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Citation	The 2014 World Sustainable Building Conference (WSB14), Barcelona, Spain, 28-30 October 2014. In Conference Proceedings, 2014, P-117, p. 1-7
Issued Date	2014
URL	http://hdl.handle.net/10722/217721
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A Life Cycle Based Green Building Product Labelling Scheme

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Abstract: *Buildings account for 40 per cent of the overall environmental burden in industrialised countries. Acknowledging that thousands of building materials are available and many might have adverse impact to the environment, careful selection of green building products could help enhance the environmental performance of construction facilities. To facilitate decision-makers selecting green building materials, a reliable and transparent mechanism is needed and a green building product labelling scheme would be the way forward. While there are various green or eco labelling schemes around the world, they are not specifically designed for the construction market. With a desire to promote a greater adoption of green building products in construction projects, the Hong Kong Green Building Council has commissioned The University of Hong Kong to develop a life cycle based green building product labelling scheme. This paper presents the key features of the green building product labelling scheme.*

Keywords: *Construction materials, environmental impacts, life cycle assessment, green label*

Introduction

Construction is one of the largest users of natural resources, water and energy, and it is undeniably a formidable polluter (Horvath, 2004). In developed nations like the United States and the European Union countries, the construction industry is responsible for about 40 per cent of the overall environmental burden (UNEP, 1999; Sjöström, 2000). In Hong Kong, building facilitates account for 90 per cent of electricity consumption (EPD, 2010), and this together with the embodied energy and solid waste arising from building facilities could result in significant impacts (EMSD, 2006). Hence, improving the environmental responsibility is becoming a critical issue in construction projects.

Nowadays, many clients are prepared to specify and use environmental-friendly building materials / products. Using green building materials and products is considered as a proactive way to reduce the environmental burden (Ortiz *et al*., 2009). However, problems arise when there is no unanimous definition for green building materials. The problem is aggravated as there is no agreed method for evaluating and comparing the life cycle environmental impacts of building materials (Curran, 2001; Guineé *et al*., 2001). With various alleged green building materials in the market, it is difficult for clients and end users to delineate which is more environmental friendly than the others. This calls for an authoritative, independent and publicly acceptable green labelling scheme for building materials that could help portray their life cycle environmental impacts.

While green or eco labelling schemes have been around in some countries, Hong Kong lacks a green labelling scheme which is specifically designed for building materials to support the

local construction industry driving towards life cycle sustainability. With continuous demand for infrastructure and construction facilities, it is necessary to establish a transparent environmental standard so that building materials of commendable environmental performance would be awarded with a recognised green label. The green building product labelling scheme should help decision-makers identifying green building materials so as to reduce the overall environmental burdens of the construction facility.

Nevertheless, it is never an easy task to develop a green building product labelling scheme as the properties of construction materials could vary dramatically and their environmental impacts could therefore be very different. Moreover, the environmental impacts could be originated from various stages of production, *viz*. raw material extraction, transportation, processing, fabrication, installation, operation, reuse, recycling and disposal of the materials. As a result, there is a need to develop a green building product labelling scheme which is based on the entire life cycle of the building material.

In this paper, the essential characteristics of the developed green building product labelling scheme is presented. The paper begins with the rationale for choosing the building products to be covered by the scheme. The environmental impact categories for assessing the greenness of building materials are exemplified. It is then followed by an introduction of the scoring mechanism. The paper concludes by discussing how to integrate the green building labelling scheme with other decision processes like the building environmental assessment models.

Research Method

An extensive desktop study was first conducted to examine the existing green or eco labelling schemes both locally and internationally. The principles, scope, assessment criteria, international standards / references adopted, benchmarking mechanism, verification methods and implementation strategies were critically reviewed. The findings provided a very strong foundation for the development of the green building product labelling scheme.

Since there is no agreed regime for classifying construction materials / products, it was considered necessary to develop an appropriate product categorisation system so that green building materials within the same category can be systematically benchmarked. To classify the diverse construction materials used in Hong Kong, the characteristics and environmental impacts of various construction materials and building services components were examined by reviewing the existing green labelling schemes. Construction experts were then interviewed to validate the material categorisation regime.

To identify the predominant building materials / products in Hong Kong in terms of their environmental impacts, the quantities of materials used in the construction projects were extracted from the bills of quantities. Subsequently, the life cycle environmental impacts of the most extensively used building materials / products were analysed through the life cycle assessment. This should help unveil the total environmental impacts and which are the most significant impact categories for each of the identified materials. SimaPro was used to generate the results of life cycle environmental impacts.

After determining the key environmental impact categories for each building material / product, the assessment guidelines could be established accordingly. In establishing the assessment guidelines, international standards including ISO 14040/44 on Life Cycle Assessment; ISO 14020/24 on Environmental Labels and Declarations; ISO 17025 on the Requirements for the Competence of Testing and Calibration Laboratories, and the well-established global eco-labelling and certification schemes were referred to ensure the credibility of the assessment guidelines. A life cycle assessment approach was applied to ensure the assessment criteria would cover various life cycle stages of a building material / product, *viz*. raw material extraction, manufacturing, distribution, product use and disposal.

The requirements were drawn up based on international standards found in other green or eco labelling scheme. However, as many materials / products used in construction projects are imported from mainland China or other countries, the requirements were carefully scrutinised to ensure that they are applicable to the Hong Kong scenario. Moreover, the standards must exceed those required by the local environmental and safety legislations. Consequently, the assessment criteria and requirements had to undergo several rounds of consultations with government officials, clients, construction professionals, contractors, manufacturers, etc. to ensure the assessment guidelines developed are acceptable to the industry. Consultation forums were also organised for a wider group of industry stakeholders and verification bodies to ensure that the proposed green building product labelling scheme is logical and practical.

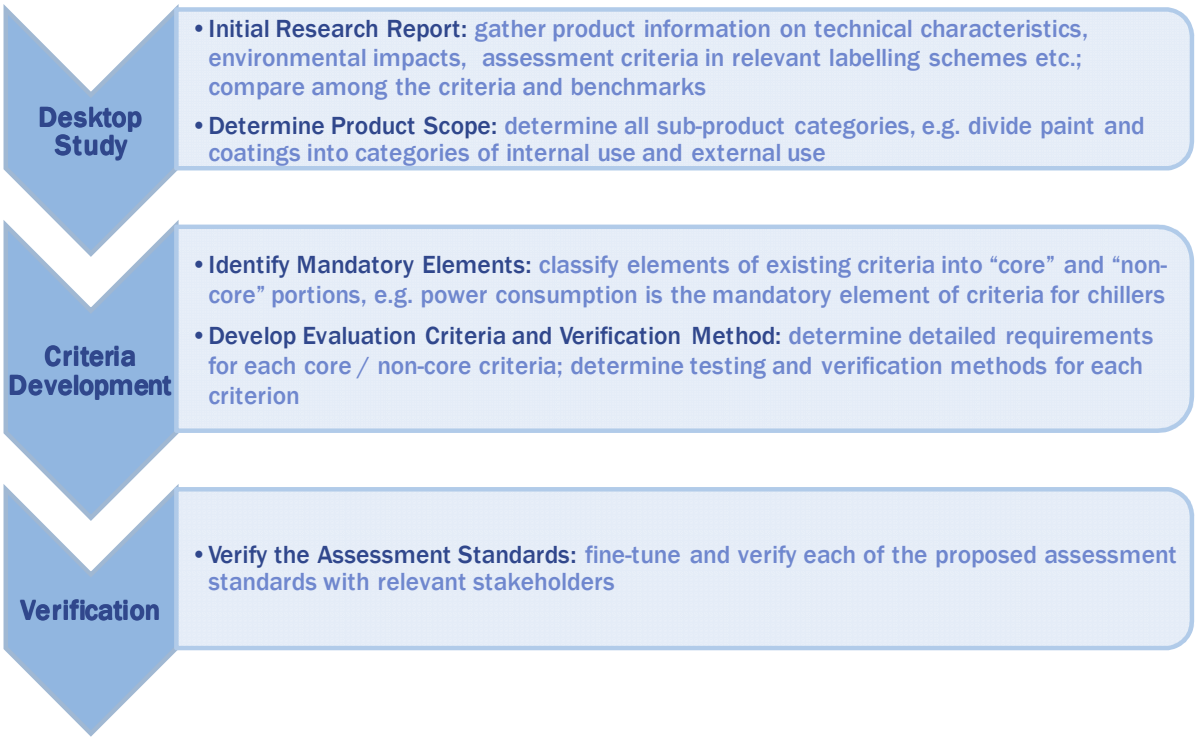


Figure 1: Stages involved in the development of the green building product labelling scheme

Product Categorisation

A detailed analysis of the bills of quantities of seven representative building projects in Hong Kong was conducted to identify the building materials with the highest environmental impacts. The material replacement over the building life cycle of fifty years, wastage in the construction stage and the types of buildings were taken into account in the analysis in order to produce a more reliable result for prioritising building materials / products in terms of their environmental impacts. In addition, the building services components were selected by analysing their energy consumption throughout the building life cycle.

The results show that reinforcement bars, copper, aluminium, tiles and concrete are the top five contributors of environmental burden in construction due to their extensive use in the building projects analysed and considerable environmental impacts. These findings are analogous to the findings of a number of studies related to environmental impacts of building materials. However, as these materials are already covered in a carbon labelling scheme recently launched by the Construction Industry Council in Hong Kong, they were not covered in the first phase of development of the green building product labelling scheme.

Based on the analysis of the bills of quantities and the life cycle environmental assessment, fifteen building materials / products were selected and they include extruded aluminium, glazing, gypsum plasterboard, tiles, stone, furniture, composite wood, paint and coating, wall covering, adhesive and sealant, chiller, compact fluorescent lamp, light-emitting diode lamp, electronic ballast, as well as cable and wire. These fifteen building materials / products are classified into four board categories namely (i) structure and façade; (ii) interior system; (iii) finishes; and (iv) mechanical and electrical, as shown in Figure 2.

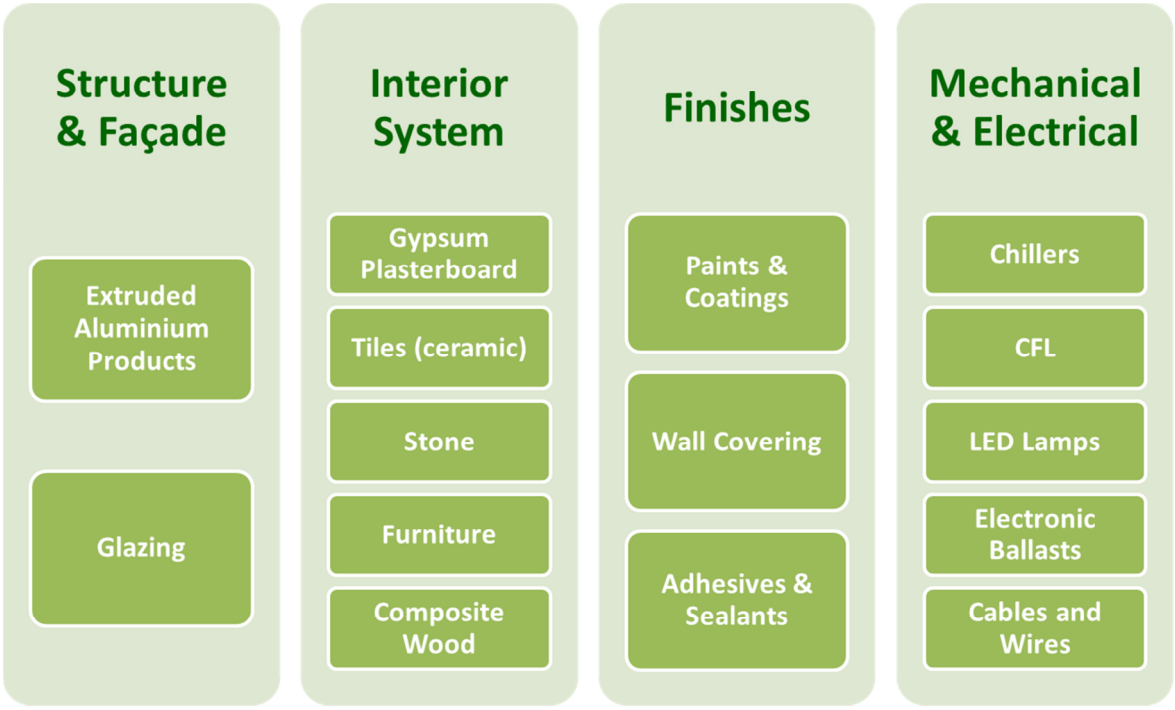


Figure 2: Product categorisation regime

Essential Characteristics

Unlike most other green or eco labels, the proposed green building product labelling scheme consists of both core and non-core criteria. The core criteria reflect the most important aspects in which a product must fulfil. Failing to satisfy any of the core criteria would result in non-qualifying for a green building product label. In contrast, the non-core criteria are meant to differentiate which product is more environmental friendly than the others. The core and non-core criteria would vary from product to product depending upon the life cycle environmental impacts of each building material / product. For example, the recycle content is one of the core criteria for extruded aluminium products. On the other hand, the serviceability is a core criterion for paint. Table 1 shows the core and non-core criteria of paint.

Core Criteria	*Non-Core Criteria*
Serviceability	Toxicity
Product information	Biocides
Heavy metals	Environmentally Hazardous Substances
Carcinogenic substances	Ozone Depleting Substances
Volatile organic compounds	Hazardous Substances

Table 1: Examples of core and non-core criteria for paint

From the manufacturer and verification body's perspective, a clear set of criteria would help ensure the environmental impacts of a building material / product are fairly and accurately reported and validated. Therefore, in the proposed green building product labelling scheme, the requirements pertinent to each criterion are specified in a transparent manner (Table 2). In addition, the score corresponding to each criterion is shown thereby manufacturers can estimate the likely score their product can achieve. This should improve the transparency and minimise the chance of dispute.

Criteria	*Requirement*	*Score*
Toxicity	The product shall not be classified as harmful, toxic, very toxic or causing sensitisation, and shall not contain more than 1% by weight of any substances classified as reproductive toxins / endocrine disruptors in accordance with EU Directive	5
Biocides	The product shall not contain any substance in accordance with the European Commission's Biocidal Products Directive	5

Table 2: Examples of assessment requirements and score for paint

Another key characteristic of the proposed green building product labelling scheme is that the product will be awarded a green label of different grades ranging from 'platinum' to 'green' based on the total score a product can achieve (see Table 3). Satisfying all the core criteria would result in 50 marks which is equivalent to a label of 'Green' category. Should the product meet the requirements of other non-core criteria, it may be awarded extra marks up to a total score of 100 which would lead to a 'Platinum' label.

Total Score	*Class of Green Label to be Awarded*
>90 to 100	Platinum
>80 to ≤90	Gold
>70 to ≤80	Silver
>60 to ≤70	Bronze
>50 to ≤60	Green

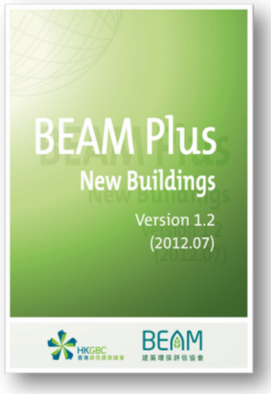
Table 3: Different levels of green label corresponding to the total score

Potential Application

In order to encourage clients, design team members and contractors selecting green building materials / products, the construction industry should seriously consider bringing in novel measures to incentivise those environmental conscious construction stakeholders. For example, the granting of gross floor area concessions for new developments in Hong Kong is associated with the local building environmental assessment scheme – BEAM Plus, and the materials aspects is one of the areas which could affect the assessment outcomes of BEAM Plus. Therefore, it is indispensable to improve the rigour of the assessment pertinent to the materials aspects. By referring to the green label awarded to building materials / products, the greenness of construction materials used in a construction project can be easily differentiated.

6 Aspects of Assessment
Site aspects
Materials aspects
Energy use
Water use
Indoor environmental quality
Innovations and additions

Table 4: Aspects of assessment under BEAM Plus – New Buildings



Another way to encourage a greater uptake of green building materials / products is by specifying the use of labelled materials, e.g. those materials achieving at least a 'Silver' label. It would be indispensable if the government can take a lead in specifying labelled green building materials / products. By doing so, manufacturers would realise the importance of green building materials / products, and strive to improve the environmental friendliness of their products to seize the market opportunity.

Conclusions

In this paper, the green building product labelling scheme as initiated by the Hong Kong Green Building Council has been introduced. The proposed scheme is based on a life cycle approach whereby the environmental impacts originated from various stages of production, *viz*. raw material extraction, transportation, processing, fabrication, installation, operation, reuse, recycling and disposal of materials are taken into account. The assessment criteria and requirements pertinent to the life cycle environmental impacts of fifteen building materials /

products have been developed accordingly. The assessment criteria consist of core and non-criteria criteria, and any products seeking the green building product label must satisfy the requirements of the core criteria.

The life cycle based green building product labelling scheme should help clients, design team members and contractors delineate the greenness of construction materials so as to improve the overall environmental friendliness of their building facilities. The green building product labelling scheme is also expected to create a market force so that manufacturers are more prepared to invest in uplifting the environmental performance of their products. These should help reduce the overall environmental burden caused by construction projects and thus make the construction industry a more environmental responsible sector.

Acknowledgement
The authors would like to thank the Hong Kong Green Building Council and The University of Hong Kong's CRCG Seed Funding for Basic Research (Grant No.: 201111159093) for funding this research project.

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