



Environmental Product Declarations worldwide: a case study in Argentina

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Abstract

Purpose This article is an exploratory study carried out from the National Institute of Industrial Technology of Argentina (INTI) with the aim of reviewing the development of the Environmental Product Declarations (EPD) registered and published by the different operators worldwide and also to investigate the potential use of EPD programs as a marketing and environmental communication tool for Argentine companies.

Methodology In the first stage of the study, the different EPD program operators were investigated by year, geographic scope and sector, considering the compliance of the programs with the ISO 14025 standard. Additionally, the need to advance in harmonization processes was analyzed, given the growing number of programs with different requirements around the world. In the second stage, the factors that influence the demand of companies for environmental impact analysis and the potential adoption of EPD programs in the Argentine market were investigated. The research was carried out through an online survey aimed at identifying the main drivers that determine the participation of companies in sectoral studies and/or start the application to an EPD program, the target audience, and the tools used to communicate the environmental impact of their products or services.

Results and discussion Type III environmental declarations have grown exponentially worldwide since the creation of the first program and The International EPD[®] System AB is today the most developed operator under the parameters of the ISO 14025 standard. The research also shows a positive trend towards the implementation of EPD programs in Argentine companies, in line with the growing demand for EPD programs around the world.

Conclusions Among the main findings of the study, it can be observed that the increasing number of EPD schemes with different requirements can lead to trade barriers in the market, which could be avoided by mutual recognition agreements between the different schemes, reducing time, costs, and documentation. Regarding the environmental impact analysis and/or EPDs programs in Argentine companies, the survey shows that most of the related products or services are intended for export and that the implementation is mainly motivated by the company's environmental policy, corporate image, competitiveness, and access to new markets.

Keywords Environmental Product Declarations (EPD) · Type III labeling · Product category rules · PCR · Argentina · ISO 14025

1 Introduction

An Environmental Product Declaration (EPD), also referred to as Type III environmental declaration, is a tool that communicates transparent and comparable information on the environmental impact of a product or service during its cycle

of life. The ISO 14025 establishes the principles and procedures for developing Type III environmental declarations and environmental declaration programs.

According to ISO 14025, program operators must draft, implement, periodically update and publish a General Program of Instructions (GPI), which establishes the requirements for the administration and operation of the EPD program. In addition, the standard determines that operators must customize the Product Category Rules (PCR) for a group of products and Sub-Product Category Rules (Sub-PCR), adding complementary methodologies to the GPI so that EPD programs allow similar products to be evaluated against the same criteria during the LCA. Furthermore,

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the ISO 14027 standard provides principles, requirements, and guidelines for developing, reviewing, registering, and updating PCR (ISO 14027 2017). Product category rules are important because they provide guidance on how life cycle environmental impacts should be estimated and reported for a category of products (Stevenson and Ingwersen 2011; Moré et al. 2022).

Different studies show that, from the consumer's point of view, the meaning of ecolabels and the interpretation of the environmental information they offer is often quite confusing. In this respect, the Flash Eurobarometer (European Commission 2013) concludes that, amongst others, only 7% of consumers believe that ecolabels provide sufficient, clear, and easy to understand information about the environmental impact of products, whereas 32% think that ecolabels provide sufficient information, but that it is not altogether clear (Ibáñez Forés et al. 2015).

The Eurobarometer confirms that more than half of European citizens have seen or heard of at least one eco-label. Among those who are aware of at least one ecolabel, 30% said they have bought a product bearing the EU ecolabel. Around a third of respondents (32%) reported that eco-labels play an important role in their purchasing decisions, while a quarter (25%) assumed they do not. Another key point is that young people are more likely to have bought EU ecolabel products (34% between 15 and 24 and 35% between 25 and 39) compared to 24% of those aged 55 and over (Eurobarometer October 2017).

Bergman et al. described that there is a growing demand from consumers to develop a framework for producing EPDs in the USA to meet growing national and international demands. According to the authors, the ability of EPDs to display environmental information about products and services in a consistent and verifiable manner has made them an important instrument in environmental perspective markets, especially in EU countries where this type of communication tool has grown exponentially (Bergman and Adam 2011).

EPD programs have grown over the last 10 years, and many countries have become operators on their own or have obtained representation as partners. Minkov et al. provided an overview of the status of EPD programs, where 27 EPD programs were found in May 2013. However, 39 EPD programs were found worldwide in February 2015 (Minkov et al. 2015). The dynamics of the EPD program in the market merited an update of the already existing analysis (cf. Table 1).

Created in 1998, The International EPD® System is the pioneer program worldwide, whose operator is located in Sweden. It has subsidiaries in Turkey, Australasia (Australia and New Zealand), Latin America (Mexico and Chile), Brazil, Argentina, Egypt, Russia, Southeast Asia (Singapore, Malaysia, Vietnam, and the Philippines), South Africa, India, and North America (the USA and Canada).

ECO Platform is an umbrella organization for EPD program operators but involves other relevant stakeholder groups. Currently, it has 64 members including The International EPD® System AB. As of the beginning of January 2022, the platform displays more than 12,000 EPDs according to EN 15804 for construction products registered worldwide (Eco Platform AISBL 2022; EN 15804 2019).

Other important member operators are Institut Bauen und Umwelt e.V. (Germany), Association PEP (France), INIES (France), The Norwegian EPD Foundation (Norway), BRE Global Limited (UK), and Stichting MRPI (Netherlands). The Sustainable Management Promotion Organization (Japan) and the Korean Environmental Industry and Technology Institute (Korea) should also be included in this list.

Bergman and Taylor described that France and other European countries have been developing sustainability initiatives and promoting EPD programs for their products. For example, in 2008, France announced the implementation of EPD programs for commodities sold within its borders by January 2011, a deadline that has since been delayed but never lifted. In addition to promoting EPD programs within the country, France is developing an industrial policy action plan with the aim of improving the environmental performance of products while promoting consumer understanding of these improvements in the European countries (Bergman and Adam 2011).

Recently, the US government assigned to the Environmental Protection Agency for fiscal year 2022 the sum of USD 250,000,000 (available until 2031) to implement a program that supports the development and harmonization of Type III environmental declarations, including measurements of greenhouse gas emissions for construction materials and products. In this context, the federal government will grant subsidies and technical assistance to companies in the construction sector for the preparation and verification of Type III environmental declarations, as well as to states and non-profit organizations that promote the reduction of the amount of carbon associated with construction materials and products (Senate of the United States 2022).

In addition, active EPD programs were identified in Thailand, Chile, and Turkey. However, some operators signed a contract as partners with The International EPD® System AB such as Brazil, Mexico, India, Russia, Australia, and New Zealand in 2020. Additionally, Egypt, Argentina, and South Africa were incorporated as partners in 2021. Therefore, with this strategy, the Swedish company has developed a significant share in the global market for operators.

According to Villa Alves et al., there are some programs in South America to assess the environmental impacts of different products; for example, Embrapa (Brazil) designed a methodology to describe carbon neutralization in beef. However, said methodology does not comply with the ISO

Table 1 EPD-like programs

Scheme name	Origin country	Geographic scope	Industrial sector scope	Year of foundation
The International EPD® System	Sweden	International	Generic	1998
Earthsure Institute for Environmental Research and Education (IERE)	USA	International	Generic	2000
SCSglobal (SCS)	USA	International	Generic	2000
ECO-LEAF*	Japan	International	Generic	2002
Korean Environmental Industry & Technology Institute EPD (KEITI EPD)	Korea	International	Generic	2002
Stichting MRPI (MRPI)	Netherlands	National	Building and construction	2002
The Norwegian EPD Foundation (EPD-Norge)	Norway	International	Generic	2002
Institut Bauen und Umwelt e.V. (IBU)	Germany	International	Building and construction	2004
Instytut Techniki Budowlanej (ITB)	Poland	International	Building and construction	2004
European Aluminium Association (EAA)	Europe	Europe	Aluminium	2005
Danish Environmental Protection Agency (EPD-DK)	Denmark	International	Generic	2006
Environment and Development Foundation (EDF)**	TW	Unclear	Unclear	2006
INIES (FDES INIES)	France	International	Building and construction	2006
Association PEP (PEP Ecopassport)	France	International	Electronic, electric & HVACR	2007
BRE Global Limited (BRE UK)	UK	International	Building and construction	2008
Sistema Declaraciones Ambientales de Productos por la construcción (DAP)	Spain	National	Building and construction	2008
Carbon Leadership Forum (CLF)	USA	International	Building and construction	2009
Agence de l'Environnement et de la Maîtrise de l'Energie + AFNOR (ADEME)	France	International	Generic	2011
Confederation of European Paper Industries (CEPI)	Europe	Europe	Paper	2011
FP Innovations (FP)	Canada	Unclear	Wood products	2011
IFT Rosenheim (IFT)	DE	National	Building and construction	2011
NSF International (NSF)	USA	North America	Generic	2011
The Spanish Association for Standard-ization and Certification (AENOR EPD)	Spain	International	Generic	2011
UL Environment (UL)	USA	International	Generic	2011
Centrum environmentálních prohlášení (CENDEC)	Czech Republic	National	Generic	2012
Canadian Standard Association Group (CSA)	Canada	International	Generic	2012
Declaración Ambiental de Productos de Construcción (DAPCO)	Chile	National	Building and construction	2012
Global GreenTag (GGT)	Australia	International	Generic	2012
ICC Evaluation Service (ICC-ES)	USA	North America	Building and construction	2012
ASTM International (ASTM)	USA	North America	Generic	2013
National Ready Mixed Concrete Association (NRMCA)	USA	International	Ready mixed concrete	2013
Product Environmental Footprint (PEF)	Europe	Europe	Generic	2013
Slovenian National Building and Civil Engineering Institute (ZAG EPD)	Slovenia	National	Building and construction	2013
The Austrian EPD Platform (EPD-AT)	Austrian	Europe	Building and construction	2013
The DAPHabitat system (DAPH)	Portugal	National	Building and construction	2013
The International EPD® System Türkiye	Turkey	International	Generic	2015
The International EPD® System Australasia	Australia & New Zealand	International	Building and construction	2015
The International EPD® System Latam	Mexico & Chile	International	Generic	2015
The International EPD® System Brazil	Brazil	International	Generic	2017
The International EPD® System India	India & Bangladesh	International	Generic	2017
The International EPD® System Russia	Russia	International	Generic	2018
The International EPD® System Egypt	Egypt	International	Generic	2020
The International EPD® System Southeast Asia	Singapore, Malaysia, etc	International	Generic	2020

Table 1 (continued)

Scheme name	Origin country	Geographic scope	Industrial sector scope	Year of foundation
The International EPD® System Argentina	Argentina	International	Generic	2021
The International EPD® System Southern Africa	South Africa	International	Generic	2022
The North American EPD System	USA & Canada	International	Generic	2022

References:

*ECO-LEAF has been integrated with CFP (Carbon Footprint of Products) and operated as “Japan EPD Program by SuMPO” since 2022

**EDF is a founding member of the Global Network for Environmental Declarations (GEDnet). EDF has signed an agreement with The International EPD® System AB and provides the following services: EPD certification, PCR development, establishment and maintenance of an international PCR database

14040/44 (2008) standard, nor with the ISO 14067 standard and only attempts to neutralize enteric methane (Alves et al. 2018).

This paper essentially has two specific aims. On the one hand, it is intended to review the development of the Environmental Product Declarations published by the different operators worldwide (cf. Sect. 3). On the other hand, it also aims to identify the motivating factors of Argentina industrial companies that have led them to choose to participate in an environmental impact analysis of the industrial sector and/or start applying for EPD programs (cf. Sect. 4).

2 Development of EPD & PCR registered and published worldwide

The first stage of the study consisted of analyzing the development of the EPD & PCR registered and published by different operators worldwide, from 1998—when the first system was created—to the present. Different operators of EPD-type programs were investigated by year, geographical area, and sectoral scope, considering the conformity of the programs with the ISO 14025 standard.

In addition, the harmonization of EPD-type programs was investigated, and finally the evolution of The International EPD® System was analyzed as it was the pioneer program, initially implemented at a European level and whose scope was later extended worldwide.

2.1 EPD-like programs

There are not many articles related to EPD in the scientific literature. Minkov et al. (2015) offer an overview of the February 2015 state of the art listing 39 EPD programs (Minkov et al. 2015).

As far as the evaluation of the transparency of the EPD programs is concerned, the clause 5.5 of ISO 14025 (ISO 14025 2006) states that the program operator shall be responsible for ensuring credibility and transparency in the operation. Likewise, in clause 5.9 of the same standard,

additional obligations are established to ensure transparency of the schemes, including public access to the GPI, a list of all the PCR documents, etc.

The obligation of the program operators to develop such program instructions is defined by clause 6.4 of ISO 14025, while the requirements for the development of PCR are defined in clause 6.7 and the Type III environmental declarations requirements in clause 7 of the same standard. In the present analysis, these three clauses were used as the main criteria for evaluating all existing EPD schemes up to October 15th, 2022.

Carbon Footprint and Water Footprint programs are not included in this study, as they address only two categories of environmental impact, which may lead to an incorrect interpretation of the outcomes. Carbon Footprint (ISO 14067 2018) and Water Footprint (ISO 14046 2014) are considered a climate declaration and are partial environmental declaration in compliance with ISO 14025 standard. The concept of climate declaration was introduced by The International EPD® System AB in 2007 and was then named “single-issue EPD” in the market. The concept simplifies that a climate declaration is an EPD according to ISO 14025; however, the information focuses on the product’s climate impact. The climate declarations may be published in parallel to EPD as a complementary communication format. However, if the specific product’s EPD climate declaration (CD) is not available, EPD consider that the same information can still be obtained in the EPDs that have been registered (EPD International AB 2021).

There are currently a large number of EPD-like programs in many countries around the world. In all continents, there are programs to assess the environmental impacts of products or services, although not all meet the requirements of ISO 14025. The International Organization for Standardization (ISO) has developed standards for eco-labeling to help structure and reduce the confusion among consumers, as the term eco-label encompasses many different interpretations in specific labels, as well as programs, schemes, etc.

Table 1 provides an overview of EPD-like programs ordered per year of foundation, including aspects such as

the geographical and sectorial scope. The last update was made on October 15th, 2022.

The analysis shows that the number of programs using PCR is very high. However, several are not fully compliant with ISO 14025. The International EPD® System AB is the operator with the most developed environmental declarations Type III in the world, which works under the strict parameters of ISO 14025.

Figure 1 shows the evolution of EPD-type programs from 1998, when the International EPD® System was implemented, to the present. The results show a trend of sustained growth of the programs in the period under analysis.

A small number of operators have registered and published a significant number of PCRs: The International EPD® System AB (Sweden) with 185 PCR, SCSglobal (USA) with 98 PCR, and ECO-LEAF (Japan) with 83 PCR. UL Environment (USA) has 42 Sub-PCR published.

Some of the operators with the largest registration and publication of EPDs are INIES (France) with 6491 EPDs, The International EPD® System AB (Sweden) with 4003 EPD, Association PEP (France) with 2166 EPDs, and Institut Bauen und Umwelt e.V. (Germany) with 1s723 EPDs. The Fig. 2 shows that most of the EPD-like programs (65%) have an international scope, followed by those with a national scope (15%) and with a scope within the Europe Union (9%).

Figure 3 shows that most EPD programs are focused on generic industrial sectors (57%), followed by those that are more specific to building and construction (30%). Both scopes add up to 88% of current programs.

According to Ecoplatform, the European platform for EPD programs in the construction sector, the programs can be classified into four categories: very large (more than 1000 EPDs registered and published), large (less than 1000 EPDs), medium (less than 150 EPDs), and small (less than 20 EPDs) (Eco Platform AISBL 2022).

Fig. 1 Evolution of EPD-like programs by year

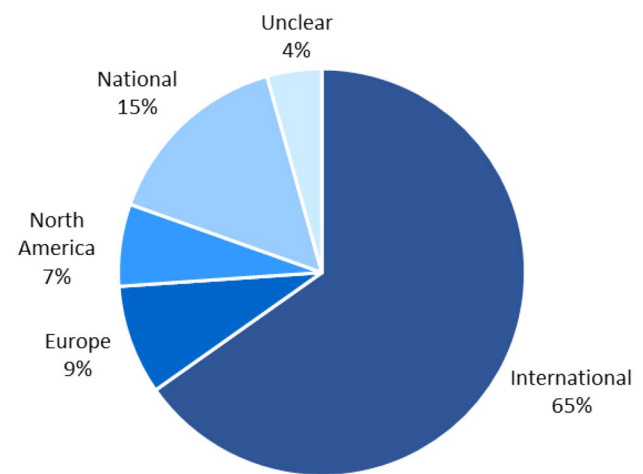
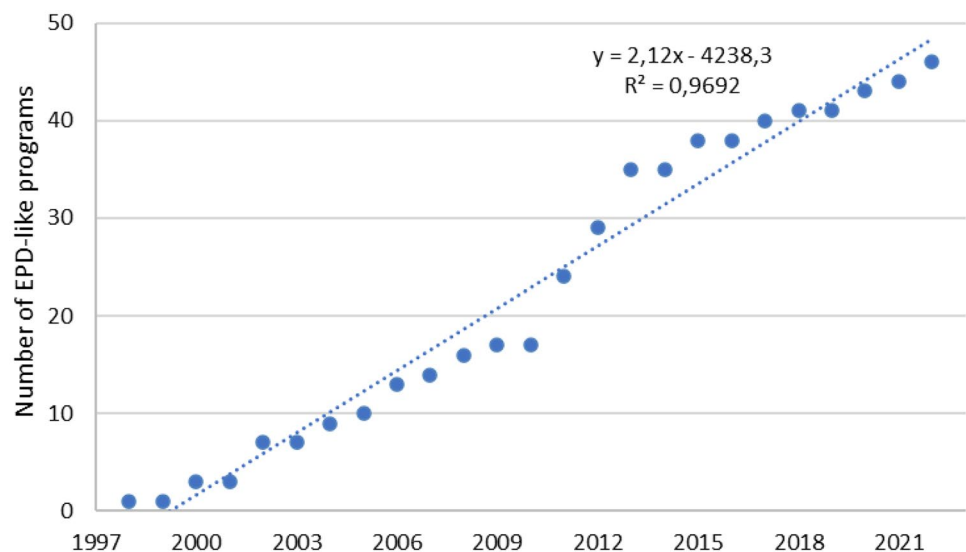


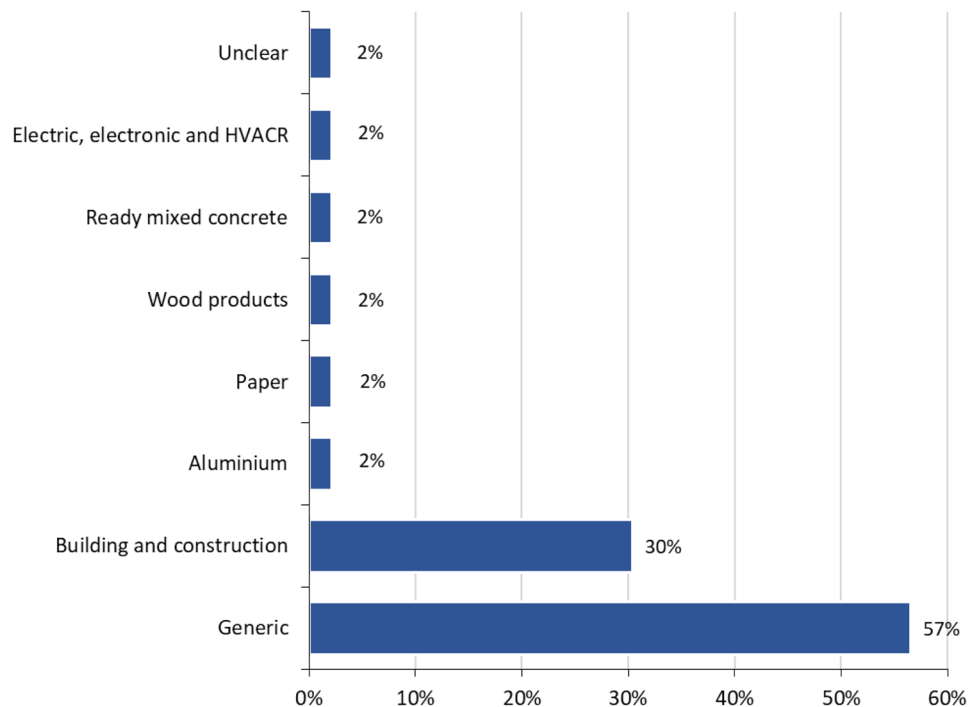
Fig. 2 EPD-like programs by geographic scope

The “very large” program category includes The International EPD® System (Sweden), Institut Bauen und Umwelt e.V. (Germany), Association PEP (France), and INIES (France). The “large” program category includes The Norwegian EPD Foundation (Norway), BRE Global Limited (UK), and Stichting MRPI (Netherlands).

2.2 Harmonization of EPD programs

The growing number of EPD schemes with different requirements may give rise to trade barriers in the market, which could be avoided by developing general guidelines on the management and application of LCA and through mutual recognition agreements between different programs. Due to the large number of existing EPD schemes, there is a need for operators to work towards harmonization to facilitate comparison of results and reduce

Fig. 3 EPD-like programs by industrial sector. References: HVACR Heating, ventilation, and air conditioning. References: HVACR Heating, ventilation, and air conditioning



overlapping documentation, time, and costs (Del Borghi et al. 2020).

Christiansen et al. studied the main concerns of consumers related to understandability, completeness, and comparability of EPD programs. Their discussion considered three main themes: reliability of data, completeness of environmental information, and adequate stakeholder engagement, providing a set of recommendations for improvement (Christiansen et al. 2006).

The aim of the PCRs is to achieve comparability in the results between different producers of the same product. And as such, the PCRs are useful as a basis in any type of Life Cycle Analysis to be used in the external communication of results.

The ISO 14025 standard does not establish the need to develop specific regional PCRs, although it is necessary to specify the geographical scope of the product system. EPD systems are mostly geographically restricted, usually to the host country of the program operator. For example, emission factors for carbon are often regional and based on technology, and there are differences in supply chains, as well as geographical and climatic issues.

Subramanian et al. (2012) developed a PCR comparison template, used as a tool to compare duplicate PCRs for the same category of products issued by different operators. They concluded that duplication is a common problem and proposed the provision of a guidance document (Subramanian et al. 2012).

As example, the process of mutual recognition between The International EPD® System AB (Sweden) and Institut Bauen und Umwelt e.V. (Germany) was introduced

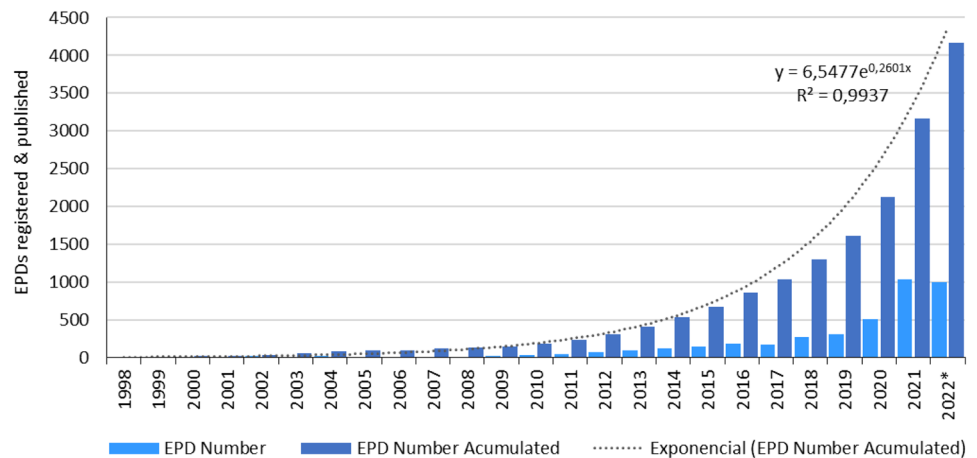
in 2013 and restricted to EPD of construction products, including furniture and textiles integrated in a building. In the case of The International EPD® System AB (Sweden) and The Norwegian EPD Foundation (Norway), the mutual recognition was introduced in 2016. Also Ecoplatform was established as a mutual recognition agreement between their members to develop a uniform European platform of EPD programs.

Mutual recognition of PCRs, GPIs, and EPDs between operators is becoming a valuable approach to reducing time, costs, and duplication of documentation. Therefore, is important the role of specific initiatives (at international, national or sectoral level) to set the basis to ensure harmonized requirements.

2.3 The International EPD® System evolution

The International EPD® System launched in 1998 has a large number of published EPDs and PCRs developed for construction and non-construction related products. So far, certain players in other countries have joined the EPD system: Belgium, Poland, Finland, Italy, Japan, Denmark, Norway, Germany, South Korea, and others. But in addition, The International EPD System is the only operator that has subsidiaries worldwide such as Turkey, Australasia (Australia and New Zealand), Latin America (Mexico and Chile), Brazil, Argentina, Egypt, Russia, Southeast Asia (Singapore, Malaysia, Vietnam, and the Philippines), South Africa, India, and North America (the USA and Canada). The number of companies with EPD was 986 as of August 31, 2022.

Fig. 4 The International EPD® System: EPD evolution by year



Analyzing the number of EPDs registered and published since the International EPD® System was implemented, in the last 10 years, the growth became exponential for all product categories from year to year (Fig. 4).

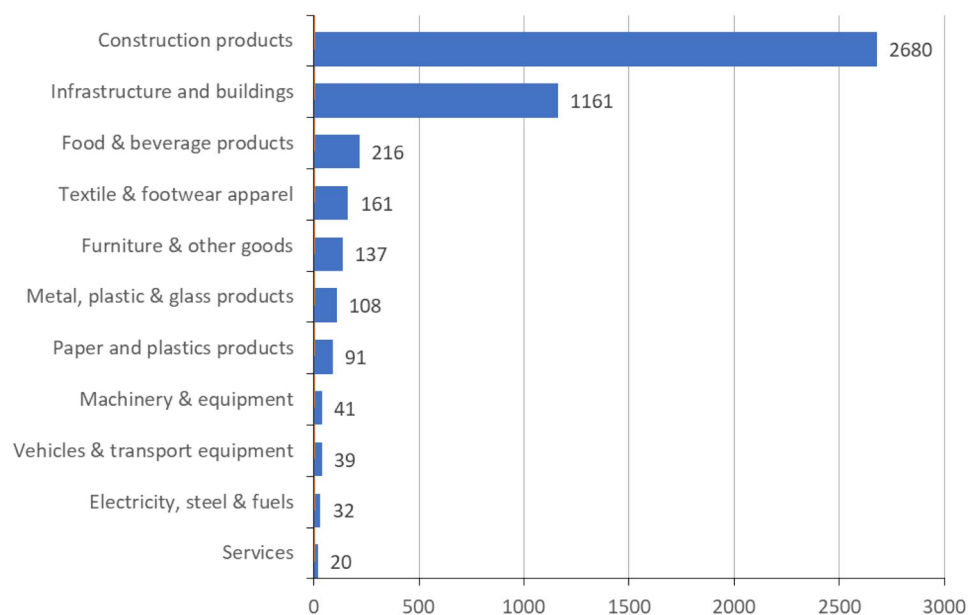
In particular, in the last 4 years, there has been an exponential growth in the number of EPDs registered and published (Fig. 5), a growth that is the result of the implementation of EPD programs in several countries, as Strazza et al. explained (Strazza et al. 2010).

The International EPD® System has been registering and publishing new EPDs, since 1998, with construction products being the most dynamic sector, followed by food and beverages, textiles and footwear, furniture, and other goods, which have grown at a much higher year-on-year rate than the rest of the economic sectors (Fig. 5). However, in the last 4 years, the rest of the sectors grew at considerable rates.

The International EPD® System holds more than 4600 published and registered EPDs on October 15, 2022. These include construction products (2680); infrastructure and buildings (1,161); food & beverages products (216); textile & footwear apparel (161); furniture & other goods (137); metal mineral, plastic & glass products (108); paper & plastics products (91); machinery & equipment (41); vehicles & transport equipment (39); electricity, steel, and fuels (32); and services (20).

The International EPD® System has registered and published a total of 185 PCRs divided in 11 categories: construction products according to EN 15804 (2019); food & beverage products; furniture & other goods; textile & footwear apparel; paper & plastics products; metal, plastic & glass products; machinery & equipment; vehicles & transport equipment; infrastructure and buildings; electricity, steel & fuels; and services.

Fig. 5 The International EPD® System: EPD evolution by industrial sector



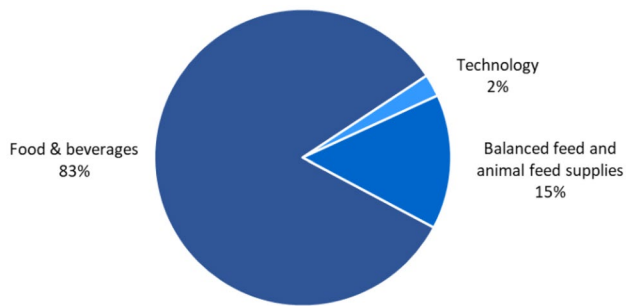


Fig. 6 Industrial sector of the participating companies

2.4 Case study in Argentina

In this second stage of the study, the factors that influence the demand of companies for environmental impact analysis and the potential adoption of EPD programs in the Argentine market were investigated. By way of useful background, some preliminary studies such as those conducted by Manzini et al. (2006) or Rätty et al. (2014) were considered.

This research was carried out through an online survey addressed to Argentine companies that currently participate or have participated in a sectoral environmental impact study and/or plan to publish an EPD. The methodological approach included (i) the definition of a multidisciplinary team, (ii) the design of a preliminary survey and a pilot test, (iii) the confirmation of the participating companies, (iv) the conduct of the survey, and (v) the analysis of results.

The questionnaire was designed with the aim of identifying the main drivers that determine the participation of companies in sectoral studies of environmental impact and/

or start the application to an EPD program, the target audience, and the tools used to communicate the environmental impact of their products or services.

2.5 Environmental impact analysis and EPD programs in the Argentine market

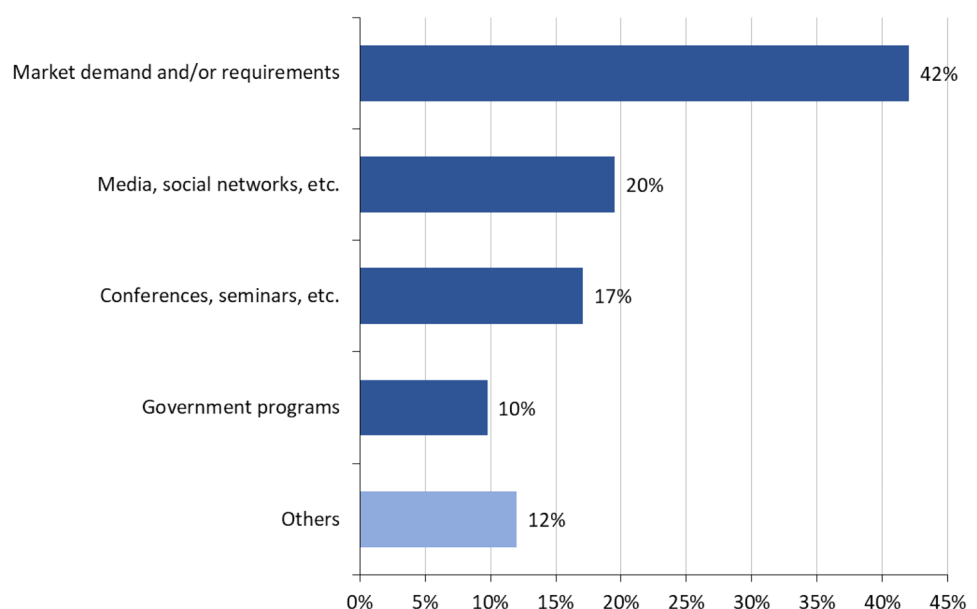
The Argentine companies that conducted the survey currently participate or have participated in a sectoral environmental impact study and/or plan to publish an EPD. They belong to the following industrial sectors (Fig. 6): food and beverages (83%), production of balanced feed, and supplies for animal feed (15%) and technology (2%).

Figure 7 shows how companies became aware of the importance of environmental issues, the calculation of environmental impacts and/or EPD programs: 42% by market demand and through the media and social networks (20%), conferences and seminars (17%), government programs (10%), etc.

This study determined that a large part of the products or services linked to environmental impact analysis and/or EPD programs are destined for export (cf. Fig. 12). Therefore, it is no coincidence that one of the channels of knowledge of companies is market demand.

In addition, the companies were asked to quantify the reasons that motivate the environmental impact analysis and/or the implementation of EPD programs (1, not important; 5, maximum importance). Figure 8 shows that most of the companies were motivated by the company's environmental policy, the improvement of the corporate image, and competitiveness issues. The most believe that their participation in a sectoral environmental impact analysis or implementation to an EPD program will improve exports and open access to new markets.

Fig. 7 Channels of knowledge about environmental issues



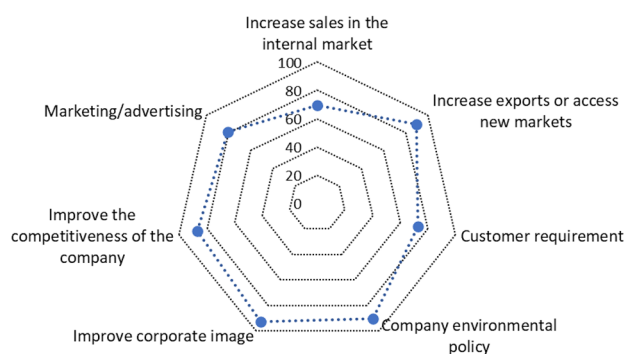


Fig. 8 Motivations for environmental impact analysis

Regarding the number of products or services for which the companies have carried out the calculation of environmental impacts, 83% of companies only have one product or service, 10% from two to five, and 7% more than five different kinds of products or services (Fig. 9).

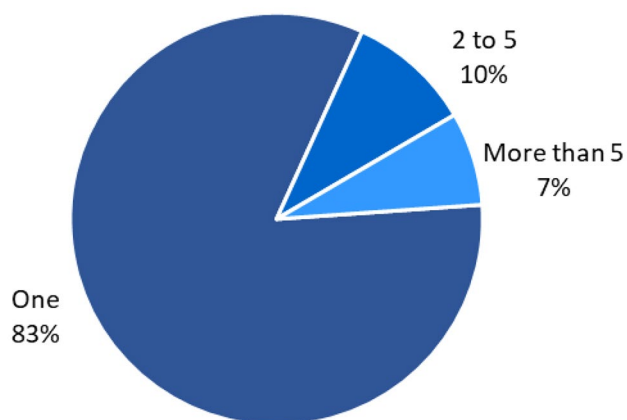


Fig. 9 Number of products or services with environmental impact analysis (current)

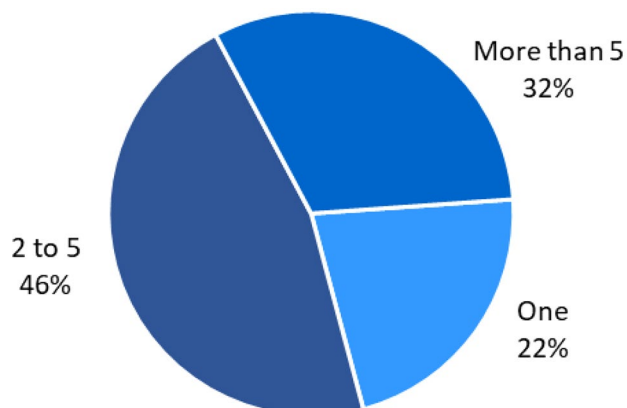


Fig. 10 Expected number of products or services with environmental impact analysis

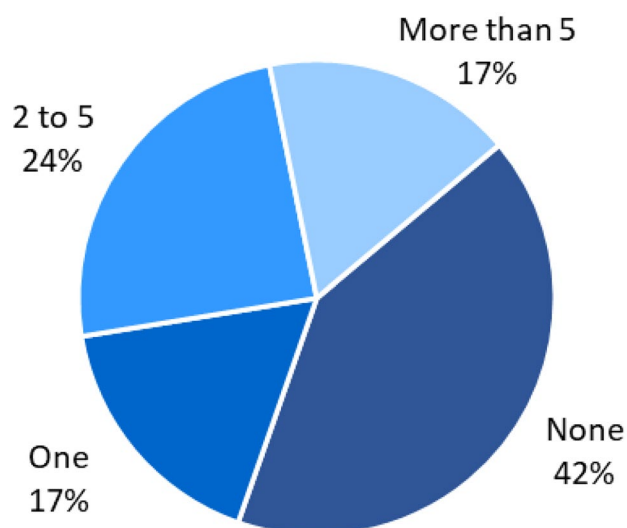


Fig. 11 Number of products or services under an EPD program

Figure 10 shows the number of products or services for which companies wish to calculate environmental impacts: 46% from two to five, 32% more than five, and 22% a single product or service.

Figure 11 shows the number of products or services that companies have certified or plan to certify through an EPD program: 24% of the companies surveyed answered from two to five, 17% more than five, and 17% one product or service. Therefore, the present study shows a positive trend towards the implementation of EPD programs in Argentine companies. In the same way, it presents an interesting challenge for the support programs of the Argentina government, in order to raise awareness and facilitate technical assistance to the remaining 42% of companies.

Figure 12 shows that 41% of the products or services whose environmental impact was analyzed are currently being exported. The destination countries are, among others, China, USA, European Union, South Africa, Chile,

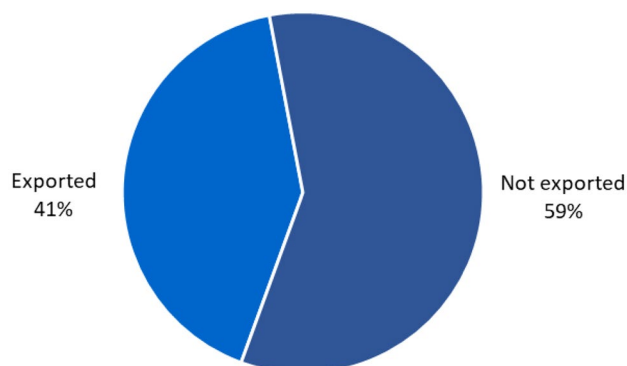
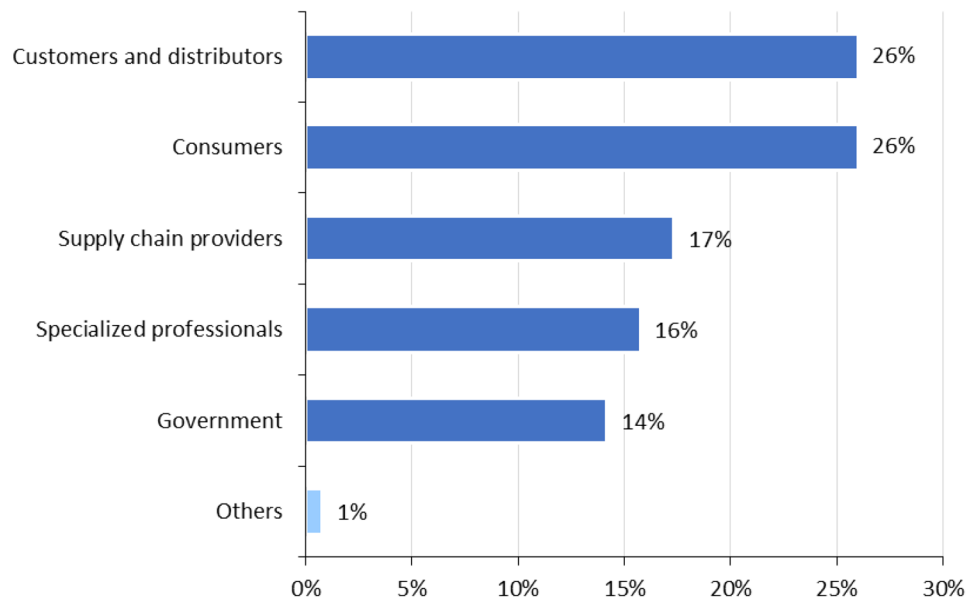


Fig. 12 Products or services under EPD programs currently exported

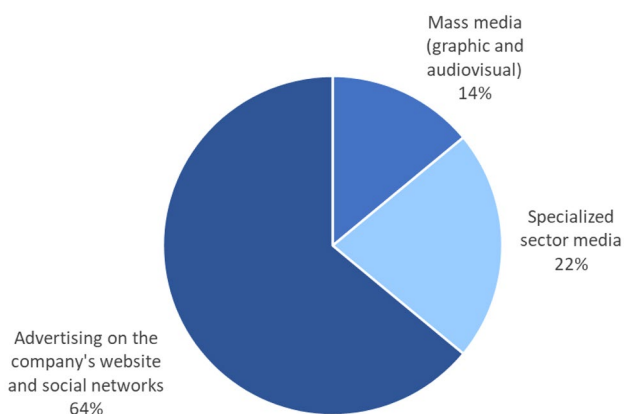
Fig. 13 Target audience of companies

and Uruguay. This result demonstrates the importance of environmental impact analysis and, more specifically, of EPD programs in the export performance of Argentine companies.

3 Target audience and communication tools used by Argentine companies

The companies surveyed were asked about the target audience of the communication of the environmental impacts of their products or services, that is, to whom they wish to communicate the results and information obtained from an environmental impact study and/or EPD programs (Fig. 13).

The evidence shows that the main target audience to which companies directs this type of environmental communication tools are consumers, clients, and distributors.

**Fig. 14** Communication tools used by companies

Additionally, the companies also identified supplier companies, specialized opinion formers, and the government.

Figure 14 shows the communication tools used by companies to publicize the environmental impacts of their products or services: 64% by advertising on the company's website and social networks.

4 Concluding remarks

Consumer trends around the world present an increasing demand for products with credible, transparent, and easy-to-understand environmental information. In this context, LCA-based EPD programs can provide reliable environmental information through Type III environmental declarations verified by an independent third party, registered and published (Del Borghi et al. 2020).

Not only are end-consumers demanding to know about environmental impacts, but also corporate customers, so it is likely that Type III business-to-business environmental declarations will increase their registration and publication in the future.

To compare the environmental performance of different products on a life cycle basis, common rules are required so that the requirements are comparable within a certain category. PCRs specify how the life cycle of a product or service impacts the environment, so they must be estimated, recorded, and published for products in each category.

This research shows the rise of EPD-like programs over the past 24 years since The International EPD® System emerged as a pioneering program. The number of programs using PCR is very high, but several are not fully compliant

with ISO 14025. Around 65% of EPD-type programs are international in scope. In general, they are aimed at generic industrial sectors (57%), and only the construction sector exhibits an outstanding participation (31%), fundamentally due to compliance with the EN 15804 standard by operators of European origin.

The growing number of EPD schemes with different requirements may lead to trade barriers in the market, which could be avoided by developing general guidelines on LCA management and through mutual recognition agreements between those different schemes. Coordination and compatibility of EPD programs between different international operators could help to increase the credibility of product comparison through Type III environmental declarations. In that sense, the mutual recognition of PCRs, GPIs, and EPDs between operators represents a valuable approach to reducing time, costs, and duplication of documentation.

Global PCRs would mean far fewer PCRs and would eliminate the need to engage in an alignment process to overcome geophic differences. However, in order to take into account regional differences, it would be necessary to develop global PCRs that are flexible enough to take into account differences in technology, supply chains, etc.

The case study carried out for Argentina shows a positive trend towards the implementation of EPD programs in companies. Around 57% of the companies became aware of the importance of environmental impact analysis and/or EPD programs due to market demand and through the media, networks, government programs (for example, those designed by INTI), conferences, seminars, etc. Likewise, the companies were motivated to implement these programs mainly due to the company's environmental policy, the improvement of the corporate image, and competitiveness arguments. In addition, there is a firm conviction that its participation in a sectoral environmental impact analysis and/or the implementation of an EPD program will improve exports and open access to new markets.

Additionally, 41% of the products or services of Argentine companies whose environmental impact was analyzed are being currently exported, which demonstrates the importance of this type of program for the effective access of said companies to international markets. This fact is even more relevant if it is considered that some destination countries for Argentine exports are explicitly supporting the growth of Environmental Product Declarations, which can generate technical barriers to trade and the need for adaptation by companies that export to these markets.

The target audiences to which Argentine companies address this type of environmental communication tools are consumers, customers, and distributors, who were identified as the main users. Second, supply chain providers, specialist opinion formers, and the government were identified. In addition, the communication tools used by 59%

of the companies to publicize the environmental impacts of their products or services are the corporate website and social networks.

As a final comment, the information collected in this research has demonstrated the potential of EPD programs as a marketing and environmental communication tool for Argentine companies.

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Data availability All data generated or analysed during this study are included in this published article.

Declarations

Conflict of interest The authors declare no competing interests.

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