The Building Blocks of Carbon Accounting:
The Role of Product Category Rules, Life Cycle Analysis, and Environmental Product Declarations

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Environmental product declarations (EPDs) are increasingly utilized for product comparison and procurement decisions regarding building materials such as "Buy Clean" policies. Important context from their supporting life cycle assessment (LCA) studies are not included in the EPD and user guidance to properly compare products for material selection is lacking. Forthcoming product category rules (PCRs) and guidance for stakeholder development and input for PCR creation address some discrepancies that will improve comparability of EPD data. As technology improves, digital EPD generators that automatically administer PCR criteria will accelerate fair EPD generation and comparison. Quality PCRs will help ensure that results can reliably inform users seeking EPDs for the current carbon accounting for various use cases.

Building Blocks Guide EPD Development

Building regulations, policy, codes, and market trends are increasingly focusing on reducing the environmental impact of materials and products. Life cycle assessment (LCA) is a method used to assess environmental impacts throughout the life cycle of a product from raw material extraction through materials processing, manufacturing, distribution, use, repair and maintenance, and disposal and/or recycling.

The results of an LCA are rarely made public due to proprietary information around product formulation, production processes, and other manufacturer data that are included in the analysis. The proprietary data and analysis in an LCA model are usually not included in the environmental product declaration (EPD). An EPD is a public-facing, transparent, third-party verified summary of the LCA results. It is based on an underlying LCA and developed in accordance with ISO 14025 (and ISO 21930 or EN 15804 for construction products and services). The EPD is intended to provide a transparent and objective summary that communicates the results of the underlying LCA for industry users. EPDs are voluntary for most building projects, but EPDs are becoming increasingly common as tools for building material and product procurement requirements, specifications, and even some building code compliance.

Through a standards-like format, product category rules (PCRs) communicate requirements, guidelines, and expectations for applying LCA methodologies to a specific product type and its supply chain. The PCR should dictate how to conduct the LCA and what is or is not included, including guidance for data selection and calculations. In theory, if all LCAs are done the same way and in accordance with the PCR, certain variables and bias are better controlled and/or at least reported. In practice, most existing PCRs do this to an extent, but there is room for improvement.

These building blocks of environmental impact disclosure are interrelated and dependent on one another for the development of quality and consistent data reporting. Reliable PCRs are needed for reliable LCAs. Reliable LCAs are needed for reliable EPDs.

Product Category Rule (PCR): A standardized set of rules that set requirements, guidelines, and expectations for a life cycle assessment (LCA) for a specific product category or process.

Life Cycle Assessment (LCA): A method to assess environmental impacts throughout the life cycle of a product from raw material extraction through materials processing, manufacturing, distribution, use, repair and maintenance, and disposal and/or recycling.

Environmental Product Declaration (EPD): A public-facing, transparent, third-party verified summary of a life cycle assessment (LCA) developed in accordance with ISO 14025, and ISO 21930 or EN 15804.

Data Quality: Current Issues in LCA and EPD Comparability

Depending on the product or material and its governing PCR, EPDs will contain varying levels of detail, including assumptions, type of data gathered, and other relevant aspects of the supporting LCA. Differences in PCR development and guidelines have led to inconsistent EPD quality and specificity. The governing ISO standards give authors of PCRs (i.e. EPD Program Operators) significant flexibility in terms of what should and should not be required. This makes it harder to optimize the architectural design and specification decisions for decarbonization. To improve data quality, PCRs could require specific data to be developed and reported in a more consistent manner for each product category. This will enable the development of LCAs that are more accurate and more comparable for products in the same product category.

The American Center for Life Cycle Assessment (ACLCA) has recognized the opportunity for PCR improvement and developed guidance to inform practices for writing PCRs. First published in 2013, an updated guidance document was released in 2022 and acknowledges recent demand for EPDs and their communication of environmental impact data, particularly embodied carbon impacts as represented by global warming potential (GWP).[1] To create the EPDs that have the most consistent basis for comparison, we need to improve PCR guidance for life cycle assessments.

A PCR is intended to standardize EPD data to promote consistency, and in some cases, comparability of compliant EPDs within a product category. As a result, published EPDs serve as de facto user references for the estimated environmental impacts across the product's life cycle. To put it simply: EPDs are summarizing the environmental impact a product has, like a nutrition label does for health impacts of food. Because of this, they are being used increasingly in procurement decisions. For a manufacturer, the creation of an EPD helps benchmark the impacts of a product for the purpose of product optimization and innovation improvements.

Results generated by LCAs and communicated through EPDs are being used to inform procurement decisions and serve as data sources in larger assessments such as whole building life cycle assessment (WBLCA) because buildings continue to be a significant source of global greenhouse gas (GHG) emissions. Currently most emissions result from building operations, but the role of embodied carbon will continue to increase as we improve operational efficiency and achieve net zero buildings. To quantify the carbon impacts of a building, information on the impacts of the building materials must be included for all materials and products in a responsible and accurate manner.

Improving the consistency and quality of EPDs would inspire confidence in their use to make important decisions. While many believe that EPDs should be comparable when their underlying LCAs follow the same PCRs, some aspects of these governing rulesets could and should be further defined and aligned to improve the basis for comparisons between products.

Just as PCRs, LCAs and EPDs build on one another for environmental impact data reporting and their variability builds on one another as well. PCR guidance that lacks adequate specifications and differences in LCA inputs and modeling can lead to large error bars in the data summarized in an EPD. This is then exacerbated by tools or databases that put inconsistent data side by side and promote it as comparable. Care must be taken to understand if EPD data is consistent enough to be looked at side by side, especially when important design decisions are being made as a result.

LCAs are developed in accordance with ISO Standards 14040 and 14044. Additional country- or industry-specific standards may apply. Completing an LCA that enables broadest applicability requires conformance to the governing ISO standards and a general adherence to common LCA practices in the marketplace, particularly if industry-specific guidance is available. This encompasses the gathering of a large amount of data for material and process inputs and outputs. This data is needed to estimate the environmental impacts through LCA calculations. The result is an LCA report, which comprehensively documents the data considered and the process that was followed to generate the results of the assessment. Its format as outlined in ISO 14044.

ISO 14040/44 does not require a critical review for non-comparative LCAs, though developers of the LCA may request either an internal or external single expert review, to increase validity and acceptance of the results. If the LCA supports an EPD, it will be reviewed as part of the EPD verification process. Comparative LCA reports must be critically reviewed by at least three external reviewers – typically referred to as a critical review panel. LCA reports are technical in nature and include judgments, assumptions, decisions, and critical feedback that is usually beyond what a general user needs to know or is equipped to adequately understand.

1 2022 ACLCA PCR Guidance – Process and Methods Toolkit. Version 1.0. Published May 25, 2022. American Center for Life Cycle Assessment. https://aclca.org/wp-content/uploads/2022-ACLCA-PCR-Guidance_v1_Introduction_05252022.pdf.

The Role of Product Category Rules in Promoting EPD Consistency

The American Center for Life Cycle Assessment's (ACLCA) PCR Guidance (2022) identifies and summarizes three primary use cases of EPDs.[2] As "Buy Clean" legislation expands, a range of practical use cases have emerged with different accountability expectations. They are:

1. Transparency

EPDs provide transparency to the data collected. For example, EPDs allow clarity around what life cycle stages are being communicated, the source for emission factors used to calculate the impact, and any underlying assumptions. In this use case, the user may be interested in how the model was developed and in understanding where improvements can be made that impact the product life cycle, but in this case the EPD and its results are not intended for the purposes of procurement or decarbonization decisions.

2. Procurement

The use of EPDs to support procurement decisions requires a greater level of specificity of LCA model parameters, data quality parameters, and life cycle stages in the PCR guidance. For example, a PCR might prescribe the use of publicly available background databases with data quality assessment for more consistency and comparability when primary data is not available. Controlling the variables reduces differences in modeling and assumptions and can contribute to a greater level of consistency and quality than EPDs intended for transparency uses alone. Users who intend to use EPD data for procurement need reliable data to help choose the product that meets decarbonization goals in addition to design goals.

Eliminating discrepancies and increasing consistency of EPDs through PCR development is becoming more critical with the growing interest in environmental impact data for public and private procurement and decarbonization decisions. Therefore, consistent, and scientifically accurate PCR development and use for the purpose of executing quality LCAs is incredibly important. This will minimize inconsistencies and increase comparability that can support all three of the use cases discussed above. ACLCA's PCR Guidance – Process and Methods Toolkit (2022) provides a list of criteria that ACLCA contends a PCR must or should include to meet the rigor required for the identified use cases, and for material specifiers to understand and identify EPDs that meet the requirements of their projects. Its publication represents a significant advancement toward resolving major discrepancies between PCRs and their LCAs to improve the data consistency across the use cases of the EPD.

3. Data Source

EPDs and their results can be used as data points that are integrated directly into a WBLCA to inform engineering and design decisions. Ideally, documentation of the notable differences in methodology or specificity is published either in the primary PCR's General Program Instructions (governance document) or as supporting documentation. Users need to integrate reliable data points into a larger LCA model of a building and understand how changes in quantity or material type affect the embodied and operational carbon impacts of the building, and how impact reductions could be optimized.

Adhering to a standardized format for EPDs as prescribed by ISO and EN standards requires the elimination of some details contained in the LCA report that make the judgment and rationale used in the analysis transparent. Without rules for these judgments, the resulting analysis would be left to subjective interpretation and reduce comparability. While some data may be irrelevant to the reporting fields of the EPD, other LCA data may be considered proprietary. Varying amounts of important context may be left out of the EPD in either case. In theory, PCRs define parameters and prescribe consistent reporting methods with the goal of reducing discrepancies and increasing comparability. In practice, PCRs have been inconsistently developed. This is due to several factors including the wide variety of organizations that author PCRs, time and attention given to development, level of detail, differences in development guidelines, experience and expertise level of stakeholders, and cost invested in PCR creation.

2 2022 ACLCA PCR Guidance – Process and Methods Toolkit. Version 1.0. Published May 25, 2022. American Center for Life Cycle Assessment. https://aclca.org/wp-content/uploads/2022-ACLCA-PCR-Guidance_v1_Introduction_05252022.pdf.

Additional Improvements for Increased EPD Consistency

Below are some aspects of life cycle assessments that would benefit from higher levels of specificity in a PCR to promote EPD consistency and comparability. Following the publication of ACLCA's PCR guidance, program operators and their stakeholders in PCR development can apply the recommendations to existing and forthcoming PCRs to instill greater confidence in EPDs meeting the rigor of current and emerging use cases.

Background Data

Availability and cost of background data for life cycle assessment is a persistent issue. Acquiring primary data from suppliers, while the best case for accurate and reliable environmental impact results, can be an arduous process. Certain suppliers consider this primary data proprietary and may not want to release it, even to their customers under NDA. Industry data sets are usually only accessible through subscriptions or licenses to a database. Poor availability of primary background data can lead to the use of "best available" data that is generalized and only partially representative of the study's conditions, which adds to the uncertainty and inconsistency of LCA results.

Additionally, many EPDs do not specify how much or which data should be primary and supplier-specific vs. average or generic data. If the relative composition of supplier-specific vs. generic data were identified and described, EPDs would more clearly communicate the assumptions made in the underlying LCA. Some PCRs are testing the practice of prescribing specific data sets to be used in the LCA model, as recommended in ACLCA's 2022 PCR Guidance. The expansion of this practice along with an increase in free and open access data sets could improve consistency and data availability. Publicly available data would lower cost burdens and support the increased use of consistent primary data. It could also resolve differences in data quality indicators, such as completeness, consistency, accuracy, transparency, and relevance by utilizing the same basis for calculations and appropriate methods to handle data gaps and variability. This could however create a new issue. If everyone in a product category is using the same exact data and is not allowed to differentiate with their own primary data, manufacturers would not be able to demonstrate the actual environmental impacts of their differentiated products.

Boundary Conditions

While a PCR usually describes the boundary conditions of the LCA study, it often falls short of specifying what inputs or processes should or should not be included. For example, manufacturing and facility practices like space lighting and sub-metering of utility usage are not always stated clearly or consistently. In addition, different industries find some ancillary data important or not for their specific needs. This leads to varying levels of detail between PCRs and their EPDs.

Modeling Assumptions

PCRs commonly prescribe assumptions to be used in the LCA model when there is a lack of data or if data quality requirements are not met. LCA and EPD comparability within a product category can be hindered if different models use different assumptions. In these cases, practitioners must use their judgment and choose what they think is most appropriate, which can result in differences in the reported impacts. For example, one LCA practitioner may choose to deem a manufacturing function outside of the boundary, while another LCA practitioner may deem it within the boundary. Allocation is the process of apportioning and assigning the inputs and outputs of a system, and their associated impacts, to its products and co-products. Some industries use supply chain specific allocation while others use economic allocation, which can lead to significantly different results. While one allocation practice may be required in a particular sector, some collective requirements or prescribed conservative assumptions can help close these gaps and enable more consistent and reliable LCA and EPD comparisons.

Conclusion

PCRs can vary significantly and there is often no single correct set of requirements for PCRs across various categories. However, writing PCRs with a strict scope, clearly defined background dataset requirements, and explicit assumptions allows program operators and industry participants to maximize the reliability and comparability of their LCAs and EPDs. It levels the playing field for LCA practitioners, creates clear incentive structures for driving upstream supply chain data collection to improve the specificity of the LCA and its results, and maximizes the utility of LCAs and EPDs as tools for decision making.

The development of a software tool that programs PCR guidelines directly into the LCA tool and expedites the creation of consistent EPDs could be of great benefit. Early successes have been demonstrated by the concrete (multiple tools and examples) and asphalt industries.

Ultimately, PCRs should be the guardrails for what and how much information goes into LCAs and EPDs. Quality PCRs will help ensure that results can reliably inform users seeking EPDs for the current carbon accounting for the various use cases.