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Environmental Product Declaration and Product Environmental Footprint Methodologies: A Comparative Review

December 2022

Environmental Product Declaration (EPD) and Product Environmental Footprint (PEF) methodologies have similar robustness and consistency. However, the EPD methodology is more scalable and fit for purpose for assessing the environmental impacts of construction products than PEF.

This paper offers a comparative review of the Environmental Product Declaration (EPD) methodology for construction products, developed by CEN/TC 350 Sustainability of Construction Works, and the Product Environmental Footprint (PEF) methodology, developed by the European Commission's Joint Research Centre. While elements of the comparison are relevant for other industries as well, this is mostly relevant for construction products and other products used for the built environment.

Product Environmental Footprint (PEF) methodology: overview and practical application

The Product Environmental Footprint (PEF) methodology was developed by the European Commission as a tool for advancing its various product sustainability initiatives. An early version of the methodology[1] (hence PEF Methodology) was published in 2010, and it was piloted by some industry sectors in a project coordinated by the European Commission, including decorative paints, hot and cold-water supply pipes, thermal insulation, metal sheets and photovoltaics (PV) systems. A subsequent proposal for methodology updates[2] (hence PEF Guidance) was published in 2019. The PEF methodology refers to these standards: ISO 14040, ISO 14025, ISO 14067, ISO 14020.

The general purpose of PEF is to support European policy as a potential methodology for regulations. Its specified intended applications are to support in-house product

[1] Product Environmental Footprint (PEF) Guide, Joint Research Centre, December 2010.

[2] Zamora, L., Pant, R., 2019. Suggestions for Updating the Product Environmental Footprint (PEF) Method. Publications Office of the EU, Luxembourg. https://doi.org/ 10.2760/424613.

sustainability analyses as well as B2B and B2C communication. There is currently no commercial application of PEF.

EPD methodology: overview and practical application

The EPD methodology was developed by the CEN/TC 350 Sustainability of Construction works, which is a standardisation group consisting of industry experts and other stakeholders (LCA consultants. government experts, NGOs, etc) developing standards for the EU and global market. The CEN standardisation in this field is very closely aligned with the comparable ISO standardisation. The original version of the EN 15804 standard (hence EPD standard) was published in 2012 and it was updated in 2019 for a closer alignment with the PEF methodology based on a mandate from the European Commission [3]. The EPD standard applies the ISO 14040 and 14025 and other standards.

The general purpose of the EPD standard is to support B2B communication and regulations. The EPD data is also used for purpose of project level life-cycle assessment of construction works under the related EN 15978 and other standards. As of today, thousands of companies publish EPDs under the EPD standard, also including in non-European countries including as far as Australia and New Zealand.

EPD vs. PEF – product category rules (PCR)

Summary: both systems apply PCRs. For PEFs, no valid PCRs exist. For EPDs, dozens of complementary PCRs in addition to the core EN 15804+A2 PCR are in use.

PCR provides specific rules for a given product category or categories to ensure consistent assumptions and practises, where the underlying standard is not prescriptive enough.

Using PEF requires the application of product category rules. As all the pilot PCRs have expired at the end of 2021, there are currently no valid product category rules in existence for PEF. PCRs for PEF must be based on a two-digit NACE (Nomenclature of Economic Activities) code division, with the three-digit option being allowed, and they must include a benchmark product to which other products can subsequently be compared.

The EPD standard provides core product category rules. New PCRs can be developed in two ways:

1. By construction product standardisation groups working under the CEN can be voluntary or for alignment with Construction Product Regulation based on the

[3] EN 15804:2012+A1:2013 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products, amended to EN 15804:2012+A1:2013 +A2:2019.

Standardisation Request from European Commission. In these cases, the PCR is published as an EN standard.

2. By program operators based on ISO 14025 and EN 15804+A2, which are organisations that oversee EPD publishing processes. Their responsibilities are defined in the ISO 14025 standard. The French and Belgian program operators have a regulatory role.

As of today, there are dozens of PCRs published as EN standards, and dozens of European program operators. There are well over 13, 000 EPDs published under the EPD standard already.

EPD vs. PEF – unit of application and scope of assessment

Summary: EPD allows a declared unit to be used even when the use stage is included. Whereas PEF requires the use stage and functional unit to be defined with multiple criteria. This makes creating PEFs more costly and getting a cross-product impact overview harder, especially when calculating the total impact of products from multiple product categories.

Parameter	**EPD Standard**	**PEF Methodology**
Scope of assessment	Several options are possible. Minimum scope is always cradle to gate with end of life (modules A1–A3, C and D). Extended scopes are also possible. Physically integrated materials can have cradle to gate only scope.	Cradle to grave only, including the whole life cycle. All life-cycle phases are required.
Life-cycle stages defined	A1, raw material extraction and processing A2, transport to the manufacturer A3, manufacturing A4, transport to the building site A5, installation into the building B1, use of the installed product B2, maintenance B3, repair B4, replacement B5, refurbishment B6, operational energy use B7, operational water use C1, de-construction, demolition C2, transport to waste processing	Raw material acquisition and pre-processing; production; product distribution and storage; use stage; end-of-life. The last two life-cycle stages are excluded for intermediate products. Names of life-cycle stages may be changed.

	C3, waste processing for reuse, recovery and/or recycling C4, disposal D, reuse, recovery and/or recycling	
Attributional vs. consequential	Attributional; all consequential impacts included in module D (impacts beyond system boundary)	Attributional otherwise, but system level changes (consequential) can be included in the use stage and end of life stage
Unit of analysis	Declared unit allowed if no use phase is included in the assessment (the building itself is seen as the functional unit).	Only functional unit is allowed. To include "what", "how much", "how well", "how long". Amount of product needed to deliver the function is called the "reference flow"
Offsets	Excluded	Excluded

EPD vs. PEF – verification and publishing process

Summary: Both EPD and PEF require an independent verification. PEF has more prescriptive rules for verifier qualification, which limits available verifiers. EPD verifiers are approved by the Program Operators, who also appoint the verifier for a specific project in some programs.

Parameter	**EPD Standard**	**PEF Methodology**
Verification	Mandatory independent verification	Mandatory independent critical review
Verification requirements	Defined in ISO 14025. Verifier can be a person or a body.	Defined in PEF Methodology. Single verifier for external communication, three verifier panel required for public communication.
Verifier approval	Program Operator	No approving body, manufacturer evaluates verifier capability
Verifier choice	For most programs, the manufacturer chooses from approved verifiers. Some programs appoint the verifiers directly.	Chosen by the manufacturer and competence self-declared against scorecard; no lists of approved verifiers
Verifier qualification	Includes knowledge from: relevant sector, product and product-related environmental	Minimum 4 years' experience of reviewing, verification and auditing practise, from LCA

	aspects, process and product of the product category, expertise in LCA and methodology for LCA work, relevant standards in the fields of environmental labelling and declarations and LCA, the regulatory framework for EPD requirements and EPD programs. Required levels of knowledge defined by the Program Operator.	methodology and practise and 1-3 years of experience from the sector or applied technologies. To qualify as a sole verifier, the experience required is doubled, or points from accreditations as a verifier.
Publishing process	The Program Operator publishes the EPD.	The manufacturer publishes the PEF themselves.
Validity of results	Maximum five years; unless technology or circumstances change enough to affect results by at least 10%.	Undefined

EPD vs. PEF – environmental impacts to be assessed

Summary: PEF and EPD provide quite similar environmental impact indicators since the mandated PEF-alignment on the EPD standards has been applied. EPD provides additional resource use data.

Parameter	**EPD Standard**	**PEF Methodology**
Global warming potential	Consisting of three categories and sum: - Total global warming potential - Fossil global warming potential - Biogenic global warming potential - Land use and land use change (LULUC) global warming potential If the GWP LULUC is < 5% of GWP-total over the declared modules excluding module D, it may be marked as "not declared".	Consisting of three categories and sum: - Total global warming potential - Fossil emissions and removals - Biogenic carbon emissions and removals - Carbon emissions from land use and land use change These are reported separately if they contribute more than 5% each to the total climate change.

Harmonized environmental impact factors	Core environmental impact indicators (as defined in the EPD Standard): Global Warming Potential indicators described above, and: Ozone Depletion, Acidification, Eutrophication terrestrial Photochemical ozone formation, Eutrophication aquatic freshwater; Eutrophication aquatic marine; Depletion of abiotic resources - minerals and metals; Depletion of abiotic resources - fossil fuels; Water use Additional environmental impact indicators (as defined in the EPD Standard): Particulate matter emissions; Ionising radiation, human health; Ecotoxicity (freshwater); Human toxicity, cancer effects; Human toxicity, non-cancer effects; Land use related impacts / soil quality	
Resource use indicators	17 resource use, waste and output indicators.	Inventories should be provided, so resource use data can be accessed to some extent.
Level of standardisation	All 13 core impact categories and resource use indicators are always required.	All impact categories shall be applied.

EPD vs. PEF – data and data quality

Summary: PEF and EPD both apply similar principles.

EPD requirements are normative, whereas for PEF data quality is evaluated dynamically considering every impact category included, which could hinder the ability to complete the assessment at the required data quality for certain products.

Parameter	**EPD Standard**	**PEF Methodology**
Manufacturer's own processes	Specific data required.	Specific data required.
Data for other processes	Generic data may be used for the processes the manufacturer cannot influence.	Generic data may be used for the processes the manufacturer cannot influence.
Data quality rules	Prescriptive rules applied, including on data age. Oldest allowed reference year: - Specific data: max 5 years - Generic data: max 10 years	70 % of every impact category must be supported by data with Overall "Good" data quality calculated using a "semi-quantitative approach" and minimum 20 % by data of overall "Fair" quality
Scored data quality parameters	Geographical coverage Time coverage Technological coverage	Technological representativeness

		Geographical representativeness Time-related representativeness Precision
Cut-offs	Maximum 5% of mass and energy can be cut off (left out) per module, e.g., per module A1-A3, A4-A5.	In the PEF Guidance, 3% cut-off on mass and energy flows is allowed
Data gaps	May be filled by conservative assumptions with average or generic data.	10% can be extrapolated.

EPD vs. PEF – allocation, normalisation and weighing

Summary: EPD standard follows attributional model in allocation. PEF allows using substitution-based model in allocation as well. EPD does not apply normalisation or weighing, PEF requires them.

Parameter	**EPD Standard**	**PEF Methodology**
Allocation priority	Based on physical properties (e.g., mass) when the difference in revenue of the co-products is low; otherwise based on revenue. Material flows like energy or biogenic carbon shall always be allocated based on the physical flows irrespective of the process.	Based on physical relationships, including substitution, otherwise on other relationships. Further rules are defined in each PCR that set the rules for multifunctionality.
Normalisation (relate impacts to e.g., one citizen in a year)	Not applied	To be created alongside the non-normalised results as additional data without aggregation using set factors.
Weighing	Not applied	To be created alongside the non-weighed results as additional data using set factors to allow creating a single overall score.

EPD vs. PEF – reporting

Summary: PEF reporting is very heavy compared to EPD for which information is limited to the essential.

Parameter	EPD Standard	PEF Methodology
Public reporting	Must include summary, scope of the study, assumptions, manufacturing diagram, LCA results and name of verifier.	Must include goal and scope of the study, life cycle inventory analysis, life cycle impact assessment results and Interpreting PEF results. Annexes will then contain items such as data quality assessment and more technical information. In addition, a validation report is published.
Confidential reporting	Verifier is provided access to the background report containing additional information, which is not shared with anyone else.	The confidential report is an optional element for critical reviewers that can contain inventories of the manufacturer if considered sensitive and cannot be made externally available.
Verification dialogue	Not published but provided usually to the Program Operator.	Published, including critical review report, recommendations and responses.

EPD vs. PEF for construction products: which one is better suited to the task?

In the context of changing regulations and standards, the choice of the methodology used for product environmental impact assessment matters enormously. In the view of the authors, the applied methodology must be robust, consistent, fit for purpose, scalable, efficient and lead to environmental benefits.

In spite of their differences, both PEF and EPD methodologies can both be considered robust for the task. In the EPD methodology, the program operators are responsible for ensuring the quality of both the verifiers and the EPDs published. PEF ensures quality by using scoring requirements.

In terms of consistency, the EPD methodology is more consistent. It does not allow consequential impact assessments for the use stage of products, unlike PEF. The EPD methodology includes consequential impacts in module D, impacts outside the system boundary. However, as any PCR for PEF would be expected to mitigate the potential impact this has, the impact is quite limited.

Only the EPD methodology can be considered fit for construction products, or indeed for any products permanently installed into buildings, including building systems, furniture or finishings. The PEF methodology considers the product itself as a function, whereas in

construction, the function is achieved at the level of the construction work itself. PEF imposes significant additional burdens to any manufacturer to define a set of functional parameters for each of their products.

Similarly, only the EPD methodology can be considered scalable. The EPD methodology has proven itself for thousands of manufacturers and has dozens of program operators publishing data, as well as several dozens of standardized PCRs. The PEF methodology's requirements generate significant additional analysis and reporting burdens, thus increasing the costs of the assessments.

The use of either methodology does lead to environmental benefits. However, greater environmental benefits can be realized through the scalability of the methodology and availability of data, which allows buyers to start setting requirements for their products and specifiers to start to make choices.

In summary, the conclusion of this comparison and the view of the authors is that the EPD and PEF methodologies have similar level of robustness and consistency, the EPD methodology is more suitable for construction products and any products permanently installed into buildings because of its superior fitness for purpose, scalability and environmental benefits.

If you are looking for ways to support a range of environmental impact assessment needs, including EPDs and PEFs, please reach out to get a demo of how One Click LCA can help you with your global environmental impacts assessment requirements in a reliable, highly automated and scalable manner.

About One Click LCA

One Click LCA is the world-leading Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD) generation software for the construction industry. One Click LCA provides solutions for construction projects, products and portfolios. It is used to decarbonize building and infrastructure projects, to create EPDs and benchmark low-carbon products and to manage and create corporate or real estate portfolio greenhouse gas reports. It is used in more than 140+ countries, includes the world's largest construction sector database and supports over 60 standards and certifications.

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