



Environmental certification of building products with high recycled content

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1. Introduction

Nowadays almost everything around us is built with processed resources, directly or indirectly, from Nature. The transformation of raw materials into building products is associated with high energy values and hence considerable burns into the environment. In fact, the construction sector consumes around 50% of the world's resources (Edwards, 2002). Therefore, environmental certifications have been developed as a way to evaluate and communicate these contents in a concise and expeditious manner. In these evaluations a range of features inherent to the materials is covered that have influence on climate change and the welfare of the building occupants. One of the parameters considered is the post consumer recycled content, which is directly related to the end of life of materials and so extremely important to close their cycle.

The aim of this dissertation is to set how post-consumer recycled content can be certified and approached on the building products. Specific objectives involve recycled content, main characteristics, define a methodology of ranking and test its application in various types of building products. At the end the objective is to give a contribution to the studied products in an environmental product catalog (4Rs).

2. Approaches and systems of environmental certification

Before an analysis of sustainability about the materials is made, it is compulsory to have knowledge of the building functions. This is the only way to decide consciously and according to the answer that is sought (Duarte, et al., 2010). From this point, it is then necessary to know all the information related to the lifecycle of the materials and its components. The methodology which is currently used for this purpose is called Life Cycle Assessment (LCA) which can be defined as the process of evaluating the impact that a product, process or activity has on the environment during all phases of their lifecycle. This study methodology is recommended in the ISO 14020 series of standards which was developed in response to global demand for more reliable base directives for environmental management of products as a mean to environmental labeling and certification. LCA's are the basis for the development of Environmental Product Declarations (EPD). Beyond these declarations there are other types of assessments oriented according to the following standards:

Table 1 - Standards used for each type of environmental labels (Proesler, Martin, 2008)

Denomination	Not verified	Verified
Environmental labels	14021 (Type II)	14024 (Type I)
Self declarations	14021 (Type II)	-
Environmental Product Declarations (EPD)	-	14025 (Type III)

The standards above in addition to serving as a base for other already established, such as ISO 21930:2007 (Sustainability in building construction - Environmental declaration of building products) and prEN 15804 (Sustainability of construction Works. Environmental product declarations. Product category rules), specifically related to construction products, also provide the basics for setting up programs in order to certify construction products. In fact, we can already find all over the world these kinds of programs. Even in some cases these labels already possess a cohesive market position and recognition, such as:

- BRE environmental profiles (UK): due to the need of assessing and certifying materials, both by the specifier fulfilling a sustainability brief and the manufacturer wanting to demonstrate a product's environmental credentials, the company BRE developed the Environmental Profiles Certification Scheme, which provides ongoing, independent assessment and certification of environmental performance;
- The Ecocycle Council for the Building Sector: network within the Swedish building and real estate sector that conducted an environmental review for the entire building sector in accordance with the environmental management principles of ISO 14000. An important task of the Ecocycle Council is to act as a contact body with the authorities, including the Ministry of the Environment, the National Board of Building, Planning and Housing, and the National Environment Protection Board;
- Byggsvarubedömningen (BVB) - Building Material Assessment: evaluates, proactively and systematically, the contents of a product and of the production process, providing the Swedish market with a common criteria and an evaluation standard. The goal is that tomorrow's buildings will be constructed using only products that have been environmentally evaluated and approved;
- SundaHus Miljödata: is a system for health and environmental assessments of products within the building and real estate trade. The core of the system consists of a database of chemical substances, various materials and a wide range of products.

3. Recyclability and recycled content

It is in the production process of the materials that resource consumption and pollutant emissions are more significant. Then, the product recycling appears as a mean to prevent greater environmental impacts. In fact, if a product can be easily recycled at the end of its lifecycle then it can be considered better than a product "environmentally friendly" but not recyclable. It is estimated that about 50 to 70% of the energy consumed in the production of materials can be prevented with recycling (Teixeira, 2008). Recycling is a term generally used to describe the reuse of materials at their end of life as raw material for a new product. From this concept it can be stated that in the construction industry due to the high heterogeneity of products the opportunity to recycle the materials is elevated but is closely linked to the production process and to the demolition works.

For a better materials use, the projects must consider the buildings end-of-life (e.g. by a deconstruction plan) so it can contribute to the augment of the quantity of both, reused materials and the separated ones as well as a way of reducing the waste to the landfill.

To Hagen, cited by (Couto, et al., 2007), the deconstruction process has a number of advantages that support its appeal:

- Instigation of a new market - recovered materials through deconstruction have more value than the ones from traditional demolition due to the care taken during the process. This way they can be reintroduced into the market;
- environmental benefits - reduces the amount of construction and demolition waste dumped in landfills, energy and pollution inherent to the various life stages of a new material;
- employment creation - additional work required for this process comparing to demolition.

It was due to these reasons that the term "design for disassembly" gained strength in the aim for sustainability in the construction sector. It can be defined as a method of developing a building / product in a manner which permits their deconstruction and reusing / recycling. It is therefore an essential action to achieve the objectives of reducing embodied energy, resources and construction waste.

3.1. Examples of recycling promotion

It has been observed a considerable increase of studies, systems and companies that focus on the premise for the recycling markets development, in which highlights:

- **Rematerialise:** sustainable materials library and online resource, offering innovative material solutions which can have both economic benefits and less environmental impact. Based upon research initiated in 1994 the this library now houses over 1,200 materials which either use less non renewable resources or come from renewable resources (Rematerialise, 2002);

- **MOR Online:** This management platform, created in 2010, was the first to be licensed under the Organized Market Waste (from Portuguese Mercado Organizado de Resíduos - MOR) which purpose is to support the waste transactions and inherent processes from electronic platforms (MOR, 2012);
- **Matrec:** is the first international eco-design database *Made in Italy* dedicated to environmentally sustainable materials and to their use in the world of industrial production, architecture and design (Matrec, 2011);
- **Recovinyl:** provides financial incentives to support the collection of PVC waste from the non-regulated PVC waste streams. Its aim is to ensure a steady supply of post-consumer PVC waste for recycling in Europe (Vinyl, 2010);
- **RECYHOUSE:** constructed by BBRI, this model building integrates a very large proportion of new materials from both recycled waste from the construction and demolition of buildings and civil engineering works and from the valorization of wastes or by-products from other industrial sectors; (BBRI, 2001)
- **4Rs system:** online catalog of environmentally friendly products and services available in the Portuguese market, where each player has a key role, coincident with the experience earned with their work sector (4Rs, 2011);
- **LiderA:** Portuguese acronym of Lead for the environment in search of sustainability construction, and is the designation of a Portuguese voluntary system which aims for an efficient and integrated support, of the evaluation and certification process of the built environments that seek sustainability (LiderA, 2009).

4. Researches

As a way to understand the Portuguese public opinion, in relation to certification systems, two surveys were prepared: one for the non-professionals and another for professionals in the construction sector. After that, the methodology of environmental certification regarding recycled content was elaborated. To achieve better conclusions, the results of each product were compared.

4.1. Surveys

The results of this study indicates that from the non professional opinions, it was possible to establish that beyond a general concern about the environment, which is sometimes a bit trivialized, there is a lack of information about the environmental burns related to the building products. As such, the idea of creating a certification system that could help them to decide in a more environmentally way and make green products more competitive was accepted by a large percentage of the interviewers (over 50%), as we can see in the figure below. Another elation that can be drawn was that for this kind of certifications the best scale of grades is the one used by LiderA, which is already widespread in the subconscious of the population (from G to A⁺⁺).

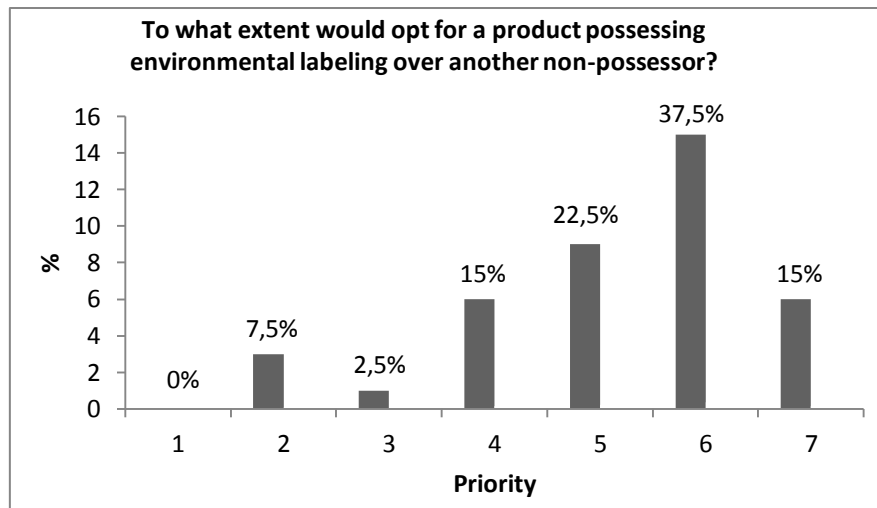


Figure 1 - Question from the survey made to non construction professionals

Additionally, on the surveys to construction professionals, it was found that 51% of respondents think that environmental information is extremely important for the business and 91% views the idea of labeling as a business booster, even if there is a poor knowledge of this kind of systems.

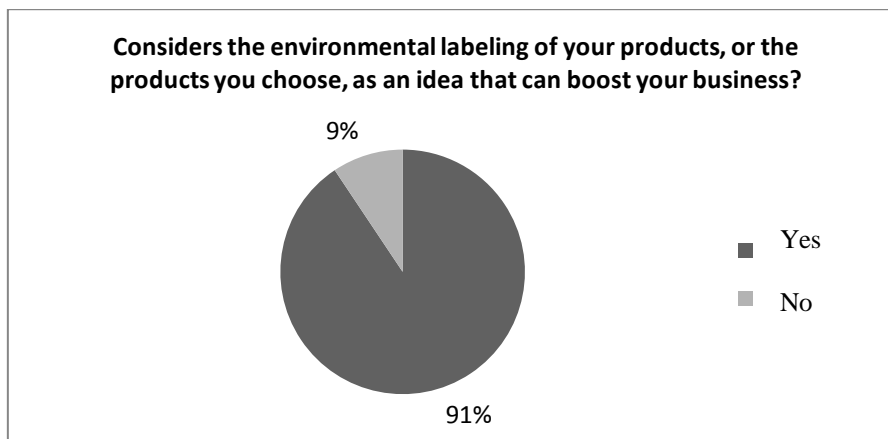


Figure 2- Questions from the survey made to construction professionals

Furthermore, they did not think that this kind of measures can be connoted to a rise in prices. However the more skeptical ones about this are mainly the producers, being the only exceptions the producers of environmentally friendly materials. Given the above, there are some ideas that may be raised concerning the possibility of being merely politically correct answers, such as:

- 51% sees environmental information as essential. However there are few construction products that gives concise and reliable information, being the designers and the owners who do not exert enough force to demand measures in that direction;
- 91% think that a labeling system can help boost business, but very few know any examples of this kind of systems;

- plagued by the consequences of the current crisis, producers think that choosing this certification course would bring costs that are not willing to spend right now.

4.2. Environmental evaluation of the recycled content

From a research and extensive contacts to national building materials producers or representatives of multinational brands, it has been developed a comparative and evaluative method of recycled content. For that it was used four types of products: decking, benches, litter bins and insulations.

This evaluation process was based on the methodology applied by the system LiderA, which focuses on the assignment of different performance levels on a scale from G to A⁺⁺. The assignment of performance levels part from a reference level E (considered as current performance) and the other levels are assigned depending on the improvements over the reference level. This methodology can be easily understood from Figure 3 - Scale of the performance levels according to the LiderA methodology, where they are presented as percentages, levels of performance improvement and enhancement factors corresponding to each scale value.



Figure 3 - Scale of the performance levels according to the LiderA methodology

So, after collecting several examples from each selected range of products, the development of an assessment of post-consumer recycled content and their costs was made for three different scenarios, varying only the weights assigned to each parameter, as we can seen in Table 2.

Table 2 - Weights of each evaluation parameter in the different assumptions

Hypotheses	1	2	3
Recycled Content	75%	25%	50%
Cost	25%	75%	50%

From the three scenarios, the third hypothesis is the closest to the ideal model due to the use of only two criteria. An imbalance between both gives rise to a lack of impartiality. In addition, sometimes in the cases 1 and 2 the evaluations results were at the threshold between the level immediately below or above, which may be considered as an inducer of error.

For the fact that results obtained by recycled products have been so high, even though sometimes presented higher costs, this confirms the idea that in the development of a method of this kind is essential to choose in a calibrated and sustained the weighting of the criteria.

Nevertheless, this study has shown to be very limited in the sense of a more concise and cohesive statement about the benefits of the recycled materials. Since the beginning, the initial purpose was suffering changes due to difficulties related to the absence of market opening for academic studies. Combined with a tenuous presence of recycled products in the Portuguese building products market, the results were neither the most expressive nor desired. In fact, this study refers only to the recycled content of materials and costs, which generated assessments that could be considered misleading as to its real environmental value.

The methodology initially proposed focused on developing a speedy method to assess the real environmental value of recycled products against its direct competitors, featuring all the essential information for an evaluation well sustained. Despite the lack of information for such, interesting results were obtained both in surveys and in the assessment presented, that may be a good support to further studies, given the reliability that characterize the data presented.

5. Conclusions

Recycle content is an important aspect since the reuse of materials can contribute to less raw materials consumption. The call for a continuing information and performance of the products through time can be an interest accretion to the client. Therefore, this can be a key factor on the recycling market development which still remains related to much skepticism.

Thus, the development of EPD (starting in Portugal) started with the aim to understand the product environmental weight through the LCA researches. These kinds of studies intend to quantify the emission and energy expenses related to each material and without them any environmental certification can be really difficult to accomplish.

In the absence of LCA and EPD's, the present methodology focused on creating and categorize the recycled content products as well as its costs, proposing a basis scale between G and A⁺⁺. This methodological approach was applied to four types of products: decking, benches, litter bins and insulation.

From this study results we should highlight a few key points:

- products made with recycled plastics and insulations with agglomeration of recycled flexible polyurethane foam can simultaneously display a high recycled content and very competitive costs;
- if it had been possible to develop a more broad study, many of the products surveyed could achieve much more satisfactory results;
- for the same reason, the products that obtained better results could strengthen their assessments taking into account their high quality that give them a great durability and good technical results.

It was also shown, through the preparation of this research, that there is an enormous lack of information, as well as a deficiency in the interconnection between the different construction sectors in Portugal. Then, it is essential a mechanism that ensures these connections and cooperation of all the parts to make this sector more neat.

To reach this objective, the creation of a team work that focuses on this premise can be the solution to this central problem. Its main goal should be gathering all the constructions representatives in order to outline coincident and sustainable paths. From the research done, several proposals can be made such as the followings:

- incentives to create DAP, by reducing taxes from the products that present good environmental results;
- support the studies and tests needed to the development of the DAP, by making agreements between companies and universities, so that the students could play a main role in the sustainable evolution of the construction market;
- augment the number of subjects/lectures, in the National Universities, related to the sustainability of the construction work, with the aim to change the perspective of the sector, by teaching new ways of facing the sector.

Nevertheless this study has shown that the recycled content assessment (and its certification) must be a process involving other parameters. Knowing which products contains de biggest percentage of recycling material can be misleading, since it does not reveal if it will have the same or more durability than other products on the market.

Despite the complexity of the studies presented, mainly because of the contacted entities lack of collaboration, they are reliable and represent a part of the reality of the construction material national market. The most obvious finding to emerge from this study is that:

- a great part of the products information, does not have scientific reliability, and is hard to access to. This situation takes credibility from the market, and makes even more urgent a system more neat and of easy access to any citizen;
- allied to the previous point it is incomprehensible, the disconnection between the construction sectors. Due to the ambition of pursuing their financial goals and own interests, a sustainable construction market is forgotten. It should be enhanced the Sweden example of the *Ecocycle Council for the Building Sector*, that although the initial difficulties in achieving a common consensus, it proved that it is possible to establish rules in a such extensive market;
- there is already a remarkable concern on the environmental sustainability in the media. However due to the lack of action to demand changes, and therefore, those who have the power to make these changes happen, it is clear to see how it has been postponed all these important measures to make something significant in the construction sector;
- there are already some government measures that can be an incentive to the recycled materials construction market (use of 5% of recycled products in public constructions (Portugal, 2011)), as well as a variety of products of good quality able to compete with products with raw materials. Nevertheless, there are still very few measures of this kind, and what it is worst is the inexistence of a state investment to create a pool and to finally understand that this might be the way to an absolutely necessary change.

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