Introduction to EC3 Uncertainty

Introduction

Environmental Product Declarations (EPDs) are useful tools for quantifying environmental impacts, including global warming potential (GWP), of materials and products. However, there are many uncertainties inherent in the calculations and reporting of EPDs.

Consider the example EPD scenarios below:

EPD A:

- A window EPD that reports environmental impacts for an entire product line of windows (as a weighted average).

EPD B:

- A window EPD that reports the environmental impacts for a single product

It is clear that the range of impacts for a specific product covered by EPD A is more uncertain than that of the single product represented in EPD B.

Building Transparency (BT) aims to support data transparency and data specificity in EPDs. Thus, EPD uncertainty is addressed in BT's Embodied Carbon in Construction Calculator (EC3) tool through the use of uncertainty factors. BT has defined a set of uncertainties, as described below, commonly found in EPDs that can be quantitatively assessed. These factors are then applied by EC3 to an EPD within its database depending on the EPD scenario. BT acknowledges that there are other sources of uncertainty in the EPD process, but these may be better captured as qualitative (rather than quantitative) uncertainties.

Types of uncertainty captured in the EC3 tool

Manufacturer Uncertainty

Definition

Manufacturer uncertainty arises when an EPD is industry-wide rather than manufacturer-specific since it is typically the result of a weighted average of inputs from contributing manufacturers.

Method for removing uncertainty

This uncertainty is removed when an EPD is manufacturer-specific.

Product Uncertainty

Definition

Product uncertainty arises when an EPD reports impacts for an entire product line (or set of products) and the impacts reported are an average of multiple products.

Method for removing uncertainty

This uncertainty is removed when an EPD is produced for each product type.

Plant Uncertainty

Definition

Plant uncertainty arises when an EPD reports impacts for a product as an average of multiple production facilities (typically as a weighted average).

Method for removing uncertainty

This uncertainty is removed when an EPD is produced for each production facility.

Supply Chain Uncertainty

Definition

Supply chain uncertainty arises from using average background life cycle inventory (LCI) data for impactful upstream inputs that are highly variable in terms of global warming potential[1].

[1]Example: Cement is a highly impactful material input to concrete production. It's GWP impact can be highly variable; thus, using average or generic LCI data for cement would be associated with supply chain uncertainty.

Method for removing uncertainty
This uncertainty is removed when an EPD's average (generic) background LCI data is replaced with supply chain-specific background data.

Batch Uncertainty (Just in Time)

Definition
Batch uncertainty arises from small batch-to-batch variations in environmental impacts.

Method for removing uncertainty
This uncertainty is removed when an EPD is batch-specific.

Basic Uncertainty

Definition
A basic uncertainty of 3% is applied to all EPDs, which aims to capture any remaining uncertainties in the LCA calculations for a product.

Method for removing uncertainty
This uncertainty is never removed.

How are uncertainty calculations performed for the EC3 tool?

When each type of uncertainty described above is applied to an EPD, a range (*i.e.* statistical distribution) of possible GWP impacts (rather than a single, exact GWP impact value) is created for that EPD. BT aims to quantify the most representative distribution of GWP that is possible for each uncertainty type for a product category. The calculations for these distributions are discussed in more detail in the EC3 General Uncertainty Methodology Document. BT has conducted uncertainty assessments for priority product categories (*e.g.*, ready-mix concrete, steel, flat glass) and uses default uncertainty values for material categories not yet addressed. Thus, the uncertainty values for each product category can be significantly different based on the realities of the product category's supply chain and associated environmental impacts.

Example 1
Ready Mix Concrete: The major contributing factor to a ready mix concrete's GWP is the cement, which is known to have a wide range of GWP impact. Thus, the supply chain specific uncertainty is high for ready mix concrete, with cement as the major contributing factor.

Example 2

Flat glass: The main source of GWP variability is the energy used in the production facility for flat glass. Contributions from the upstream supply chain to the GWP are both low and not highly variable. Therefore, flat glass has relatively low supply chain uncertainty but more significant plant uncertainty.

For improved comparability within the same category, Building Transparency has selected the 80th percentile of the range of possible GWP impact as the *uncertainty-adjusted GWP*. This value was selected because the 80th percentile is a reasonable conservative estimate that incentivizes higher EPD data quality and specificity versus comparing the reported value in the EPD (*i.e.* an average value).

How are these uncertainty values applied in the EC3 tool?

Application of each type of uncertainty is applied based on the information found in the EPD. This information can be found in the uncertainty checklist for a digitized EPD as shown below.

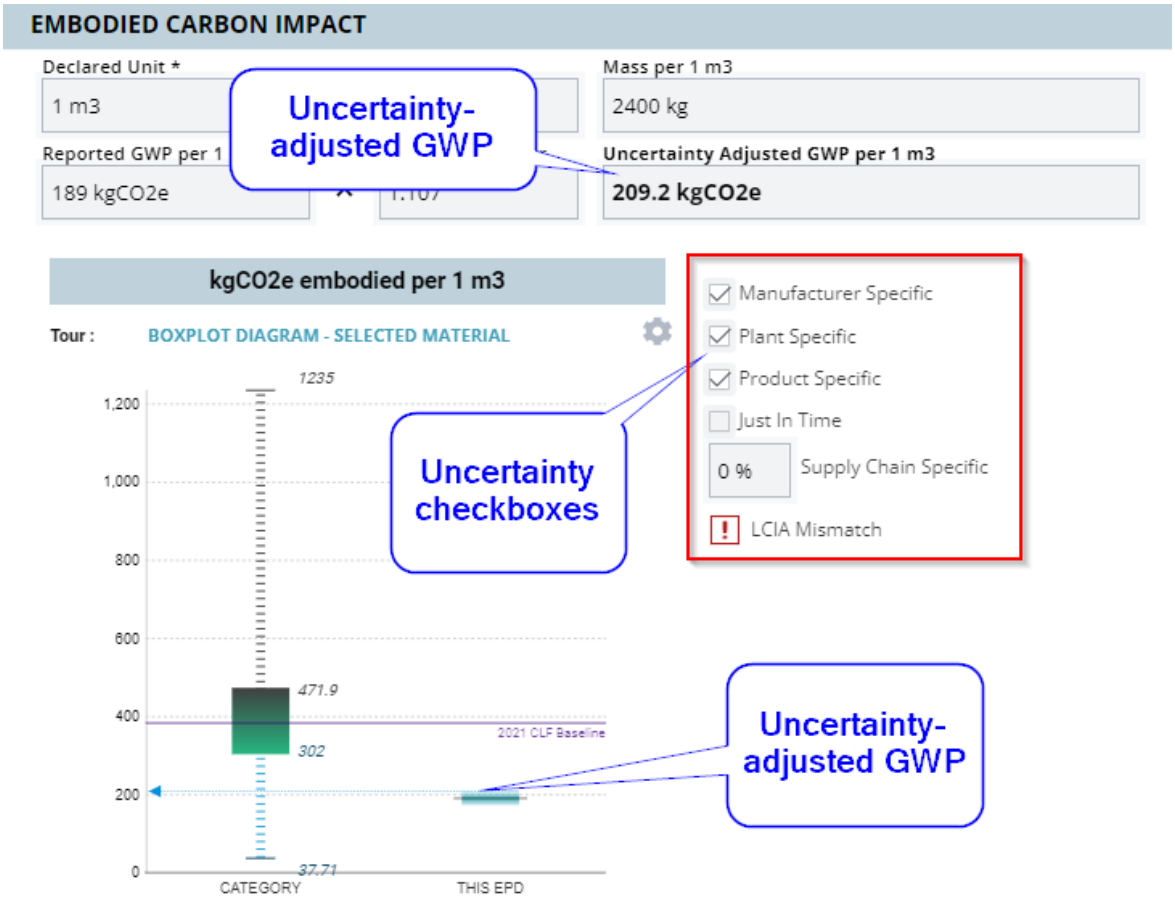

Figure 1 - Uncertainty represented in the EC3 tool.

When boxes in the uncertainty checklist are checked, the associated uncertainty is removed. For instance, the EPD shown above is manufacturer-specific, plant-specific, and product-specific. However the data uses no supply-chain specific data and is not batch-specific.

Alternatively, compare Figure 1 to Figure 2. The EPD is supply chain, manufacturer, plant, product AND supply chain specific. Thus, the uncertainty associated with the EPD is less than shown in Figure 1.

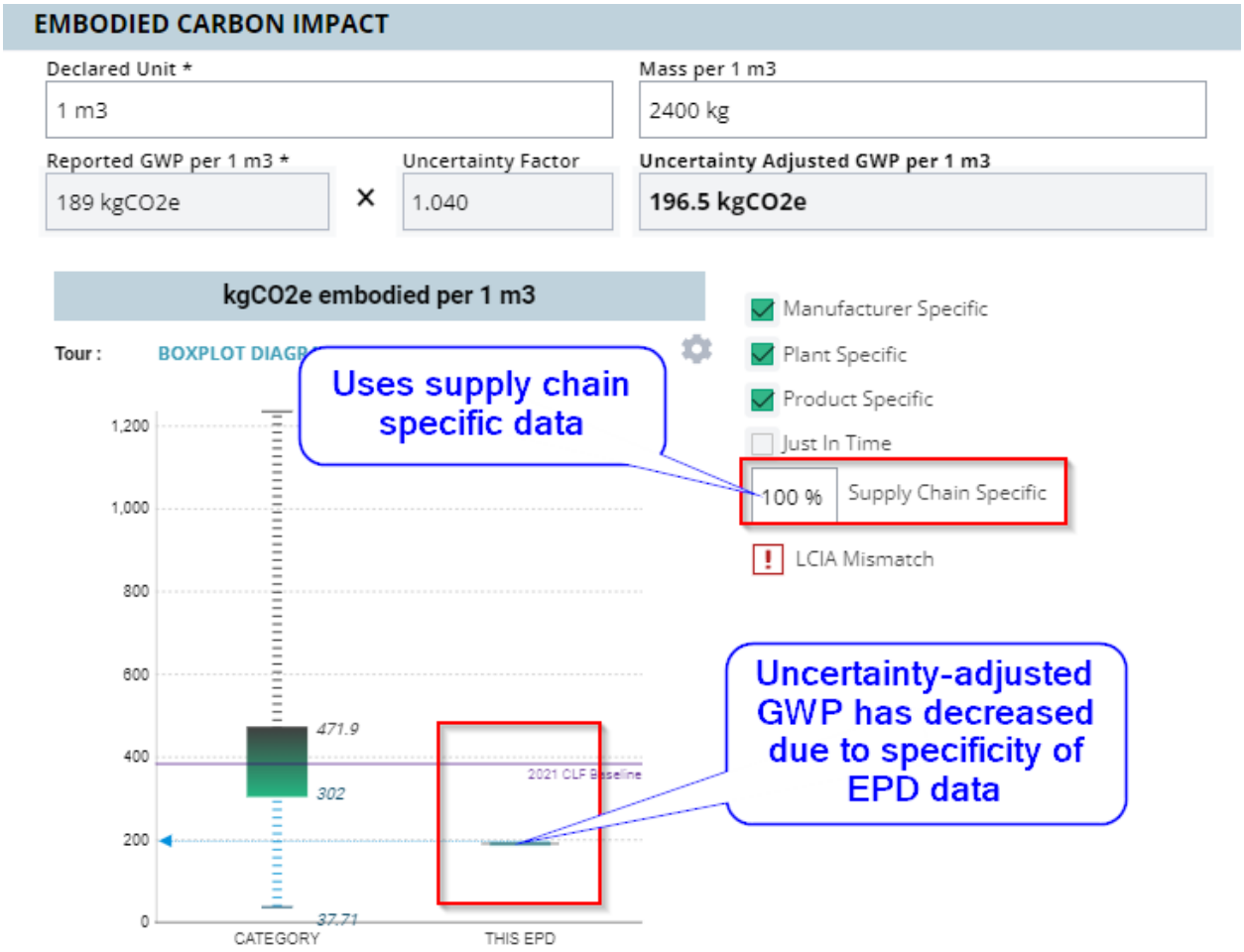

Figure 2 - Example EPD with supply chain specific background data. (The EPD is also manufacturer-, plant-, and product-specific)

The uncertainty-adjusted GWP is used in EC3's statistics such as the comparison boxplot on the left side of Figures 1 and 2, and in EC3's Building Planner in order to incentivize the use of EPDs that use highly specific background and foreground data.

Are there other resources or examples of this type of uncertainty methodology being applied, reviewed or published?

Peer Reviewed Publication by the Carbon Leadership Forum that Maps to EC3 Applied Uncertainty Methodology: Embodied carbon in construction materials: a framework for quantifying data quality in EPDs

Example of similar methodology approach: Q Metadata For EPD Quality - Assured Environmental Product Declarations (EPD) For Healthy Competition And Increased Transparency