IMPLEMENTING INTERNATIONALLY HARMONISED LIFE CYCLE ASSESSMENTS (LCAs) & ENVIRONMENTAL PRODUCT DECLARATIONS (EPDs) FOR LIGHTING PRODUCTS

GLOBAL LIGHTING ASSOCIATION

CONTENTS

EXECUTIVE SUMMARY

Climate change and increases in global population will require additional efforts to reduce the impact humans have on the environment. The global movement towards product sustainability has driven an intensified focus on understanding the environmental impact of products throughout their life cycles.

Life Cycle Assessments (LCAs) and Environmental Product Declarations (EPDs) have emerged as essential tools for quantifying and communicating this impact.

LCAs and EPDs bring immense benefits and applications to the lighting industry, enhancing transparency, credibility, and driving innovation in sustainable product development.

However, there are also challenges and gaps in current LCA and EPD methodologies for lighting products. One objective of this White Paper is to draw attention to the risk that regions will address these gaps and challenges differently, creating inconsistencies in the approach to LCAs and EPDs and limiting their benefits.

This White Paper calls the industry to action to develop standardised methodologies for LCAs and EPDs and to standardise these methodologies under Product Category Rules (PCRs) for lighting products.

Conducting LCAs and developing EPDs can be complex, time-consuming and costly. The collection of accurate data, the choice of appropriate impact assessment methods, and the interpretation of results require expertise and resources that may not always be readily available.

In addition, while PCRs are a step towards comparability, there are several factors (including the use of disparate software, data and databases) that can produce different EPD results for the same product, creating variability that impairs clear decision making.

Another objective of this White Paper is to emphasise that standardisation should take place at a global level and incorporate region-specific clauses whenever regional practices or regulation require this. For example, the PEP Association in France has developed LCA/EPD Product Category Rules for luminaires. PEP PSR 0014 and a few of the existing and developing global PSRs could serve as a future starting point for the standardisation of methodologies in the lighting industry.

Implementing a well-supported standard for EPDs in the lighting industry will create a strong ecosystem and market dynamic, benefiting service providers and practitioners alike.

With a harmonised approach and solid foundation, the lighting industry can effectively quantify and communicate the environmental impact of its products through internationally harmonised LCAs and EPDs.

This White Paper aims to assist interested parties in understanding the need for LCAs and EPDs for lighting products and the challenges surrounding the use of existing LCA and EPD methodologies. This is a call to action to support growing standardisation initiatives in IEC TC 34 and to avoid diverging LCA and EPD practices to the extent practicable.

CHAPTER 1

Introduction

The lighting industry plays a crucial role in society, and its activities have environmental implications. Rapid technological advancements and increased adoption of energy-efficient lighting solutions have led to increased regulatory reporting, driving the need to understand the environmental performance of different lighting products. LCAs and EPDs provide a comprehensive and systematic framework to assess the environmental impact of lighting products at different stages of their life cycles, including production, use and end of life.

Chapter 2 focuses on understanding the need for globally harmonised LCAs and EPDs for lighting products. It examines the current complexities of LCAs and EPDs in lighting products by analysing factors such as energy consumption. Definitions and principles, regional differences, and benefits and applications of LCAs and EPDs in the Lighting Industry are examined.

Chapter 3 addresses challenges and gaps in LCA and EPD methodologies along with the lack of methodology uniformity. It highlights misalignment in existing standards and guidelines with a view to pinpointing what can be done to rectify this with improved lighting standards.

While LCAs and EPDs are important tools for sustainability assessments, the methodologies for LCAs and EPDs for lighting products are still emerging, and there is a risk that the regions will address gaps and challenges differently, creating inconsistencies in the approach to LCAs and EPDs. This lack of harmonisation poses challenges for stakeholders seeking to analyse lighting products based on their environmental impact. Divergent methodologies may lead to inconsistent and unreliable results and hinder the credibility and transparency of LCAs and EPDs. The importance of early stakeholder interaction with regulators is stressed.

Implementing internationally harmonised methodologies for LCA and EPD creation for lighting products can address the challenges posed by methodological discrepancies.

Chapter 4 reviews regional solutions for achieving methodology uniformity and describes the topics to be considered in a standardised approach.

To aid stakeholders who require additional information and assistance in implementing internationally harmonised LCAs and EPDs for lighting products, Chapter 4 will provide some recommendations. It will explore ways to address data challenges, promote knowledge sharing and collaboration across regions, enhance stakeholder engagement, and propose strategies for effectively utilising and communicating LCA and EPD results.

Implementing international standards for LCA and EPD creation in the lighting industry is crucial to enhance transparency and credibility. It drives innovation, environmental sustainability and policy advancements.

CHAPTER 2

The Need for Globally Harmonised LCA and EPD Methodologies for Lighting Products

There is little doubt that a growing environmental interest in many countries and regions is fuelling the use of LCAs and EPDs across a wide range of product categories within the building construction and infrastructure sectors. Structured data on environmental performance will increasingly be required for lighting products in the medium term, with a strong desire for EPDs in the long term.

Some regions and countries are already actively pushing for this type of environmental information. The European Union, for example, is doing so through its Ecodesign Directive and the proposed Ecodesign for Sustainable Product Regulation and Construction Product Regulation. China requests environmental information in their Eco Design Initiative, and Japan through its Green Public Procurement (GPP) and Green Contract Law.

2.1

Complexity of LCA and EPD Methodologies for lighting products

While there is clearly a growing trend for LCAs and EPDs in general, it should also be recognised that there are still a number of issues to be addressed, with regard to their implementation for lighting products.

The complexities of implementing LCAs and EPDs for lighting products arise from the need to analyse a diverse range of inputs including (but not limited to) energy consumption, resource depletion and emissions generation. In assessing the environmental impact of lighting equipment, it is important to make the distinction between general Energy Related Products (ErP), such as switchgear, and Energy Using Products (EuP) such as lighting products, as the latter require added analysis for their operational energy use. Increased innovation and lighting systems advancement has created the need for structured methodologies to quantify factors such as energy costs and the contributions of features such as dimming and trimming, constant light output, occupancy sensing and daylighting controls.

Another area of LCA and EPD complexity affecting lighting products is the handling of regionally disparate elements, such as the electricity generation mix of the use location (e.g. coal versus hydro power generation) and product transportation methods and distances (e.g. air freight versus sea freight over intercontinental distances).

It is very important that LCA and EPD producers are cognisant of such regional nuances and variations and use internationally attuned (IEC standardised) methodologies to develop EPDs

that can be used globally, rather than being restricted in relevance to regions or local provinces.

A further complication is that there are several influences that can produce different EPD results for the same lighting product, creating variability that impairs clear decision making. These include factors such as:

- software options that use different methodologies;
- use of secondary data versus primary data, versus industry average data;
- use of different and often proprietary databases for secondary data;
- use of lighting control scenarios that allow for interpretation and assumption variations based on region and application.

To ensure that the user is not misinformed about comparability, the methodologies should require – upfront in the EPD:

- a clear description of these factors, with an explanation that they can produce different EPD results,
- specificity about the type of data and software used to create the EPD.

2.2

Benefits of Globally Harmonised LCA and EPD Methodologies

LCAs and EPDs are essential tools for product environmental assessments, which would very much benefit from a globally aligned, harmonised approach.

Harmonised methodologies would facilitate consistent and reliable reporting of environmental performance data, allowing stakeholders to make informed decisions based on accurate and transparent information. Standardisation would also reduce the potential for greenwashing and ensure that industry claims are trustworthy, credible and verifiable.

Standard methodologies would also help improve the ability of stakeholders to understand the environmental performance of lighting products. This would simplify benchmarking and empower consumers to make sustainable choices, based on reliable and consistent information.

However, implementing internationally harmonised methodologies for LCAs and EPDs for lighting products is complex, as the currently available methodologies used to develop them vary significantly across countries and regions. The divergent methodologies and lack of harmonisation results in duplication of efforts and leads to conflicting results, which complicates the transparency and credibility of LCAs and EPDs. Besides this, stakeholders may also face difficulties in accessing reliable and up-to-date information about lighting products, especially from multiple manufacturers operating in various jurisdictions.

A focal point is the need to adopt common methodologies, also known as Product Specific Rules (PSR, see Chapter 3 for an explanation of terminology), that are internationally harmonised while accommodating regional differences for various lighting product groups such as lamps, luminaires, control gear, and control devices. The use of common methodologies for each lighting product category can facilitate comparability of performance outcomes across regional and national boundaries.

2.3

Benefits of LCA and EPD Standardization for the Lighting Industry

LCA and EPD standardisation can offer several benefits for the future of the lighting industry:

- Driving innovation and sustainable product development: A standardised framework for LCAs and EPDs can incentivise manufacturers to innovate and improve the environmental performance of their lighting products. Transparency of environmental impact assessments creates a level playing field, encouraging sustainable practice and the development of greener technologies.

- Policy and regulatory advancements: The adoption of internationally harmonised methodologies for LCAs and EPDs can help inform policy and regulatory developments in the lighting sector. Governments and industry associations can leverage standardised information to promote more environmentally preferable products through regulations, procurement policies, and financial incentives.

2.4

Metrics and possible regulations

For well over a decade, manufacturers and suppliers of quality lighting products have been using objective methods in general environmental standards (i.e. ISO 14040, ISO 14044, ISO 14025) to credibly define and benchmark environmental performance and make truthful and transparent environmental claims.

There are indications from some regions that climate change related building regulations, including quantified reporting of CO_2 impacts for some building products, may become mandatory in coming years. It is important that stakeholders from such regions begin early interaction with regulators, offering the recommendations that internationally standardised ISO and IEC methods provide technically and commercially credible pathways for such implementation.

CHAPTER 3

Challenges and Gaps in LCA and EPD Methodologies

There are gaps in the currently available suite of LCA and EPD standards, leading to a lack of uniformity of methodology for lighting products. To address the current gaps and to avoid unnecessary methodological divergence among different regions, standardisation from a globally recognized Standards Development Organization (SDO) like IEC is recommended.

This White Paper issues a call to action for the industry to develop standardised methodologies for LCAs and EPDs and to standardise these methodologies, as so-called Product Specific Rules (PSRs) for lighting products. Product Category Rules and Product Specific Rules are defined in ISO 14025 and IEC 63366, respectively, as

- **Product Category Rules (PCR)** – a set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories[1]
- **Product Specific Rules (PSR)** – a set of specific rules, requirements and guidelines, based upon and complementing the PCR, for a specific product group

These concepts are explained in 3.1.2 and 3.1.4 below.

To ensure consistency in the IEC community, PCR refers to rules at the electrical and electronic products and systems (EEPS) level, and PSR[2] refers to rules at the product level (i.e. IEC TC 34 Lighting).

PSRs thus complement more generic PCRs, and add specific rules for lighting products to more general rules applicable to all building products or electrical and electronic products and systems. However, note that the term PSR is just emerging and has not (yet) found widespread adoption.

[1] ISO 14025:2006, 3.5

[2] Concepts similar to PSRs are alternatively known as sub-category PCRs, c-PCRs (complementary Product Category Rules), or Part B specifications. Additionally, when the split between more generic and more specific rules is being emphasised, PCRs are sometimes referred to as core PCRs.

3.1

Existing IEC and ISO committees, standards and guides

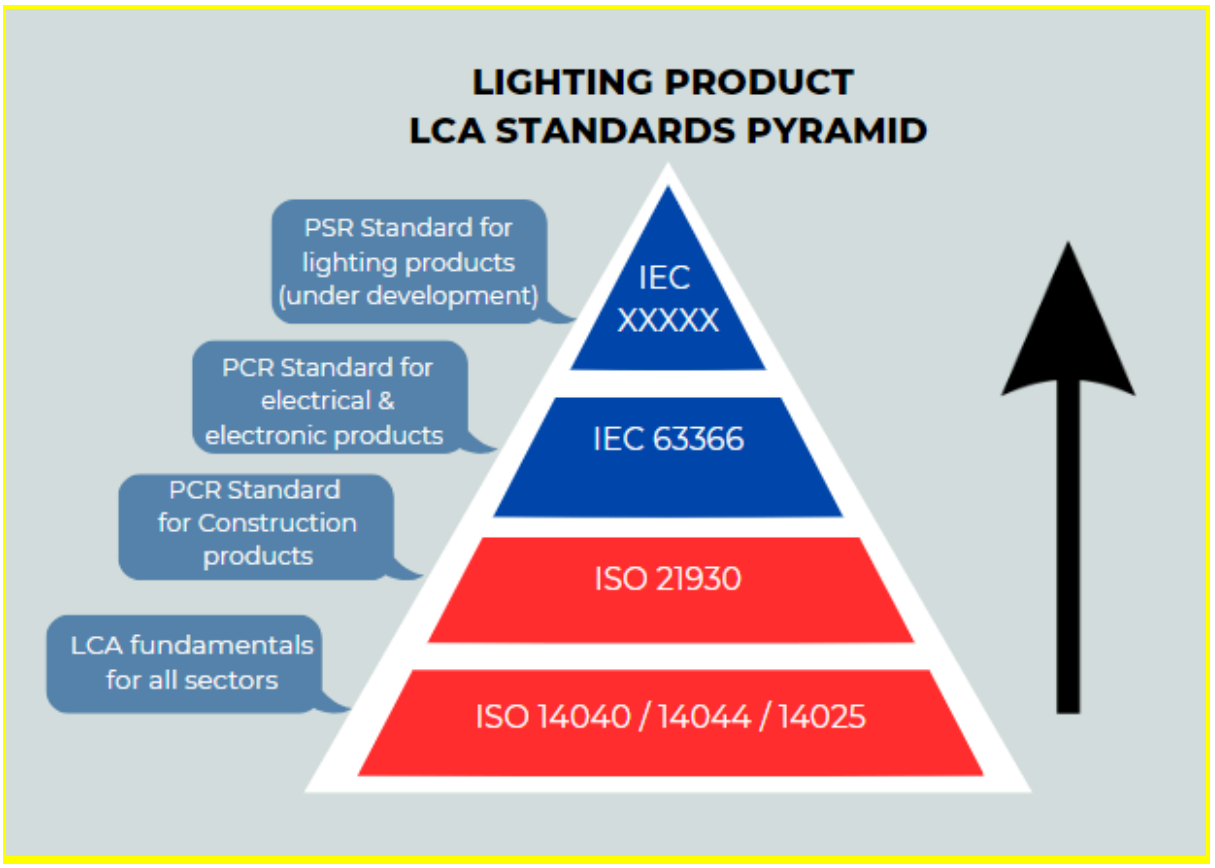

Figure 1: Lighting Product LCA Standards Pyramid

Standardisation of LCA and EPD methodologies has been the subject of intense research and debate since the 1990s. The effort has resulted in a suite of well-established standards that mostly stem from the construction industry. Figure 1, shows the standards most relevant for the lighting industry in a "standards pyramid".

The standards pyramid depicts the relevant standards as a progression, with narrowing scope from bottom to top. In the upward progression, the rules to create the EPD become increasingly detailed and specific. These more specific rules facilitate EPD creation, as the rules become increasingly relevant to manufacturers' products.

An extensive introduction to the standards is beyond the scope of this White Paper. Yet, a short informal characterisation of each is provided, introducing the concepts that are key to the objectives and further reading of this White Paper.

3.1.1

ISO 14040 and 14044

- *ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework.*
- *ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines*

These standards describe the principles, framework, requirements, and guidelines for life cycle assessment studies. They provide the basic methodological framework for life cycle assessment studies and the requirements to which any such study should adhere. These standards, however, leave the individual practitioner with a range of choices, including objectives and scope of the study. Thus, they fall short in delivering a framework for uniform and comparable LCAs.

3.1.2

ISO 14025

- *ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations Principles and procedures.*

ISO 14025 steps up in providing a framework for Environmental Product Declarations (EPDs, or "Type III environmental declarations"). This International Standard establishes the principles and specifies the procedures for developing EPD programmes and EPDs. Basing itself on the ISO 14040 and 14044 standards, it elaborates on the governance principles for EPD program operators and third-party verification.

The standard introduces the key notion of Product Category Rules (PCRs): specific rules, requirements, and guidelines for developing EPDs for a given product category. These PCRs are essential to reaching a harmonised way of reporting environmental impacts. They detail the product category, the system boundaries, the impacts to be reported, and the life cycle stages to be included.

3.1.3

ISO 21930

- ISO 21930: *Sustainability in buildings and civil engineering works – Core rules for environmental product declarations and services*

ISO 21930 specifies the PCRs for construction products and construction services. Note that EN 15804 also specifies PCRs for construction products and services. It is closely related to ISO 21930.

3.1.4

IEC 63366

- ***IEC 63366: 202X*** *Product Category Rules for life cycle assessment of electrical and electronic products and systems.*

IEC 63366 is a horizontal standard[3] to assist product standards writers, still in development in the IEC. It guides the development of PCRs for electronic and electrical products and systems. These standards elaborate the PCRs for electrical and electronic products for which the use stage is important for environmental performance.

Note that EN 50693 is better known in Europe and also specifies PCRs for electronic and electrical products. It is closely related to IEC 63366.

The EN 50693 and IEC 63366 standards introduce the concept of Product Specific Rules (PSRs). These are sets of specific rules, requirements, and guidelines - based upon and complementing the PCR -- for a specific product family. Thus, PSRs complement PCRs and further define elements such as functional units and default scenarios in the product-specific context.

ISO international PSRs are available for many construction products. However, as yet, few international publications exist for electronic and electrical products and systems. Pioneering IEC publications cover electrical cables and switchgear and control gear, but no such internationally standardised Product Specific Rules currently exist for lighting products. A useful source of information is **IEC TS 63058:2021:** *Switchgear and control gear and their assemblies for low voltage - environmental aspects; TC 121.*

3.1.5

IEC Technical Committee TC 34

Considering the interest in LCAs and EPDs for lighting products, the IEC Technical Committee TC 34 is currently working on a new project to develop an international standard for harmonised environmental PSRs for lighting products.

[3]IEC Guide 108 Horizontal Functions - A horizontal standard is a standard that shall be applied when no dedicated product specific standard exists.

3.2

Lack of methodological uniformity: gaps

The absence of internationally standardised Product Category Rules and Product Specific Rules leads each practitioner to produce an EPD differently. This lack of harmonisation reduces its effectiveness, and ultimately contributes to a lack of usefulness among lighting sector stakeholders.

To achieve methodological alignment, PCRs and PSRs should be standardised globally within an internationally recognized SDO. At the very least, they should define a functional unit, specify controls functionality and energy saving scenarios, provide a method to deal with product families, and tie product performance into the established product and application performance standards for lighting, as will be detailed in Section 4.2.

Some aspects of PCRs and PSRs can be standardised globally, while others are region-dependent. The standard should thus incorporate region-specific clauses whenever regional practices or regulation require this. The PCR and PSR should also identify these aspects and require that they are communicated clearly upfront in the EPDs so the user is not misinformed about comparability.

Lighting products and systems are more complex than many simple building materials, and the use stage of lighting products significantly dominates the environmental impacts (in some cases over 90%)[4]. In this respect, lighting differs from the majority of building products.

In standards language, environmental impact reporting on a per product basis is based on the Declared Unit (DU), while environmental impact reporting that includes the quantified performance delivered, is based on a Functional Unit (FU). For accurate and fair product comparison, it is essential that the determination of the DU and FU are properly standardised, and then used in all EPDs.

Current approaches to EPDs taken by the building industry tend to focus on the environmental footprint of the manufacturing stage. Thus, additional hardware is penalised when productive gains achievable during the use stage – for example with the operation of lighting controls -- would be ignored.

Lighting controls implementation requires additional hardware in the form of sensors or extended electronics. The environmental benefits from the use of lighting controls include reductions in energy consumption and carbon emissions. These energy savings should lead to a reduced environmental footprint for the use stage being reported in the EPD.

A sound methodology for lighting products incorporates energy savings from controls and avoids a situation where controls are considered additional devices with separate carbon calculations, thereby enabling a proper trade-off between additional hardware and any resultant energy saving gains. The methodology should be specific to avoid the incorporation

[4]March 19, 2024 LEDucation Presentation: Decarbonization of Lighting-The Hotspots Leela Shankar, James Salazar & William Paddock

of control scenarios that allow for interpretation and assumption variations based on region and application. Furthermore, as discussed in 4.2.2, the full impact of controls must be considered at the application level, supported in a limited form by these specific default scenarios within the EPD calculation.

CHAPTER 4

Proposed Solutions for Achieving Methodology Uniformity

4.1

Overview of regional lighting PSRs

Program Operators are organisations that oversee EPD programs and provide essential services to EPD practitioners. Among these services are PCR and PSR development and review, arranging the selection of independent EPD verifiers and PCR/PSR panel review members, and publication of EPDs. ISO 14025 Section 6 gives a full list of requirements for Program Operators.

No comprehensive overview of current Program Operators is evident, and it is not in the scope of this White Paper to develop this overview. However, a regional understanding of mainly European Program Operators who focus on the construction sector can be obtained from the ECO Platform organisation and its website.[5]

For lighting, as of 2024, three of the Program Operators in the ECO Platform have developed regional Product Specific Rules for lighting: the PEP Association (France), IBU (German Institut Bauen und Umwelt) and EPD Italy. These rules have different but overlapping scopes. The PEP Association has published "PEP PSR 0014[6] for luminaires" and "PEP PSR 0007 Self-contained emergency electrical equipment" for emergency luminaires. IBU has published" Part B: Requirements on the EPD for Luminaires, light sources and control gears" and EPD Italy has published "EPDItaly 020, PCR Part B for Public Lighting". Furthermore, some of the published lighting EPDs follow these Product Specific Rules. However, not all of the published lighting EPDs are based on such rules, as some use the more generic core PCRs: EN 15804 AMD 2, EN 50693 or proprietary core PCRs.

There are additional initiatives for developing lighting PSRs underway globally, as of 2024. Smart EPD, in collaboration with several manufacturers and organisations such as the National Electrical Manufacturers Association (NEMA), is developing a luminaire PSR for North America[7]. Lighting Europe is developing PSRs for lighting components, building on its collaboration with the PEP Association over PSR0014. In China, the development of PSRs for lighting has also been

[5] https://www.eco-platform.org/eco-epd-40.html
[6] http://www.pep-ecopassport.org/create-a-pep/produce-a-lca/
[7] Smart EPD

announced to support its carbon footprint program. Standards will ultimately be developed by GB[8] TC 224 and be preceded by association standards from MoHURD[9] CSUS and CNLIC[10] among others.

Multiple regional/proprietary PSRs for lighting exist, and published lighting EPDs are based on these PSRs, or on Product Category Rules that are not specific to lighting. The risk of divergence looms large, should these initiatives continue without alignment, and, indeed, some of the risk has already materialised.

4.1.1

Beyond lighting industry learnings

Of course, all this is not unique to the lighting industry. The ISO website demonstrates that many of the construction industries have already filled the gap in the standards pyramid. There are 120 PCRs on the ISO website that complement a core PCR with product specific rules.

4.2

Topics to be addressed in a lighting PSR standard

Based on the requirements in IEC 63366 for PSRs and an analysis of the available regional PSRs, it is proposed that at least the following topics should be handled in a PSR standard:

1. Functional Unit,
2. Controls,
3. Product Family,
4. Default Scenarios e.g. for transportation models and energy mixes, and conformity with product and application performance standards.

4.2.1

Functional Unit

In Chapter 3.1, it was illustrated that "merely" reporting product impacts may misrepresent environmental impacts and penalise good product performance, such as long lifetime and high luminous flux. To counter this effect, the ISO 14040 and 14044 standards have proposed the "Functional Unit" as the reference unit for product comparison. The Functional Unit quantifies the primary function (performance characteristics) of the product and provides a reference to which the inputs and outputs are related.

[8]National Standards of the People's Republic of China
[9]Ministry of Housing and Urban-Rural Development of the People's Republic of China
[10]China National Light Industry Council (cnlic.org.cn)

ISO 14040 provides an example Functional Unit for methods to dry hands, being "drying one pair of hands" (the quantified performance). This unit is suited to compare several methods to dry hands: e.g. towel and air drier system. The presentation[11], which can be found at US DOE Advanced Manufacturing Office, provides many more illustrative examples.

For example, the PEP PSR0014 has defined the Functional Unit for luminaires as: *"Provide lighting that delivers an outgoing artificial luminous flux of 1,000 lumens during a reference lifetime of 35,000 hours*". Consequently, impacts are normalised to the actual lifetime and luminous flux of the product.

Environmental impacts of PEP (for 1,000 lumens over 35,000 hours) = Environmental impacts of the reference product x (1,000 / Outgoing luminous flux of the reference product in lumens) x (35,000 / Assigned product lifetime of the reference product in hours).

No Functional Units have been defined yet for other lighting products such as control gear, lamps or LED modules. It is crucial that these metrics are standardised to serve as an internationally harmonised reporting metric.

4.2.2

Controls

The energy savings through controls depend heavily on the application and cannot be accurately calculated on a product level without the detailed application context. This application context is not known at the product level.

To ensure that controls are included in environmental declarations and to avoid divergence in approaches, a standardised PSR should set default scenarios for controls and create transparency for the controls scenario applied in the EPD.

Given the crucial role of the use stage on the environmental impacts for lighting products, and the important role of controls to reduce these impacts/this impact, it is essential that the industry defines a harmonised approach to quantify the effect of controls through international standards. Not including controls ignores their environmentally beneficial aspects. Comparability of EPDs will be severely hampered if no harmonised approach becomes available. PEP PSR 0014 and a few of the existing and developing global PSRs define a number of default control scenarios that could be considered as a first step towards future standardisation and/or be the base for further regional elaboration.

[11] Defining Functional Units for LCA and TEA (energy.gov)

4.2.3

Product Families

The lighting industry is characterised by product families. Some families comprise a few product types with differentiating performance characteristics such as luminous flux and colour temperature. Configured luminaires offer many more products within the family category. The environmental impacts may vary considerably within a given luminaire family. Traditionally, a worst-case approach has been employed to create an EPD for product families where the impacts of the product type most affected are reported. Typically, this would be the product with the highest lumen output. This approach can seriously misrepresent (i.e. overstate) the environmental impacts of the products in a family.

The more recent IEC 63366 standard defines an approach based on homogeneous product families and allows for extrapolation of environmental impacts within the family. This approach is generic, and IEC 63366 proposes that it be further detailed for specific product categories. Regional PSRs such as PEP PSR 0014 and Smart EPD define homogeneous luminaire product families and describe extrapolation from a reference product to a target product.

Creating EPDs for every type in the product family is costly and logistically complicated. It is scientifically valid to extrapolate the environmental impacts from reference products to other products in the homogeneous lighting product family. The lighting industry is urged to adopt a harmonised way of dealing with product families for inclusion in a standardised PSR.

4.2.4

Default scenarios and regional differentiation

Many of the environmental impacts depend heavily on the in-service application and cannot be accurately calculated on a product level. It is necessary that the PSR defines default scenarios that can be used in lieu of the actual application context. These default scenarios can be thought of as conservative “average case” application scenarios.

An example of this scenario is lighting controls, which is highlighted in Section 4.2.2. Additionally, there are other areas where default scenarios may be useful: e.g. for transport, energy mix during use stage, packaging and recycling. Harmonised scenarios for these stages will further enhance comparability and also ease the assessment workload of both EPD practitioner and verifier.

PEP PSR 0014 and a few of the existing and developing global PSRs define a number of default scenarios that could be considered as a first step towards standardisation and/or be the base for further regional elaboration. To ensure that the user is not misinformed about comparability, the PSR should require – upfront in the EPD - a clear description of these scenarios, with an explanation of how they are interpreted and applied.

4.2.5

Conformity with product and performance standards

The calculations described in the Product Specific Rules rely on factors such as luminaire system boundaries, power, lifetime or luminous flux. To ensure consistency, each EPD practitioner should interpret and/or measure these concepts in exactly the same way during EPD creation. Reference to the established product and performance standards is instrumental to ensure this common understanding and measurement. Referring to international standards is a solid step in this direction (e.g. measurement of luminous flux – an important criterion relative to the Functional Unit – is based on EN 13032).

Moving forward, the appropriate global vocabulary must be introduced along with the globally standardised measurement methods.

4.3

Broader industry ecosystem implications

Figure 2, depicts the stakeholders in the EPD ecosystem, illustrating that EPD practitioners are dependent on services beyond those offered by the Program Operators. To successfully and conveniently create EPDs, a practitioner will at least need appropriate analytical software, databases and verification services. Note that use of software options that employ different methodologies, variable data sources, and proprietary databases can produce different EPD results for the same lighting product, creating variability that impairs clear decision making.

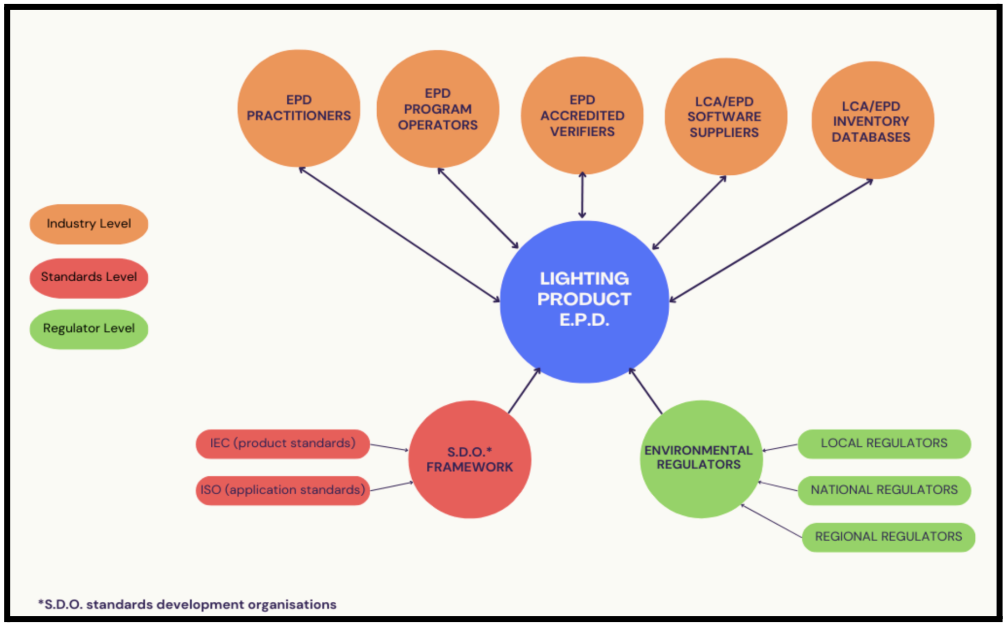

Figure 2: Stakeholders in the EPD ecosystem

Conclusion

LCAs and EPDs are becoming essential tools for quantifying and communicating the environmental performance of products and systems.

In the lighting industry, the need for LCAs and EPDs is becoming increasingly important due to advancements in lighting system technology, more regulatory requirements, and heightened consumer expectations for environmental product stewardship. It is crucial to understand and compare the environmental performance of different lighting products, especially considering the use-phase energy costs and the benefits of features such as dimming, trimming, constant light output, occupancy sensing, and daylighting controls.

To ensure the relevance and global usability of LCAs and EPDs, it is important for LCA/EPD producers to recognise regional variations and use internationally attuned (IEC standardised) Product Specific Rules (PSRs) in their development. This will enable the EPDs to be used globally, rather than being restricted in relevance to specific regions or nations.

There are challenges and gaps in current LCA and EPD methodologies that must be addressed, especially considering the use of EPD metrics (such as carbon footprint) in building programs and rating systems. Understanding the risk of diverging EPD practices in the lighting industry is paramount, and topics that need to be addressed in standardised Product Specific Rules should be identified.

This paper has reviewed topics to be covered in a lighting PSR: Functional Unit, controls, product families, default scenarios and conformity with product and application performance standards. Existing and developing Product Category Rules (PCRs) for luminaires can serve as a starting point for international standardisation of methodologies in the lighting sector.

With a harmonised approach and a solid standards-based foundation, the lighting industry can effectively quantify and communicate the environmental performance of its products through internationally harmonised methodologies. Since this is currently not in place, this White Paper is a call to action for the lighting industry to work together, as outlined in this paper, to support growing standardisation initiatives in IEC TC 34 and to avoid diverging EPD practices.

ANNEX

Supplementary Information

Life Cycle Assessment (LCA) & Environmental Product Declaration (EPD)

The IEC is developing a horizontal standard with guidance for drafting PCR and PSR standards: *IEC 63366 Product category rules for life cycle assessment of electrical and electronic products and systems*. Horizontal standards are aimed at standards writers working within standards development organisations and designed to assist with guidance on drafting and implementing PSRs for various electrotechnical product sectors. This standard will define PCRs for electronic and electrical products and systems and provide guidance on how to develop PSRs for the various IEC technical committees. Such PSRs further define items, such as functional units and default scenarios in the product-specific context. The LCA principles and framework are based on the ISO 14040 series of standards (ISO 14040 and ISO 14044). Some of the development complexities include:

- Defining product families and how to develop EPDs for a large number of products
- Addressing some gaps in environmental databases relevant to lighting products
- Harmonising data from multiple manufacturers operating in various jurisdictions

Benefits and Applications of LCA & EPDs in the Lighting Industry

As an example of best practice, the IEC and the electrical switchgear and control gear sector has made a major contribution with the publication of: *IEC TS 63058:2021 Switchgear and control gear and their assemblies for low voltage - Environmental aspects* (Currently under development and update as international standard IEC 63058 ED1).

Product specific rules under IEC Technical Specification IEC TS 63058:2021, establish a structured and harmonised assessment of impacts in terms of characterised impact indicators (e.g. CO_2 emissions and ozone depletion) over the whole life cycle of the product. This offers a simplified means for manufacturers to calculate the product environmental impacts and, with this readily accessible data, allows contractors, installers, and end users to assess environmental impacts at the system level. Beyond providing guidance to manufacturers in evaluating and improving the environmental performance of their products, the standard promotes communication of environmental information throughout the supply chain.

About the GLA

The Global Lighting Association (GLA) is a collective of national and regional lighting associations, representing over 5,000 lighting manufacturers with annual sales of US $75 billion. Our mission is to promote sustainable and energy-efficient lighting solutions while enhancing light quality. As a global forum, the GLA facilitates the exchange of technical and policy information among industry leaders. Additionally, it serves as an authority on matters relevant to the global lighting industry. Importantly, the GLA adheres to national and regional competition law in its activities. If you would like to learn more, you can visit our website at globallightingassociation.org.