impacts to a specific product system (Wu and Low, 2011). Various carbon labelling schemes has been developed based on the LCA methodology, e.g. the Singapore Green Labelling Scheme (Singapore), the CarbonFree (US) and the Carbon Label (UK). The Singapore Green Labelling Scheme was launched by the Ministry of the Environment in 1992. It aims to help the public to identify environment-friendly products. Similarly, the CarbonFree was developed by an independent non-profit carbon offset provider, the Washington-based Carbon Fund, along with Edinburgh Centre for Carbon Management in 2007. The Carbon Label shows the carbon footprint of the product and was introduced in UK in 2006.

According to Erskine and Collins (1997), the greatest challenge to LCA is its credibility, which requires transparency in system boundary definition, the availability of data, data quality and the methods used. Without transparency, comparing the carbon emission level of different products will be extremely difficult and unrealistic. Consumers, who usually do not have access to the full embodied carbon data of the product and make the buying decision solely based on the information presented on the label, cannot truly identify and select the low-carbon products. This paper therefore aims to: 1) investigate the transparency issues in the three carbon labelling schemes; and 2) identify a few key factors that should be provided in the carbon labels for construction materials.

CARBON LABELS

Driven by the pressing pressure of environmental challenges, there have been a number of attempts to initiate environmental labelling or eco-

labelling schemes (Ball, 2002). Environmental labelling programs may provide one or several pieces of environment-related information, such as modelling of energy consumption, water consumption, carbon emissions and wastes. These pieces of information are aggregated into a single score for making decisions when selecting materials.

Carbon labelling schemes of building materials are designed to address the impact of global climate change to the construction industry. Climate change is mainly caused by increase in greenhouse gas (GHG) emissions from both natural and man-made sources. However, it is widely believed that man-made sources, such as human activities, are the most important factors. The design of carbon labelling programs often follows the LCA rules, similar to other environmental labelling programs, by assigning elementary flows and potential environmental impacts to a specific product system. The whole labelling process consists of estimating the inputs of raw materials, energy, the emissions to air, land and water associated with the manufacture of a product, operation of a process or provision of a service (Nisbet et al., 2000).

PAS (Publicly Available Specification) 2050 was published by the British Standards Institution on 29 October 2008 and included details requirements for the assessment of GHG emissions arising from goods and services (Sinden, 2009). The newly revised PAS 2050:2011 clearly stated that assessment of the GHG emissions of products shall be carried out using LCA techniques (British Standards Institution, 2011). The new ISO 14067 Carbon footprint of products – requirements and guidelines for quantification and communication is still under development at the time of this study. However, according to the draft version of the ISO/DIS 14067, the quantification and reporting of a carbon footprint product (CFP) is based on the principles of the LCA methodology provided in ISO 14040 and ISO 14044. According to ISO 14040 and ISO 14044, LCA can be used in product development and improvement, strategic planning, environmental performance indicator selection and marketing (International Organization for Standardization, 2006). It can be used to classify emissions into groups categorized by the environmental impacts they may cause and aggregate the emissions in each category to an equivalency potential based on how much each emission contributes to the respective impact. While a LCA study usually involves several kinds of environmental impacts, only the impact of carbon emissions is considered in a carbon labelling program. Based on the LCA principles, there are several carbon labels which are currently used to certify green building materials.

Singapore Green Label Scheme (SGLS)

The SGLS was launched by the Ministry of the Environment in 1992. The SGLS aims to help the public identify environment-friendly products that meet certain eco-standards specified by the scheme and seeks to

encourage the level of eco-consumerism in Singapore as well as to identify the growing demand for greener products in the market (Singapore Environment Council, 2012). If the building materials, e.g. precast concrete columns, are certified by the SGLS, the green label shown in Figure 1 will be used.

Figure 1 The green label for a sample precast concrete column in the SGLS

(Source: Singapore Environment Council, 2012)

According to the SGLS certification guide, in order to apply for the green label certification, the manufacturers need to pass relevant test, e.g. the standard leaching test for cementitious product, and provide details of the manufacturing process. A sample product should be sent to an accredited laboratory in Singapore to test the carbon emissions level. The key points that should be noted in the SGLS are therefore:

1. The SGLS uses a single score to indicate the carbon emissions level of the construction materials.

2. The carbon emissions level is tested in accredited laboratories in Singapore. The LCA methods, assumptions and boundaries for different construction materials are therefore kept consistent so that comparisons can be made.

3. The SGLS has global eco-labelling network partners so that the test results of these labelling schemes can be used to gain affiliate labelling schemes for the Singapore Green Label.

4. Emissions to the air during the production process of the construction materials shall be controlled within the environmental regulation limits set by the NEA in the Code of Practice on Pollution Control (NEA, 2000).

CarbonFree

The CarbonFree label was developed by the Washington-based Carbon Fund, an independent non-profit carbon offset provider, along with Edinburgh Centre for Carbon Management. The labelling program was established in March 2007. According to the CarbonFund (2013), the CarbonFree certification is a meaningful and transparent way to provide environmentally-friendly, carbon neutral products to customers. The certification process includes four steps, which are:

- Perform a LCA to determine the carbon footprint of the products using the CarbonFree Product Certification Carbon Footprint Protocol AND one of the leading LCA product methodologies.
- Register and certify the products as CarbonFree.
- Offset the products' carbon footprint quarterly, based on actual sales.
- Renew the product annually (CarbonFund, 2013).

Once the results are submitted to and accepted by the panel, the CarbonFree Label can be used when promoting the products. The label is shown in Figure 2.

Figure 2 The CarbonFree Label developed by the CarbonFund

(Source: CarbonFund, 2013)

A few key points that should be noted in the CarbonFree Label include:

- While the protocol suggests that at least one of the three LCA standards should be adopted (i.e. World Resources Institute/World Business Council for Sustainable Development Greenhouse Gas Protocol for Product Accounting and Reporting Standard; PAS 2050:2008; and ISO 14044:2006), it is difficult to ensure consistency because the CarbonFund is not responsible to either conduct the LCA study of the product or provide accredited laboratories to do so.
- As can be seen from Figure 3, the carbon emissions from six major processes are calculated. It should be noted that carbon emissions

generated from capital facilities, such as offices and manufacturing of physical infrastructure, are voluntarily included. Carbon emissions generated from product use can also be excluded if written consent is obtained from CarbonFund. These voluntary inclusions will make comparisons between different products difficult.

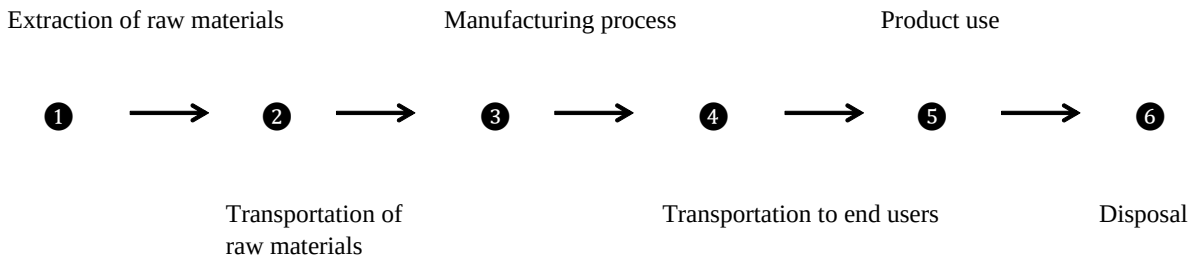

Figure 3 GHG emissions that should be considered when applying CarbonFree

(After CarbonFund, 2012)

- Emissions that should be included in the LCA include CH_4, $_{N2O}$, SF_6, Hydrofluorcarbons (HFCs), Perfluorocarbons (PFCs) and Biomass CO_2 emissions. These greenhouse gases will be converted to CO_2 equivalents (CO_2e) in the CarbonFree.

- Unlike the SGLS, the embodied carbon of the construction material is not shown in the label. Instead, the manufacturer donates an amount of money which goes into third-party validated offset projects. The amount of carbon emissions that is offset by the donation will be shown in the label. In other words, CarboFree is more related to identify the manufacturers' contribution towards corporate social responsibility than the development of low-carbon products.

Carbon Label

The Carbon Label shows the embodied carbon footprint of the product. The label was introduced in UK in 2006 by the Carbon Trust. According to Carbon Trust (2013), similar to the CarbonFree, the main LCA methods that the Carbon Label uses include PAS 2050 and WRI/WBCSD Greenhouse Gas Protocol Product Standard. A few key points that should be noted in the Carbon Label include:

- Similar to the SGLS, the Carbon Label appoints an evaluation team to ensure consistency. The team has a leader and will be the first point of contact throughout the evaluation.

- When the results of the LCA pass the internal review of the Carbon Trust, the Carbon Label, an example of which is shown in Figure 4,

can be used when promoting the products, with the carbon footprint of the products listed at the right of the label.

Figure 4 The Carbon Label developed by the Carbon Trust

(Adapted from: Carbon Trust, 2013)

It should be noted that along with the listed carbon footprint of the products, a product emissions report shall also be provided. In the report, a summary of the company's strategy to manage carbon cross the company as a whole should be provided. In addition, a summary of the company's objectives/targets for the reduction of GHG emissions across the company as a whole should also be provided.

DISCUSSION

A comparison between the three carbon labels can be found in Table 1. As can be seem from Table 1, all three carbon labelling schemes follow LCA standards, with especially emphasis on WRI/WBCSD and PAS 2050. It should be noted that the newly revised PAS 2050:2011 and the ISO 14067 (Carbon footprint of products – requirements and guidelines for quantification and communication) all highlighted transparency as one of the most important criteria when evaluating and communicating the carbon footprint of a product. This is because the goal of carbon labels is to provide businesses and consumers with meaningful information that will ultimately allow them to make informed decisions about product choice (Cohen and Vandenbergh, 2012).

However, as can be seen from Table 1, various standards are referred to in these three carbon labelling schemes.

Table 1 Comparison between the carbon labels on criteria regarding transparency

Criteria \ Carbon labels	SGLS (Singapore)	CarbonFree (US)	Carbon Label (UK)
Evaluation standards	LCA standards (not specifically listed)	WRI/WBCSD PAS 2050 ISO 14044	WRI/WBCSD PAS 2050
Accredited evaluation team or accredited laboratories	Yes	No	Yes
Embodied carbon listed in the label	Yes	No	Yes
Standard unit of measurement	CO_2	CO_2e	CO_2e
Product emissions report	No	No	Yes
Emissions reduction plan	No	No	Yes
Unit of assessment	Product unit	Company	Functional unit or product unit
Period of assessment	1 Year	1 Year	2 Years

According to Karl and Orwat (1999), the crucial point of environmental labelling is the credibility of the ecolabel information. Without credible sources of information, it is unlikely that the carbon labels will provide useful information for customers to make informed decisions. For example, a few processes are voluntarily included in the CarbonFree. It is subject to the analyst's own LCA assumptions relating to whether or not these processes should be included. This may also affect the completeness principle, which clearly stated that all product life cycle GHG emissions arising within the system and temporal boundaries for a specific product should be included for assessment.

The comprehensiveness of the carbon footprint is currently represented by a single sign. Doublet and Junbluth (2010) stated that a comprehensive list of environmental product information should be provided along with the product to make transparent and comparable communications. The product emissions report and reduction plan from the Carbon Label is a very good start to include such information for third parties (e.g. customers) to make decisions (e.g. to purchase the product or not).

CONCLUSIONS

The construction industry is one of the largest sources of GHG emissions and strategies must be taken for the industry to evolve towards a "green" industry. Carbon labelling schemes for construction materials can provide the carbon information of the products to enable customers to make informed decisions. Transparency in both the guidelines to assess carbon emissions and the carbon labels is important for consumers to make informed decisions, but the principle of transparency has yet been fully developed and implemented. Carbon labelling is in its infancy and much need to be done on transparency, which may include using a uniform methodology, relying on accredited evaluation team and laboratories, providing product emissions report and establishing emissions reduction plan. As carbon labelling is one of the most important strategies for the construction industry to achieve sustainability, the principle of transparency cannot be overlooked to bridge the communication gap.

REFERENCES

Ball, J. (2002). Can ISO 14000 and eco-labelling turn the construction industry green? *Building and Environment*, 37(4), 421-428.

British Standards Institution (2011). PAS 2050. http://www.bsigroup.com/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050. Viewed: 20 Oct. 2012.

CarbonFund. (2012). CarbonFree production certification – carbon footprint protocol. http://www.carbonfund.org/site/2012-03-15%20-%20Product%20Certification%20Protocol%20-%20Final.pdf. Viewed: 23 Jun 2013.

CarbonFund. (2013). CarbonFree certification. http://www.carbonfund.org/offset/product-certification. Viewed: 23 Jun, 2013.

CarbonTrust. (2013). Carbon Trust certification. http://www.carbontrustcertification.com/page?pageid=a042000000FjjEv. Viewed: 23 Jun, 2013.

Cohen, M.A.and Vandenbergh, M.P. (2012). The potential role of carbon labelling in a green economy. *Energy Economics* 34, S53-S63.

Crawley, D. and Aho, I. (1999). Building environmental assessment methods: applications and development trends. *Building Research & Information*, 27(4/5), pp.300-308.

Doublet, G., and Jungbluth, N. (2010). Environmental product information (EPI) and LCA. *The International Journal of Life Cycle Assessment*, 16(1), 90-94.

Erskine, C.C. and Collins, L. (1997). Eco-labelling: success or failure? *The Environmentalist* 17, 125-133.

ISO 14040 (2006). Environmental management - life cycle assessment - principles and framework, International Organization for Standardization, Geneva.

Karl, H., and Orwat, C. (1999). Economics aspects of environmental labelling. In: The international yearbook of environmental and resource economics 1999/2000: a survey of current issues, H. Folmer, and T. Tietenberg, eds., Elgar, Cheltenham, 107-133.

Klotz, L., Horman, M. and Bodenschatz, M. (2007). A lean modeling protocol for evaluating green project delivery. *Lean Construction Journal*, 3(1), pp.1-18.

National Environment Agency. (2000). Code of practice on pollution control. http://www.nea.gov.sg/cms/pcd/coppc_2002.pdf. Viewed: 23 Jun, 2013

Nisbet, M., VanGeem, M.G., Gajda, J. and Marceau, M. (2000). Environmental life cycle inventory of Portland cement concrete. SN2137. Portland Cement Association, Skokie.

Petersen, A.K. and Solberg, B. (2002). Greenhouse gas emissions, life-cycle inventory and cost-efficiency of using laminated wood instead of steel construction. Case: Beams at Gardermoen airport. *Environmental Science & Policy* 5(2), pp.169-182.

Sinden, G. (2009). The contribution of PAS 2050 to the evolution of international greenhouse gas emissions standards. *International Journal of Life Cycle Assessment*, 14(3), 195-203.

Singapore Environment Council (2010). Overview of the green label scheme. http://www.sec.org.sg/awards/greenlabel/overview. Viewed: 6 Mar 2010.

Worrell, E., Price, L., and Martin, N. (2001A). Energy efficiency and carbon dioxide emissions reduction opportunities in the US iron and steel sector. *Energy*, 26(5), pp.513-536.

Worrell, E., Price, L. K., Martin, N., Hendriks, C., and Meida, L. O. (2001A). Carbon dioxide emissions from the global cement industry. *Annual Review of Energy and Environment*, 26(8), pp. 303-329.

Wu, P. and Feng, Y.B. (2012). Using lean practices to improve current carbon labelling schemes for construction materials – a general framework. *Journal of Green Building*, 7(1), 173-191.

Wu, P. and Low, S.P. (2011). Managing the embodied carbon of precast concrete columns. *Journal of Materials in Civil Engineering*. 23(8), pp. 1192-1199.