EXPLORING EPDs FOR CONSTRUCTION SECTOR IN THE INDIAN CONTEXT

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ABSTRACT

This paper presents an analysis of the growing relevance of Environmental Product Declarations (EPDs) in the context of India's rapidly expanding construction sector. This is of significance due to the construction industry's substantial environmental footprint driven by material extraction, fabrication of building materials, and transportation. The study aims to examine the benefits and barriers associated with EPD adoption in India, with the objective of promoting sustainability in the built environment. To achieve this, the paper explores the utility of EPDs in enhancing transparency, supporting green building certifications, and strengthening manufacturers' competitiveness by offering verifiable environmental data. Key findings include that EPDs serve as critical tools for communicating the environmental performance of construction products, which helps mitigate embodied carbon and reduce instances of greenwashing. However, challenges such as high costs, limited awareness, technical complexity, lack of India-specific Product Category Rules (PCRs), and insufficient regulatory support currently hinder broader implementation. The implications suggest that addressing these barriers through policy incentives, awareness

campaigns, capacity-building programs, and industry-wide collaboration is essential for widespread adoption. This work contributes to the growing body of literature supporting the integration of EPDs into India's construction sector and emphasizes the need for systemic changes to align national practices with international sustainability standards, ultimately fostering a more environmentally responsible and future-ready construction industry.

KEYWORDS: *Environmental Product Declaration (EPD), Life Cycle Assessment (LCA), Sustainable Construction, India, Green Building, Environmental Impact.*

1. Introduction

The construction industry globally exerts a substantial environmental impact, contributing significantly to greenhouse gas emissions through material production, transportation, and construction processes, as well as consuming vast quantities of natural resources [1]. This considerable environmental burden has led to an increasing global awareness and concern, requiring a focused effort on adopting more sustainable practices within the built environment. Environmental Product Declarations (EPDs) have emerged as a crucial mechanism to address this concern by providing a standardized and transparent means of communicating the environmental performance of construction materials and products throughout their lifecycle [2]. A key aspect of this environmental impact is the total greenhouse gas emissions associated with all stages of a building material's life, from raw material extraction to its eventual disposal [3]. In the context of India, the construction sector is experiencing rapid growth, fuelled by rapid urbanization and infrastructure development. This expansion makes it crucial to integrate sustainable development principles into the core of the industry, and EPDs hold the potential to be a vital tool in this transition. This paper aims to thoroughly explore the potential benefits and inherent challenges associated with the widespread adoption and effective implementation of EPDs within the Indian construction sector, examining their role in promoting a more sustainable and environmentally responsible built environment.

2. Environmental Product Declarations EPDs

EPDs are standardized, independently verified documents that offer a comprehensive overview of a product's environmental impact throughout its entire lifecycle [2]. These documents are similar to nutrition labels on the food products but applied in case of building materials, providing transparent and quantifiable data on various environmental indicators [4]. The information presented in an EPD is based on the Life Cycle Assessment (LCA), which systematically measures

the environmental impacts associated with a product from its raw material extraction and manufacturing to its use phase and end-of-life stage [4]. To ensure consistency and comparability between EPDs for similar products, the LCA must adhere to specific Product Category Rules (PCRs) [1]. These rules define the specific methods and assumptions for conducting the LCA, ensuring that all the EPDs for a particular product type are directly comparable. An important part of EPDs is their third-party verification by independent and accredited organizations, which lends credibility and ensures the accuracy of the environmental data presented [2]. This verification process builds trust among users and enhances the value of EPDs for certification purposes.

The core purpose of EPDs is to communicate transparent and comparable environmental performance data throughout a product's lifecycle to a wide range of stakeholders [2]. This transparency enables informed decision-making by manufacturers, architects, engineers, contractors, and policymakers. EPDs facilitate standardized and fair comparisons of the environmental performance of functionally equivalent products, allowing for the selection of more sustainable options [2]. Furthermore, EPDs play a crucial role in achieving credits and meeting the requirements of green building certification schemes such as LEED, BREEAM, and others, as well as in facilitating green public procurement initiatives [5].

EPDs offer significant benefits to various stakeholders in the construction industry. For manufacturers, they provide opportunities for market differentiation by showcasing their commitment to environmental transparency, enhancing their brand reputation and building trust with environmentally conscious customers [2]. Furthermore, EPDs help manufacturers meet increasingly stringent regulatory requirements and identify areas within their production processes where they can optimize resource use and reduce their environmental impact. For architects, engineers, and designers, EPDs serve as a valuable tool for making informed decisions about

material selection, enabling them to choose products with lower environmental footprints and thereby reduce the overall embodied carbon of their building projects [5]. This ultimately contributes to achieving their sustainability goals and meeting the growing demand from clients for greener buildings. Contractors benefit from EPDs by being able to specify and use materials that comply with increasingly stringent client and regulatory demands for sustainable construction [5]. For policymakers, EPDs offer a valuable data source for understanding the environmental performance of the construction sector, enabling them to develop informed regulations and policies aimed at reducing embodied carbon and track progress towards national and international sustainability targets [2].

The foundation of EPDs lies in adherence to fundamental principles and international standards. ISO 14025 is the globally recognized standard that establishes the principles and procedures for developing Type III environmental declarations, providing a consistent framework for EPD creation and communication [5]. Product Category Rules (PCRs) are equally critical, as they specify the rules, requirements, and guidelines for developing EPDs for a particular product category, ensuring that EPDs within the same category are based on consistent methodologies and are therefore comparable [1]. The underlying Life Cycle Assessments (LCAs) are conducted according to the principles and framework outlined in ISO 14040 and ISO 14044 [5]. Furthermore, EN 15804 provides the rules specifically for the product category of construction products' EPDs in Europe and has gained widespread adoption globally [5]. These standards collectively ensure a robust and internationally harmonized approach to EPD development and utilization in the construction sector.

3. Current Global State of EPDs in the Construction Sector

A review of existing literature highlights the growing global recognition of EPDs as essential tools for evaluating and reducing the environmental impact of the construction industry [6]. Studies from various countries demonstrate the application of EPDs in building lifecycle assessments, facilitating the selection of materials with lower environmental footprints, and promoting more sustainable construction practices. Industry reports also support the increasing demand for and utilization of EPDs by a diverse range of stakeholders across the construction value chain [1]. These reports indicate a clear trend towards the mainstreaming of EPDs as a means of enhancing transparency and enabling informed decision-making in the pursuit of more sustainable buildings and infrastructure.

Globally, numerous EPD programs and program operators have emerged to satisfy the increasing demand for environmental declarations in the construction sector [7]. These programs operate across different regions, including Europe, North America, Asia, and Australia, and adhere to various international standards such as EN 15804 and ISO 21930. Each program may have its own specific characteristics, geographical focus, and emphasis on particular product categories. For instance, the International EPD System has a global reach and is recognized as the inventor of the EPD and PCR concepts [7]. In North America, programs like UL, ASTM International, and NSF International have established themselves as key providers of EPD verification services [8]. Software platforms like One Click LCA and Ecochain operate globally, offering tools for conducting LCAs and generating EPDs. Europe has a well-established EPD landscape with prominent programs such as IBU in Germany, EPD Norge in Norway, and BRE Global in the UK [9]. The emergence of EPD databases and platforms, such as EC3 in the USA and various country-specific databases in Europe, further facilitates the accessibility and usability of EPD data for construction professionals. Table 1 provides an overview of some of the key EPD programs and

program operators worldwide, including their region of origin, the standards they comply with, and the key features.

Table 1: Overview of Global and Regional EPD Programs and Tools

Program Name	Region/Country	Standards Complied	Key Features/Focus
The International EPD System	Global	ISO 14025, EN 15804	Global coverage, inventor of EPD and PCR concepts
UL	USA	ISO 14025, EN 15804	Product certification, SPOT database
ASTM International	USA	ISO 14025, ISO 21930	Focus on PCR development, public PCR/EPD database
NSF International	USA	ISO 14025, EN 15804	Public health standards, testing, and certifications
One Click LCA	Global	ISO 14025, EN 15804	Software for LCA/EPD generation, large database
Institut Bauen und Wmwelt (IBU)	Germany	ISO 14025, EN 15804	Major European program for construction products
EPD Norge	Norway	ISO 14025, EN 15804	National program for Norway
BRE Global	UK	ISO 14025, EN 15804	Leading UK program for construction products
EPD Italy	Italy	ISO 14025, EN 15804	National program for Italy

EPD Denmark	Denmark	ISO 14025, EN 15804	National program for Denmark
FDES (PEP ecopassport)	France	ISO 14025, EN 15804	Focus on electrical and electronic products
EPD Ireland	Ireland	ISO 14025, EN 15804	National program for Ireland
SCS Global Services	USA	ISO 14025, EN 15804	Sustainability certifications
Global Green Tag	Australia	ISO 14025, EN 15804	Focus on green building products
EPD Australasia	Australia and New Zealand	ISO 14025, EN 15804	Regional program for Australia and New Zealand
EPD China	China	ISO 14025, EN 15804	National program for China
EPD India	India and Bangladesh	ISO 14025, EN 15804	Regional hub for the International EPD System
EC3 Tool	USA	ISO 14025, ISO 21930	EPD database for construction products

The adoption of EPDs in the construction sector has witnessed substantial growth globally in recent years. The number of published EPDs has increased exponentially, indicating a rising awareness and commitment to environmental transparency [1]. This growth is driven by many things, including projects seeking green financing and a growing demand for sustainable and low-carbon building materials from architects, engineers, and clients [2]. Government regulations and procurement policies in regions like the European Union and parts of North America are increasingly mandating or incentivizing the use of products with EPDs [2]. A noteworthy

development is the introduction of the Global Cement and Concrete Associations' (GCCA) carbon rating system, for which EPD serves as a prerequisite. This system allows for the carbon footprint of cement and concrete products to be rated, providing a clear and standardized way to assess and compare their environmental performance. [10]. Furthermore, the growing influence of green building certification schemes, such as LEED and BREEAM, which recognize and reward the use of products with EPDs, is also a significant factor [5]. The development of more specific and PCRs is also a notable trend, reflecting a move towards greater accuracy and relevance of EPDs for particular product categories.

4. Need for Adoption of EPDs in India

India's construction sector is currently experiencing rapid growth, driven by extensive urbanization and ambitious infrastructure development initiatives. This expansion presents a significant opportunity to steer the industry towards more sustainable building practices and mitigate its substantial environmental footprint. Adopting EPDs can play a pivotal role in this transition by providing the necessary transparency and data for informed decision-making. There is a growing awareness in India regarding the embodied carbon emissions associated with construction materials, and EPDs offer a reliable means to quantify, track, and ultimately reduce these emissions. By providing transparent environmental data, EPDs can facilitate the selection and increased use of more sustainable and low-carbon construction materials in India, contributing to a greener and more environmentally responsible built environment. Furthermore, the adoption of EPDs can promote greater transparency and accountability concerning the environmental performance of construction products within the Indian market, helping to curb instances of "greenwashing" and fostering greater trust among consumers and stakeholders [11].

The adoption of EPDs in India aligns with the nation's environmental regulations and supports its broader sustainability goals and commitments under international agreements. Its widespread adoption and use can provide a clear pathway for the decarbonization of the construction sector, which is essential for India to meet its long-term target of net-zero emissions by 2070. As India strives to balance economic growth with environmental stewardship, EPDs can serve as a valuable tool for monitoring progress and achieving its sustainability targets. Moreover, EPDs can facilitate the growth and wider adoption of green building certification systems in India, such as those offered by the Indian Green Building Council (IGBC) and GRIHA (Green Rating for Integrated Habitat Assessment) [12]. By providing the necessary environmental performance data for material assessment, EPDs contribute to increasing the number of certified green buildings across the country, enhancing their market value and environmental credibility. For Indian manufacturers and construction companies, providing EPDs can be a significant differentiator, enabling them to meet these evolving market expectations and potentially gain a competitive advantage in the rapidly growing green building sector. This competitive edge extends beyond domestic borders, as having verified EPDs can provide export opportunities to countries with strict environmental regulations, such as the European Union, which increasingly demands low-carbon footprint products. Furthermore, as carbon finance is gaining importance, the precise emissions data within EPDs becomes invaluable, providing the credible verification required for companies to participate in the carbon markets and trade carbon credits.

5. Challenges for EPD adoption in India

Despite the clear need and numerous benefits associated with EPDs, the widespread adoption and effective implementation of these declarations in the Indian construction sector face several significant challenges. One of the primary obstacles is the current low level of awareness and understanding regarding the concept, benefits, and practicalities of EPD development and

utilization among key stakeholders, including manufacturers of construction materials, architects, engineers, contractors, and policymakers across India [6]. This lack of familiarity hinders both the supply of EPDs from manufacturers and the demand for them from the construction industry. Another significant barrier is the high costs associated with undertaking comprehensive Life Cycle Assessments (LCAs) and subsequently developing verified EPDs. These costs can be particularly very significant for small and medium-sized enterprises (SMEs), which constitute a substantial portion of the Indian construction materials market. The technical complexity involved in the EPD development process also presents a challenge, requiring specialized expertise in LCA methodologies, intricate data collection, and strict adherence to specific international standards and PCRs. The limited availability of locally relevant PCRs that are specifically tailored to the unique characteristics of Indian construction materials, manufacturing processes, and diverse regional contexts further complicates the process. Relying solely on international PCRs might not always accurately capture the specific environmental impacts within the Indian context. Accessing reliable, and India-specific life cycle inventory (LCI) data for various construction materials and processes is also a major hurdle. Without robust local LCI data, the accuracy and relevance of EPDs developed for the Indian market can be compromised.

The current lack of strong regulatory policies or specific policy incentives from the Indian government to actively promote and encourage the widespread adoption and use of EPDs in the construction sector also acts as a significant impediment [6]. The absence of clear governmental signals and support can significantly slow down the rate of adoption. The inherently fragmented nature of the Indian construction industry and its often complex and informal supply chains can make data collection, collaboration among stakeholders, and the implementation of standardized EPD practices considerably more difficult. There is also a potential risk of "greenwashing" or misleading environmental claims if EPDs are not subjected to rigorous third-party verification

processes or if the underlying data is not entirely transparent and reliable [5]. Maintaining the credibility and integrity of EPDs is paramount to their effectiveness in genuinely promoting sustainability. Finally, there is a degree of inherent resistance to adopting new practices and technologies within the traditional Indian construction industry, where immediate cost considerations often take precedence over longer-term environmental benefits. Overcoming these established practices requires effectively demonstrating the long-term value and broader benefits of EPDs that extend beyond immediate financial implications.

6. Proposed Suggestions to Tackle the Challenges in EPD Adoption

To overcome the existing challenges and facilitate the widespread adoption of EPDs in the Indian construction sector, a multi-layered approach involving policy interventions, awareness and capacity building initiatives, promotion of collaboration and standardization, fostering a circular economy, and leveraging the role of construction industry associations is essential. The Indian government can play a crucial role by implementing clear and consistent regulations that require the use of EPDs for specific types of public infrastructure projects or for building materials exceeding certain environmental impact thresholds. Providing financial incentives, such as subsidies, tax breaks, or grants, can also encourage manufacturers, particularly SMEs, to invest in conducting LCAs and developing verified EPDs for their construction products. Integrating EPD requirements at both the national and state levels would further create a strong market demand for environmentally declared products. Furthermore, the development of India-specific PCRs through collaborative efforts involving government agencies like the Bureau of Indian Standards (BIS), industry associations, academic institutions, and LCA experts is crucial to better reflect the Indian context.

Widespread awareness campaigns, workshops, and comprehensive training programs targeting manufacturers, construction professionals, architects, engineers, and policymakers are vital to educate them on the importance, benefits, and practical aspects of EPDs. Integrating LCA and EPD concepts into the curriculum of architecture, engineering, and construction management programs at Indian universities and technical institutions will help build an understanding about the importance of EPDs and their use and projected demand in future. Promoting the establishment of national and regional industry platforms, forums dedicated to EPDs in the construction sector will facilitate collaboration and the exchange of best practices among stakeholders [13]. Encouraging greater collaboration between construction material manufacturers and LCA consultants, potentially through government-supported programs that provide technical assistance and resources for EPD development, can streamline the process [4]. Developing and adopting standardized templates, guidelines, and user-friendly digital tools can further simplify the creation, verification, and accessibility of EPDs. Promoting the use of industry-average EPDs, developed by relevant industry associations, can serve as a more accessible and cost-effective entry point for manufacturers, particularly SMEs.

Supporting the establishment of efficient infrastructure and systems for the collection, processing, and reuse of construction and demolition waste, while integrating EPD data to accurately track the environmental performance of these circular economy initiatives, will further contribute to sustainability. Construction industry associations in India, such as the Builders' Association of India (BAI), the Indian Green Building Council (IGBC), the Confederation of Indian Industry (CII), and various material-specific associations, have a significant role to play in raising awareness about EPDs, developing industry-specific PCRs, providing essential training and resources to their members, and actively advocating for supportive government policies that promote their adoption [5]. Highlighting existing initiatives undertaken by these associations to

promote sustainable construction practices and the use of EPDs can further encourage wider engagement and the development of new efforts.

7. Conclusions

EPDs stand as an essential tool for the Indian construction sector, offering a standardized and transparent means to quantify and communicate the environmental impacts of building materials and products. Their core purpose lies in providing objective, comparable, and third-party verified data, empowering stakeholders to make informed decisions that contribute to a more sustainable built environment. The global landscape reveals a significant and growing trend in EPD adoption, driven by increasing environmental awareness, stringent regulations in various regions, and the influence of green building certification schemes. This global trend underscores the importance and relevance of EPDs in the pursuit of a more environmentally responsible construction industry. For India, the need to embrace EPDs is particularly critical given its rapidly expanding construction sector and the urgent need to mitigate its environmental footprint. The adoption of EPDs can facilitate the selection of low-carbon materials, promote transparency, support green building certifications, and enhance the competitiveness of Indian manufacturers in the global market. However, the widespread implementation of EPDs in India is currently hindered by several challenges, including limited awareness, high costs, technical complexities, lack of local PCRs and LCI data, and insufficient regulatory support. To overcome these obstacles and unlock the full potential of EPDs, a concerted effort is required from all stakeholders. This includes proactive policy interventions and strong government support, comprehensive awareness and capacity building initiatives, the promotion of collaboration and standardization across the industry, a dedicated focus on fostering a circular economy within the construction sector, and a proactive role for construction industry associations in driving the adoption of sustainable practices. By addressing these challenges strategically and collaboratively, India can harness the

transformative power of EPDs to make its construction industry a more environmentally responsible and sustainable, aligning it with global best practices and contributing to a greener built environment for all.

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