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Current status and future challenges

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Environmental Product Declarations (EPDs) of construction products in Spain: Current status and future challenges

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Abstract. The current decarbonisation scenario demands a decrease in embodied and operational environmental impacts of buildings, wherein the Life Cycle Assessment (LCA) method and the Environmental Product Declaration (EPD) play a crucial role. The main objective of EPDs is to provide validated and geographically representative data to conduct LCA, since they play a major practical role in the application of LCA. However, development of EPDs in the European context remains irregular. Several countries, such as Germany and France, have a great number of EPDs of construction products, while other countries, such as Spain, present a much lower number. This study aims to analyse the existing EPDs of construction products developed in Spain, and to identify the EPD programs, the type of products (building system or element-associated), which LCA information modules are included, and the accuracy of the declared impact values. The results obtained show that ceramic cladding, gypsum plasterboard, cement, and clay products are those with the greatest number of EPDs. On the other hand, building service products have relatively few EPDs. Finally, several recommendations are proposed towards improving EPD development and challenges are detected.

1. Introduction

The current climate change scenario [1] and the challenges of decarbonisation [2] have increased the consideration of embodied and operational impacts during the building design process. The relevance of embodied impacts lies in the fact that they are recalled subsequent to the reduction of energy consumption in the operational phase and are related to the integration of materials and products into the building [3].

The requirement for the calculation of embodied emissions has risen in importance in current EU regulations [4]. The LCA method is he scientifically valid method to estimate the embodied impacts produced throughout the life cycle of a building [3]. The environmental data regarding the building elements, materials, and process plays a major role therein, and therefore the existing EN 15978 standards [5] for building LCA propose Environmental Product Declarations as verified certification to communicate the environmental performance of a specific product [6]. Moreover, EPDs can reduce uncertainties in the LCA results, due to the use of specific product information [7]. The EPD data sources are endorsed by the International Reference Life-Cycle Data (ILCD) System for the development of a consistent and robust LCA [8]. In order to adapt EDP data to a building, LCA is required to multiply the environmental performance factors from the EPD by the material quantities of this product, while using the same functional unit.

The implementation of LCA in the building design process is currently undergoing a phase of considerable growth, especially in the field of Green Building Rating Systems (GBRS) [6]. In the context of Europe, the use of EPDs to conduct the LCA is mandatory to meet a variety of requirements. For example, in BREEAM international [9], one of the requirements for the development of the LCA is to demonstrate the use of at least 5 regional/local materials and products from verified EPD data sources. The Verde certification of the Green Building Council España (GBCe) [10] requires the use of EPD for 70 to 100% (of total mass) of concrete, ceramics, gravel, and sand. For other materials, the use of EPD is required for 20 to 40% (of total mass). The use of EPDs is included for materials of the structure, insulation, and finishing. Furthermore, 50% of the EPDs should include a cradle-to-grave assessment in accordance with the EN 15804 standard [11].

Therefore, the greater the number and variety of materials and building products with geographically representative EPDs, the more feasible and easier it is to complete the LCA of the building in the design process and to achieve LCA credits for sustainability certification. The use of products from regional and local manufacturers can also contribute towards reducing the embodied impacts of building products and materials [3]. These facts provide evidence of the use of reliable, verifiable, and geographically representative information on the environmental performance of building products and materials. The level of development of the EPD programs and the number of regionally manufactured products with EPDs play a significant role. Although Spain has a limited number of EPD products (Figure 1) several strategies are being promoted in order to decarbonise the building sector and current studies highlight the LCA as relevant to this end [12].

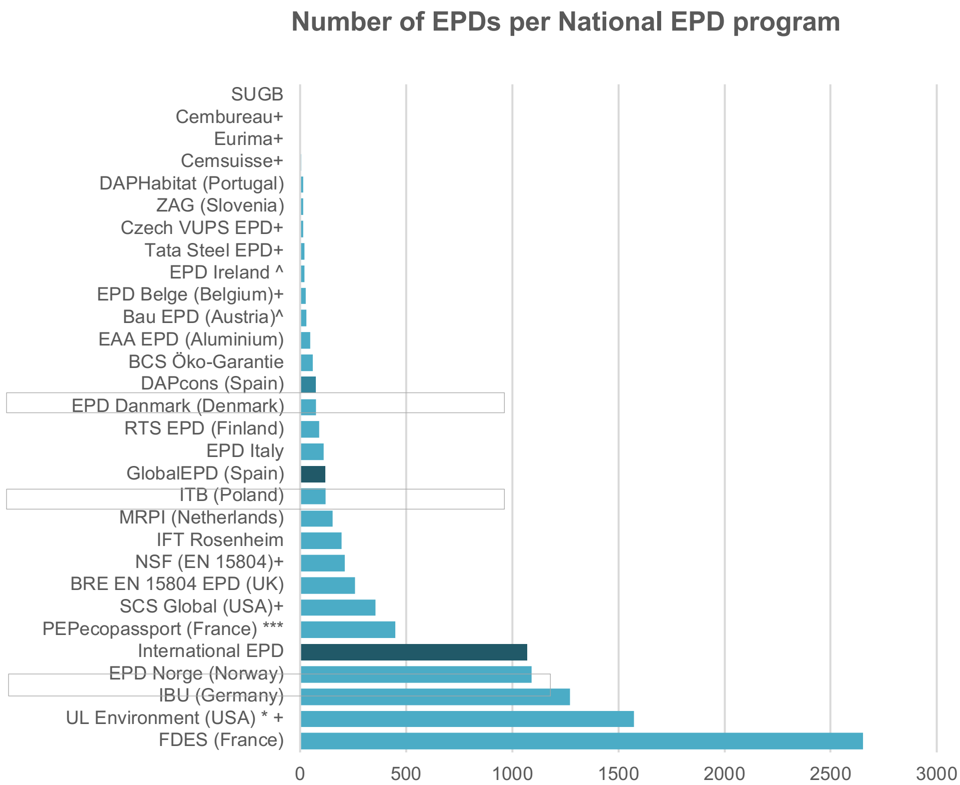

Figure 1. Existing National EPD programs and the number of EPDs that each program has published (Source based on: https://constructionlca.co.uk/)

In the European context, the use of EPDs in building LCA current practice implies several limitations. The review of existing studies in the field [6,13–15] suggests that there are two types of limitations. The first is related to the EPD market, derived from the costs and times of the certification process [13], which can limit accessibility to all types/scales of manufacturing firms. The second is related to the use of environmental data (verified and validated) in a building LCA. There are still only a limited number of construction products with EPDs [6], and in several cases they contain incomplete information on LCA modules [16] or provide data incompatible for comparison purposes, for example due to differences in Product Category Rule (PCR) programs [15]. However, the specific situation and recent developments in Spain have yet to be analysed. Questions therefore arise as to the identification of the existing EPD programs in Spain, and to the number of products that are included in each program. We also inquire as to which types of enterprises (scale) are developing EPDs of construction products, and, given the utility of EPDs to carry out an LCA in a building, which products are manufactured and certified in Spain that have an EPD and how many building systems can be assessed with these certified products/materials.

In order to respond to these questions and overcome these knowledge gaps, this study aims to analyse the main characteristics of the EPD market/development in Spain and the utility/scope of regionally representative EPDs in carrying out LCA and aims to detect the challenges to be addressed for an increase in the use of EPDs in LCA in current practice and in the GBRS. The focus of this study is on the identification of key aspects of the EPD certification process (such as certification programs), and on the product and manufacturer characteristics of the EPDs of construction products in Spain.

2. Methods

The study first conducts a compilation of existing EPD programs that have supported the development of geographically representative EPDs in Spain. The search has covered open-published EPDs that are valid at least until the end of 2021. It includes the three existing EPD programs in Spain: the international EPD® System; GlobalEPD (from the Asociación Española de Normalización y Certificación (AENOR)); and DAP Construcción, which all include products manufactured in Spain.

Secondly, the collected EPDs of different materials and products are analysed and classified. This includes the identification of the type of product and to which building systems it can be applied. The EDP comprises information related to the product and manufacturer characteristics (type of products, building system that the product can be used, the region in which that product is manufactured and the scale of the manufacturer). Finally, the analysis of the obtained results is presented, and the conclusions are drawn (see Figure 2).

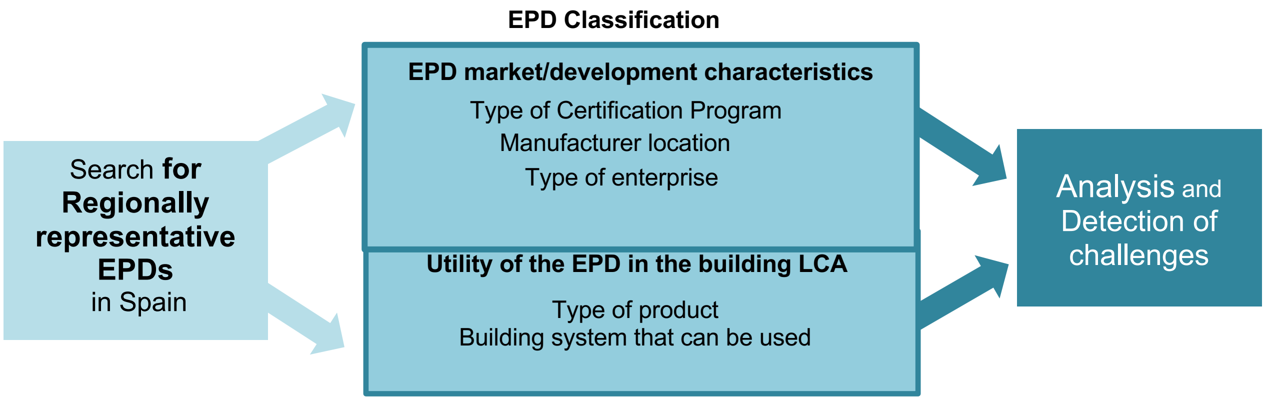

Figure 2. Schema of the methodology developed in this study.

3. Results

The results related to the EPD market (Figure 3) show that the most commonly used EPD program is EPD international (40%), followed by AENOR (33%) and DAPconstrucción (27%). AENOR (GlobalEPD) and DAP Construcción are Spanish national programs.

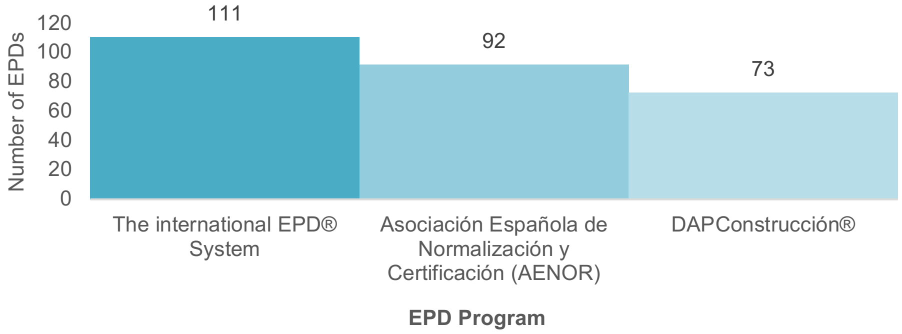

Figure 3. EPD by program

Table 1. Occurrence in the Spanish Provinces of the Construction Product (CP) Manufacturing Process

Summary by Region	Occurrence in the Spanish Province of the CP manufacturing process	Percentage
Andalusia	116	23%
Aragon	26	5%
Asturias	9	2%
Balearic Islands	0	0%
Canary Islands	3	1%
Cantabria	8	2%
Castilla la Mancha	27	5%
Castilla and León	17	3%
Catalunya	59	12%
Basque Country	34	7%
Extremadura	5	1%
Galicia	24	5%
Madrid	49	10%
Murcia	1	0%
Navarra	5	1%
La Rioja	21	4%
Valencia	90	18%

Table 1 shows the summary values of the occurrence of Spanish provinces where construction products with EPDs are manufactured. The region where the highest number of the construction products with EPDs have been fully or partially manufactured is Andalusia (23%), followed by Valencia (18%), Catalunya (12%), and Madrid (10%). Notice that several construction products are manufactured in different locations (the information declared in the EPD identified more than one manufacturer location) or the EPD has a sectorial certification that includes different manufacturers for the same product.

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This high number of EPDs in Andalusia can also be beneficial for regions such as the Algarve (Portugal). Table 1 also provides evidence that the construction product manufactured is generally not focused on one single province, and that there are sectorial EPDs that cover more than one province or region in Spain (17 EPDs).

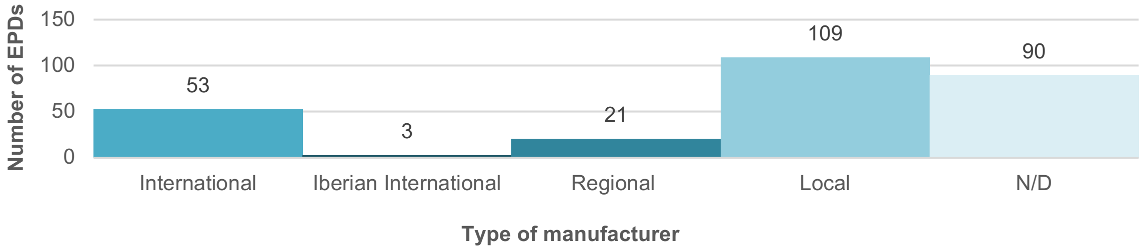

Figure 4. Number of EPDs per manufacturer scale.

The scale of the manufacturing firm is defined by the type of company and the manufacturer's location (e.g., if there is more than one location for the factories or just one) (Figure 4). The classification aims to detect four scales: International, Iberian (including Spain and Portugal), Regional (including more than one manufacturing point in Spain), and Local. Figure 4 shows that local-scale enterprises are producing more than half of the environmental product certifications. The classification follows the criteria to identify the location of the EPD manufacturing and the number of manufacturing points involved. For example, if the product manufacturing involves two manufacturing points in the same province, then it is considered a local scale. However, if the product is manufactured in more than one province (at least declared in the EPD that the enterprise has manufacturing points in different provinces) it is assumed that is a regional scale.

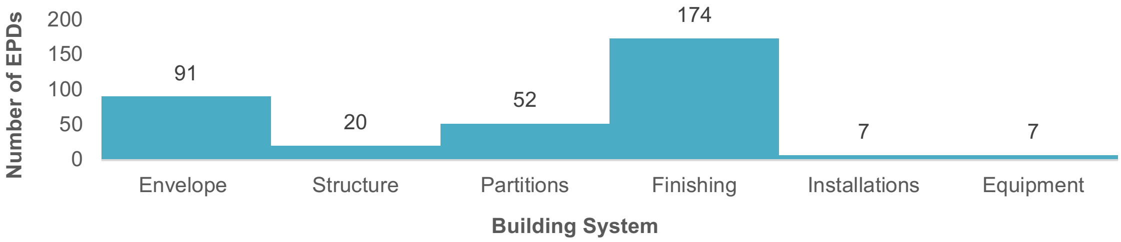

Figure 5. EPDs per building element.

The results related to the utility of EPD in the LCA of the building show that the finishing is the building system with the highest number of EPDs followed by the envelope (see Figure 5). The results also demonstrate that EPDs can be applied in more than one building system. For example, cement can be used in the structural system, in the partitions, and in the finishing systems.

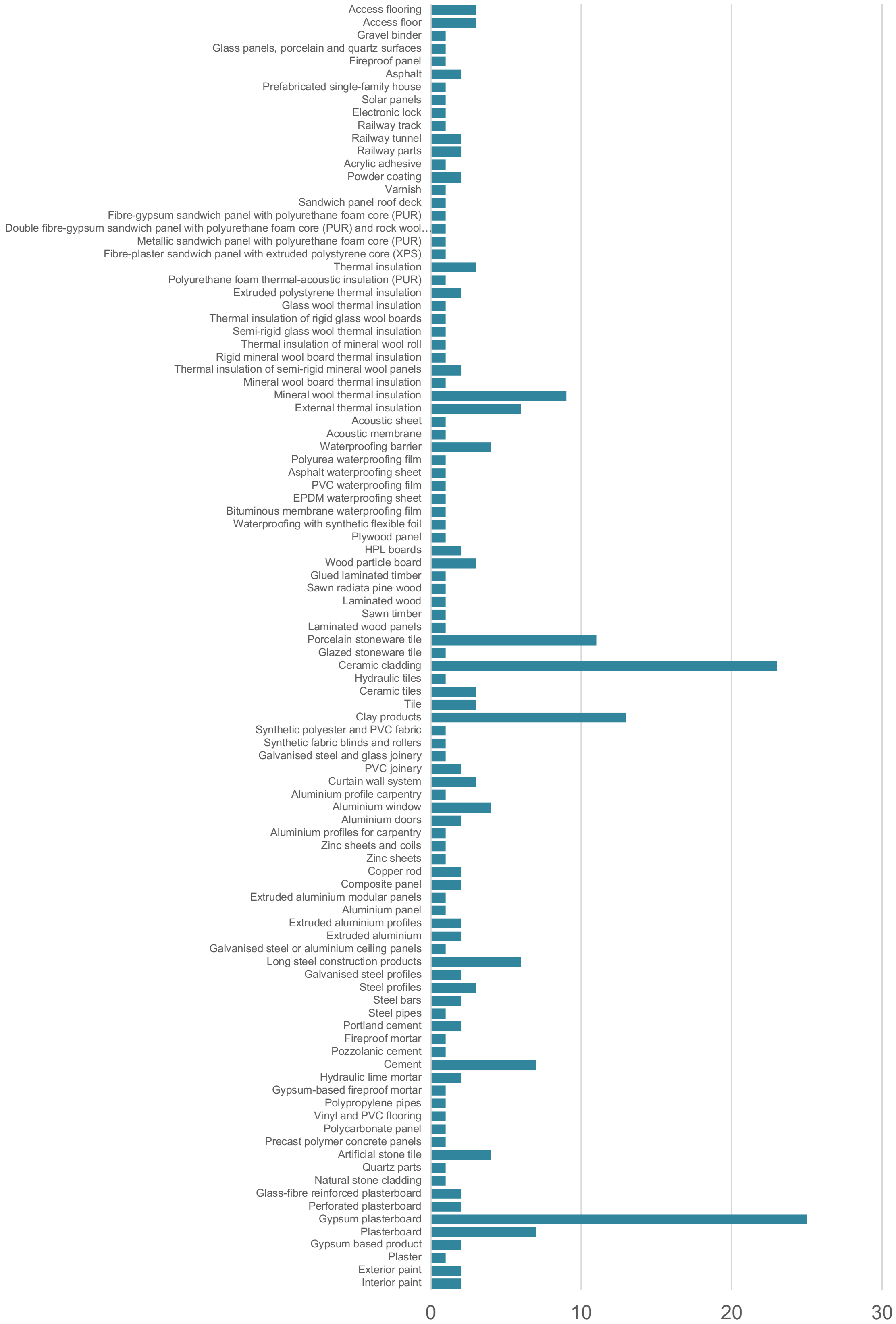

Figure 6. Number of EPDs per type of product.

Figure 6 shows that the product with the highest number of EPDs is gypsum plasterboard (25), followed by ceramic cladding (23), mineral wool from porcelain tiles, plasterboard, cement, steel construction products, clay products, and external thermal insulation.

4. Discussion

The present study focuses on drawing the state-of-the-art market and products characteristic of the construction product EPDs in Spain. The results show that most Spanish construction product EPDs are focused on the finishing system, and that the mean of the construction product with EPD is 2.45. Hence, on average, for each construction product, there are at least two products with EPD to be compared.

Results show (Table 1) that there is a diversification in the location of the manufacturers (one product is manufactured in more than one province or region), which can increase complexity in transport modelling. The EPDs should therefore provide a range of solutions to address this issue, especially sectorial manufacturer EPDs. Moreover, considering the limited number of construction products with EPDs (Figure 5), further research is needed to explore the extent to which the use of EPDs can render a complete building LCA feasible by considering a case study. This would demonstrate, for example, the limitations of existing materials and products with EPDs for a complete building LCA to be carried out.

The results show that there are more EPD programs in the Spanish context (currently three), compared to most other European countries (see Figure 1). It can be beneficial to increase the number of EPDs, nevertheless, the product comparability can be limited derived from differences in the impact results (e.g., in the functional unit definition). Differences in PCR programs can influence the EPD comparability. In several cases, when comparing the EPD results for the same type of product, the results had unexpected variations, far from the average values [15]. Moreover, different LCA stages and modules (system boundaries) can make the results differ. EPDs frequently fail to cover all the stages of the product life cycle [17]. Phases such as the construction, operation, or end-of-life, are not always included in the EPD results [17], even though, GBRS and existing EPD standards [11,18] endorse the use of complete life cycle EPDs. Therefore, one of the challenges detected herein involves the potential risk of the incomparability of results derived from the difference in certification programs. In this vein, the accuracy of the results and the comparability of different product EPDs with different PCR programs should be carefully analysed.

Given the difficulties in the detection of the product manufacturer location when analysing the EPDs, the results show that the Spanish region where most of the construction products are fully or partially manufactured is Andalusia (20% of concurrency rate). This fact increases the opportunities to promote the use of regional products with EPDs, in a region where their use is not frequently included in public building tenders, and with one of the lowest rates of GBRS-certified buildings in Spain [10]. Moreover, an unexpected observation reported in Figure 4 is that the highest number of EPDs are from local-scale manufacturers. It means that not only international-scale companies are interested in having this type of certification for their products and that the local market has started valuing this type of environmental certification. However, further effort should be invested in promoting, encouraging, and supporting construction product manufacturers to certify their products with environmental declarations Type III. Currently, the integration of construction products with EPDs into the building construction process and the execution of LCA using EPDs remain a voluntary action to attain several credits in the GBRS (the number of credits depends on the certification program). Therefore, more effort should be put into promulgating its relevance in the construction sector, thereby promoting not only training and dissemination of these types of certifications, but also the benefits of integrating the LCA method into the building design process.

5. Conclusions

The implementation of building LCA in GBRS and national regulations is increasing the requirement for the use of EPDs as a data source, even though generic datasets still need to be employed for the verification of the results and for the supply of missing information. This is increasing the development of these environmental declarations in various regions and countries. However, this increase has not been homogeneous across all countries and regions in Europe. Focused on analysing the status in Spain, this paper shows that in Spain the development of EPDs remains limited both in terms of the number of EPDs and the type of construction products (mostly finishing products) despite the considerably high number of Spanish national EPD programs (three). Furthermore, the existing number of EPDs suggest that there are limitations to conducting a complete building LCA using regionally representative EPDs in Spain. The results demonstrate that existing challenges are related to increasing the number and types of construction products with EPDs, thereby covering more structure, partitions, envelope, and equipment system products. Moreover, other challenges that need addressing are related to the harmonisation of the certification programs and PCRs. Finally, this study has also detected that the integration of the environmental assessment supported by verified and validated data sources (such as EPDs) should be a mandatory requirement supported by public institutions, and not merely relegated to voluntary application in GBRS.

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