Drastic

Demonstrating affordability, sustainability and circularity

# Data Collection Protocol for Multi-cycle Sustainability and Circularity Assessment

DELIVERABLE D2.2

# Deliverable Information

| | |
|---|---|
| Grant agreement | 101123330 |
| Project title | Demonstrating Real and Affordable Sustainable Building Solutions with Top-level whole life-cycle performance and Improved Circularity |
| Project acronym | DRASTIC |
| Project coordinator | VITO |
| Related work package | WP2 – Process and design guidelines & sustainability performance assessment |
| Deliverable number | D2.2 |
| Deliverable description | This report presents the data protocol needed for the sustainability assessments on product and building level. Requirements will be defined for geometrical information (3D models) such as building footprint and volume and semantic information, such as material properties. In addition, requirements for data on the use phase (e.g., user profiles, monitored energy consumption) will be included. The protocol will follow international standards and best-practices and define new standards where needed and is mainly targeted at product developers and environmental impact assessors. The key point delivered in this report is a concise protocol to conduct beyond the state of the art environmental and circular impact assessment. |
| Related task(s) | T2.3 – Data collection protocol |
| Lead organisation | CAALA |
| Contributing partner(s) | Madaster, VITO, Tecnalia |
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| Dissemination level | PU |

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## Quality Control

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| Lisa Damen | VITO | 20 SEP 2024 | V1 |
| Paul Klein Lankhorst | Madaster | 25 SEP 2024 | V1 |

## History of Changes

| Version | Change made | Date |
| --- | --- | --- |
| V0.1 | First draft | 10 SEP 2024 |
| V1 | Draft for internal review | 17 SEP 2024 |
| V2 | Update after internal review | 25 SEP 2024 |
| V3 | Final update for submission | 30 SEP 2024 |

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# Executive Summary


The Horizon Europe research project Drastic aims to reduce whole life carbon and increase circularity across the European built environment. In meet this objective, five pilot projects will demonstrate varied and innovative solutions to reduce operational and embodied carbon emissions while promoting the reclamation and reuse of materials. Drastic's goal is to show how these solutions, combined with improved business models, can lead the way towards the decarbonisation of the EU's building stock by the year 2050.

The data collection protocol outlined in this document is designed to support sustainability assessments carried out by CAALA, Madaster, VITO, and Tecnalia for both product and building-level evaluations within the Drastic project. The protocol establishes a harmonized approach to ensure consistent and efficient data capture, enabling comprehensive Multi-cycle Life Cycle Assessments (MLCA), Multi-cycle Life Cycle Costing (MLCC) and circularity assessments. It aims to streamline the data gathering process while sensitizing project participants and future users on the importance these assessments, thereby enhancing stakeholder understanding of the value of accurate and detailed data.

The protocol distinguishes two primary levels for conducting sustainability assessments: building and component. These hierarchical assessment levels ensure a systematic approach to data collection, facilitating detailed evaluations across varying granularities. Each level is associated with specific data points, categorized as either project-specific or product-specific. Data collection points are organized into tables for building and component levels, using attributes such as type, unit, priority, and source to guide data entry. In order to cover the MLCA methodologies defined in D2.1, additional data points for components following the cascading scenarios based on the R-strategies were added. This ensures that the benefit of developing a sustainable product with an extended service life can be made visible in the assessment of environmental KPIs.

The collection process leverages three main methods: geometry data, decision trees, and structured forms. These tools ensure harmonized data collection across demonstrators and stakeholders, while a shared platform (Teams/SharePoint) supports real-time collaboration. Data will be securely stored and transferred through databases hosted on servers within Europe, adhering to stringent data protection standards. The protocol includes quality checks and pilot testing to maintain high data quality, supported by training sessions for demonstrators and a feedback loop for continuous improvement.

Effective implementation of the protocol relies on coordinated efforts among project participants. VITO, as project coordinator, oversees the quality and consistency of the data collection, while CAALA and Madaster provide the technical applications and manage data security. Tecnalia focuses on traceability data requirements. Regular feedback meetings and updates ensure smooth communication and alignment with project goals.

Overall, this protocol provides a comprehensive framework for collecting and managing the data needed for sustainability assessments, ensuring robust and consistent workflows for the Drastic project.


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By establishing clear guidelines and responsibilities, it supports the project's overarching objective of promoting sustainable and circular construction practices.

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# Acronyms

| | |
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| API | Application Programming Interface |
| EPD | Environmental Product Declaration |
| KPI | Key Performance Indicator |
| MLCA | Multi-cycle Life Cycle Assessment |
| MLCC | Multi-cycle Life Cycle Costing |

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# Glossary

| | |
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| Building | The highest hierarchical assessment level considered in this framework, such as a house or an office building, consisting of elements. |
| Component | The lowest hierarchical assessment level considered in this framework, consisting of materials, such as a construction product (e.g. a brick or a prefabricated façade element) or a work section (e.g. brickwork) depending on the subject of the guidance and assessment. |
| Construction product / building product | Item manufactured or processed for incorporation in construction works, supplied by a single responsible body (EN 15804:2012+A2:2019). |
| Element / building element | The middle hierarchical assessment level, considered in this framework, such as an external wall or a flat roof, consisting of components. |

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# 1 Introduction

## 1.1 Objectives and Scope of the Data Collection Protocol

The primary objective of this data collection protocol is to facilitate the systematic gathering of data required for sustainability assessments done by CAALA, Madaster, VITO and Tecnalia at both product and building level. By establishing a harmonized approach, the protocol ensures that all necessary data for multi-cycle sustainability and circularity assessments can be efficiently and consistently captured, regardless of the specific focus of the assessment.

In addition to streamlining data collection, the protocol aims to raise awareness among project demonstrators and future users about the importance of Multi-cycle Life Cycle Assessments (MLCA) - Multi-cycle Life Cycle Costing (MLCC) and the data needed for this process. Through this sensitization, stakeholders will better understand the critical role that accurate, comprehensive data plays in evaluating the environmental and economic impacts of materials and products throughout their life cycle.

Ultimately, this protocol serves to align both technical processes and stakeholder awareness, supporting more robust and consistent sustainability assessments across the Drastic project. In addition, the protocol is connected to the digital traceability platform since it ensures a structured approach to collecting evidence that supports information tracking in those selected multi-cycle scenarios for analysis, while avoiding the multiplicity of data collection tasks.

## 1.2 Structure of This Document

This document outlines the data collection protocol for the Drastic project. In the first section of chapter 2, the data structure is described, including a definition of the assessment levels, a detailed list of all relevant data points and their characteristics, and additional data points that are especially relevant for MLCA. The second section of chapter 2 describes how data will be collected and managed, followed by section 2.3 which explains the process to ensure consistently high data quality throughout the project. Finally, after the general concept of the data collection is defined, section 2.4 specifies the roles and responsibilities among the project participants are established.

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# 2 Data Collection Principles

## 2.1 Data Structure

### 2.1.1 Assessment Levels

When conducting environmental and economic impact assessments, the concept of "assessment levels" plays a crucial role. In the D2.1 document[1] of the Drastic project, several levels are distinguished and defined for conducting these assessments: building, element, component, and construction product. These distinctions are essential for creating a structured understanding of how assessments should be approached, however a brief discussion on their ambiguity and a clear definition is crucial to ensure correct data collection and processing.

A building, as defined in the document D2.1, is the highest hierarchical assessment level, and should cover the entirety of the building structure including foundation, that is required to enable the usage of the building. It can contain multiple dwellings or separate, not structurally connected buildings, as long as they are located within close proximity and on the same property (EN 15978:2011).

The building consists of several elements, which in turn consist of one or more components. These components, for their part, can be a single type of material (e.g. concrete or a brick), but also a single construction product (e.g. a prefabricated façade element) or work section (e.g. brickwork) consisting of a combination of several materials. The category of an element is needed to define the implementation and function of one or multiple components within the building. As the classifications of the term element can be different, for the purpose of this project a list of pre-defined elements (see Annex A.2) will be used to avoid mislabelling and ensure a clean data base for all demonstrators.

Finally, the component can be understood as a single product consisting of one material or several other materials. While this level of abstraction is useful for breaking down a complex product, it is also lacking a clear universal definition. The component category serves to subdivide product-level assessments, helping to aggregate or disaggregate data as needed. Similarly to the element categories, a pre-defined selection of options for component categories is defined to ensure a consistent data collection process. These component categories are as follows: "internal", for all internal coverings, "core" for all structural parts of the element, and "external" for all components that are applied to the external side of the core. In the case of components that cannot be broken down to these categories (e.g. in windows), all component parts are assigned to the category "core".

From the perspective of the data structure, these distinctions will be incorporated on different levels. The main assessment level in the digital platform will be the one of the building level, with product level granularity for each of the data points listed in chapter 2.1.2 to support the assessment on building level. This can be explained by the fact that for both building and product level, with the EN 15978:2011

[1] Design Guidance Framework Based on Multi-cycle Sustainability and Circularity Assessment (July 2024).

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and EN 15804+A2:2019 respectively, LCA assessment frameworks are in place and can be followed. The element and component levels will be used as a defining category to locate and group the products within the building. This structure will ensure that all essential data points for the final application of a building LCA are collected for all products that are assessed, while staying flexible enough to allow as assessment on a lower level.

### 2.1.2 Data Collection Points

In this chapter the various data points that are relevant for the sustainability assessments process and that are either mandatory or optional to be collected, are outlined. These data points are organized in a table that provides a structured overview of what information is required, using multiple attributes for classification and prioritization purposes, as well as to facilitate both the data collection and quality assessment processes.

The **scale** indicates the level at which each data point has to be collected, either at the building level, or for each component part (which can be a material or a product, hereinafter referred to as component level). This is the smallest unit that the object in question can be broken down to. There are separate tables for building-level data (Table 1) and component-level data (Table 2 and Table 3). Building-level data points needs to be collected once per building assessed, component-level data points once per component.

**Category** describes the type of data point that is whether project-specific or product-specific. Project-specific data is required for data processing on the building level, and it includes general building information such as gross floor area, as well as data on the quantity of each product within the building and the element of the building it belongs to. Component-specific data is not project or building specific, but generally describes one product within one specific life cycle. This distinction is important to clarify when a certain data point is needed and is the reason for two separate Tables for component-scale data: Table 2 containing project-specific data for each component, and Table 3 consisting of data points describing components regardless of the project they are intended to be used in.

The **type** and **unit** define the format of the data point, indicating how the information should be provided. There are generally three options: 1) free text or number input, 2) a pre-set selection for data points, or 3) a selection of a number within a certain range, that has to align with the technical data structure within the assessment software and therefore needs to have one of the expected values. If only few selection options are available, they are directly mentioned in the respective cell, larger lists can be found in Appendix A and are referenced accordingly.

**Priority** refers to the importance and each data point is giving a priority level based on its relevance to the assessment process. There are three categories: A – necessary, indicating that the data point is essential for data processing reasons or for the assessments, B – increases analysis quality, meaning that filling this data point will enhance the depth and accuracy of the analysis, and C – optional is classifying all data that is seen as additional and might improve the useability of the data within the

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assessment software or has a significance for traceability and the harmonisation of information, but is not essential from a technical or analysis point of view.

**Source** shows where the data will be coming from. For building-specific data, the amount of each material in the building has to be assessed by using geometry data generated by the demonstrators. For product-specific assessments (parts of Table 2 and Table 3), the data points will be derived from the decision tree, which will be filled out by the demonstrators for each of the components and elements that need to be included in the assessments. All other data mentioned in Table 1, Table 2 and Table 3 will be included in other types of forms or questionnaires, located within the software or a third-party web tool, or answered in direct interviews. For these data points, the source will be generally described as form.

Finally, **usage** defines how the data might be utilized to improve the understanding on what certain data points are needed for. There are four options: building-level MLCA/MLCC, including energy demand calculation, component-level MLCA/MLCC, circularity assessment, and the last being traceability data, meaning that the data point is not directly used in any assessment but needed to ensure traceability for future life cycles.

Table 1 details the project-specific data points on building scale, and are therefore only needed once per project assessed.

*Table 1: Building scale data points*

| Category | Name | Type | Unit | Priority | Source | Usage | Comment |
|---|---|---|---|---|---|---|---|
| Project-specific | Project Name | Text | - | A | form | traceability | |
| Project-specific | Project Address | Text | - | B | form | traceability | |
| Project-specific | Building Type | Selection (see A1. Building Types) | - | A | form | building MLCA/MLCC | |
| Project-specific | Construction Completion Year | Whole number | a | A | form | traceability, building MLCC | Starting year of building use is considered the same as this data point. For renovation cases, this is refers to the original construction year of the building. |
| Project-specific | Estimated duration of the Construction Phase | Whole number | a | C | form | traceability | |
| Project-specific | Project Type | Selection (New Construction, Refurbishment) | - | A | form | traceability | |
| Project-specific | Gross Floor Area (GFA) | Decimal | m² | A | geometry / form | building MLCA | This data point can be derived from geometry, but due to its importance as reference unit, a second validation |

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| | | | | | | | through a form is recommended. |
| Project-specific | Net Floor Area (NFA) | Decimal | m² | A | geometry / form | building MLCA | This data point can be derived from geometry, but due to its importance as reference unit, a second validation through a form is recommended. |
| Project-specific | Reference Area | Decimal | m² | A | form | building MLCA/MLCC | This data point can be the same as GFA or NFA, or a different one, in case an alternative reference area should be used (e.g. useable area). |
| Project-specific | Analysis Period | whole number | a | B | form | building MLCA/MLCC | |
| Project-specific | Temporary use | y/n | - | B | form | traceability | |
| Project-specific | Expected duration per use cycle | whole number | a | B | form | building MLCA/MLCC | This data point is related to the use period by the same tenant/user. |
| Project-specific | Expected number of use cycles | whole number | - | B | form | building MLCA/MLCC | |
| Project-specific | Project Type | selection (new built, renovation) | - | A | form | building MLCA/MLCC | |
| Project-specific | Renovation year | whole number | a | A | form | building MLCA/MLCC | Only needed if building is a renovation project. |

Table 2 contains all data points that are needed for a building-level assessment which have to be collected for each component separately. These are e.g. the amount of each component within the building, data on how each of the components is attached and accessed within the building, but also information on whether the component is reused or can be reused, both points are essential to correctly calculate the building MLCA/MLCC (see 2.1.3).

*Table 2: Component scale data points on building-level*

| Category | Name | Type | Unit | Priority | Source | Usage | Comment |
|---|---|---|---|---|---|---|---|
| Project-specific | Element type | Selection (see A2. Element Types) | - | A | geometry (IFC), form | building MLCA | An IFC model includes classifications that can be translated to software specific categories, otherwise they have to be selected manually |
| Project-specific | Element name | Text | - | C | form (geometry) | traceability | Depending on the format of the geometry, an element name can already be included there. |

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| Project-specific | Element Inclination | Number (between 0 and 90) | ° | A | geometry | building MLCA | |
| Project-specific | Element Orientation | Selection (see A3. Element Orientation) | - | A | geometry | building MLCA | |
| Project-specific | Amount | Decimal | - | A | geometry, form | building MLCA/MLCC | Depending on the format of geometry, a manual correction might be needed |
| Project-specific | Unit | Selection<br>(m, m², m³, piece) | - | A | geometry, form | building MLCA/MLCC | m² and m³ can be imported from IFC-models, m and m² from simplified models |
| Project-specific | Volume of Material | decimal | m³ | C | geometry, form | building MLCA/MLCC | |
| Project-specific | Weight of Material | decimal | kg | B | form | building MLCA, circularity | |
| Project-specific | Transport Type | Selection (Train, Truck, Plane, Ship) | - | A | form | building MLCA | If multiple transport types are used, this data point and the distance need to be filled for each type. This data point relates only to the transport of the finished component to the construction site. |
| Project-specific | location start | text / address | - | C | form | building MLCA/MLCC | |
| Project-specific | location end | text / address | - | C | form | building MLCA/MLCC | |
| Project-specific | distance | decimal | km | A | form | building MLCA/MLCC | |
| Project-specific | Detachability - Connection type | Selection (A5. Connection Type) | - | B | decision tree (Are the components easy to separate and identify?) | circularity | Type of connection |
| Project-specific | Detachability - Accessibility of the connection | Selection (A6. Accessibility of Connection) | - | B | decision tree (Are the components easy to separate and identify?) | circularity | Accessibility |
| Project-specific | Detachability: Intersections | Selection (A7. Intersections) | - | B | decision tree (Are the components easy to separate and identify?) | circularity | |
| Project-specific | Detachability - Product edges inclusion | Selection (A8. Product Edges Inclusion) | - | B | decision tree (Are the components easy to separate and identify?) | circularity | |
| Project-specific | Was this product already Used? | Y/N | | A | form | building MLCA | |

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| Project-specific | Can this product be reused? | Y/N | | A | form | building MLCA | |
| Project-specific | Amount of packaging waste | decimal | kg | B | form | building MLCA | |
| Project-specific | Losses due to breakages | Percentage | % | B | form | building MLCA | |
| Project-specific | Personnel cost during installation | decimal | € | B | form | building MLCA | |

Finally, Table 3 contains all data that is essential specifically for the component MLCA/MLCC and circularity, and feed into building-level MLCA/MLCC in a later stage, as it describes each component independently of the building it would later be used in, as well as giving some information for traceability purposes. It is also needed to calculate the environmental effects of using non-standardised components which cannot be covered by already existing Environmental Product Declarations (EPDs, see 2.1.3).

*Table 3: Component scale data points on product-level*

| Category | Name | Type | Unit | Priority | Source | Usage | Comment |
|---|---|---|---|---|---|---|---|
| Product-specific | name (material name) | Text | - | C | form | traceability | |
| Product-specific | Component type | Selection (Interior, Core, Exterior) | - | B | form | component MLCA | |
| Product-specific | Material Classification Type | Selection () | - | B | form | component MLCA/MLCC, building MLCA/MLCC, circularity, traceability | |
| Product-specific | Material Classification | Selection | - | B | form | component MLCA/MLCC, building MLCA/MLCC, circularity, traceability | Based on the previously selected type, each framework provides a list of possible selections. |
| Product-specific | Material Thickness | decimal | m | A | form | component MLCA/MLCC, building MLCA/MLCC, circularity | |
| Product-specific | Index | whole number | - | A | form | component MLCA/MLCC, building MLCA/MLCC, circularity | This data point allows describing multi-composite materials in the digital platform (e.g. reinforced concrete). All materials belonging to the same material layer within an element will have the same index. |

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| Product-specific | Fraction | decimal (between 0 and 1) | - | A | form | component MLCA/MLCC, building MLCA/MLCC, circularity | This data point is related to "Index" and describes the volumetric fraction of each material within a multi-composite layer. |
| Product-specific | functional unit | Selection (kg/piece/m²/m³) | - | A | form | component MLCA/MLCC, circularity | |
| Product-specific | raw density | decimal | kg/m³ | B | form | component MLCA, circularity | If the component consists of a complex mix of materials, this table either needs to be filled for each material separately (see Index) or once for the entire component, skipping this data point. |
| Product-specific | weight per functional unit | decimal | kg/FU | A | form | component MLCA/MLCC, circularity | |
| Product-specific | Replacement Period | whole number | a | A | decision tree (Does it increase the total lifespan in relation to BAU?) | component MLCA/MLCC, building MLCA/MLCC, circularity | assumed "new" lifespan |
| Product-specific | Description | text | - | C | form | traceability | |
| Product-specific | GTIN | text | - | C | form | traceability | |
| Product-specific | Product code | text | - | C | form | traceability | |
| Product-specific | Manufacturer | text | - | C | form | traceability | |
| Product-specific | Unique identifier of the external dataset for primary material | text | - | A | form | component MLCA/MLCC, building MLCA/MLCC, circularity | This input is needed if an existing dataset is used |
| Product-specific | Dataset type for primary material | Selection (Ökobaudat, Ecoplatform) | - | A | form | component MLCA/MLCC, building MLCA/MLCC, circularity | This input is needed if an existing dataset is used. The current selection options may be extended in the future. |
| Product-specific | Transport costs (€/kg) | decimal | €/kg | A | form | MLCC | |
| Product-specific | Cost during manufacturing process (€/kg) | decimal | €/kg | A | form | MLCC | This data point can be total, but ideally split by type of input/output flow within the manufacturing process. |
| Product-specific | % Primary Feedstock | decimal (between 0 and 1) | - | A | decision tree (Does it use primary materials?) | component MLCA, building MLCA, circularity | Total percentage of primary materials |

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| Product-specific | % Renewables | decimal (between 0 and 1) | - | A | decision tree (Does it use primary materials?) | component MLCA, building MLCA, circularity | Biobased primary materials |
| Product-specific | % Renewable feedstock Sustainably Produced | decimal (between 0 and 1) | - | B | decision tree (Are the primary resources known to be scarce?) | component MLCA, building MLCA, circularity | For biobased primary materials |
| Product-specific | % Non-renewable feedstock Sustainably Produced | decimal (between 0 and 1) | - | B | decision tree ((Are the primary resources known to be scarce?) | component MLCA, building MLCA, circularity | For non-biobased primary materials |
| Product-specific | Component reuseable | Y/N | - | B | decision tree (Can it be used in the same function without transformation?) | component MLCA, building MLCA | |
| Product-specific | Component repairable | Y/N | - | A | decision tree (Is it easy to maintain and repair over the lifespan?) | component MLCA, building MLCA | |
| Product-specific | Component Re-Purposable | Y/N | - | B | decision tree (Can it be adapted without physical transformation?) | component MLCA, building MLCA | |
| Product-specific | Component Restorable | Y/N | - | B | decision tree (Can technical performance be restored through replacements?) | component MLCA, building MLCA | |
| Product-specific | Component Re-Manufacturable | Y/N | - | B | decision tree (Can the parts be used to produce a new product?) | component MLCA, building MLCA | |
| Product-specific | % Secondary - Reused | decimal (between 0 and 1) | - | B | decision tree (Does it use secondary materials?) | component MLCA, building MLCA, circularity | |
| Product-specific | % Secondary - Repaired | decimal (between 0 and 1) | - | B | decision tree (Does it use secondary materials?) | component MLCA, building MLCA, circularity | |
| Product-specific | % Secondary - Repurposed | decimal (between 0 and 1) | - | B | decision tree (Does it use secondary materials?) | component MLCA, building MLCA, circularity | |
| Product-specific | % Secondary - Refurbished | decimal (between 0 and 1) | - | B | decision tree (Does it use secondary materials?) | component MLCA, building MLCA, circularity | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Product-specific | % Secondary - Remanufactured | decimal (between 0 and 1) | - | B | decision tree (Does it use secondary materials?) | component MLCA, building MLCA, circularity | |
| Product-specific | % Recycled | decimal (between 0 and 1) | - | B | decision tree (Does it use secondary materials?) | component MLCA, building MLCA, circularity | |
| Product-specific | % Recycling Efficiency | decimal (between 0 and 1) | - | B | decision tree (Are there established recycling options?) | component MLCA, building MLCA, circularity | |
| Product-specific | Total distance travelled by resources | decimal | km | B | decision tree (Are the resources locally sourced?) | component MLCA, building MLCA | Since a component will consist of multiple resources, a total distance for all resources instead of location start and end for each of them reduces complexity (as it would add another scale level – resource) |
| Product-specific | Transport Type | Selection (Train, Truck, Plane, Ship) | - | A | form | component MLCA, building MLCA | If multiple transport types are used, this data point and the distance need to be filled for each type. This data point refers to the transportation of materials needed to fabricate the component. |
| Product-specific | Energy Recovery | Y/N | - | B | decision tree (Are there established energy recovery options?) | component MLCA, building MLCA | |
| Product-specific | Acceptability for Recycling | Y/N | | B | decision tree (Does the composite nature hinder acceptability for recycling?) | component MLCA, building MLCA | |
| Product-specific | % Biodegradable | decimal (between 0 and 1) | - | B | decision tree (At the end of the technical lifespan is it biodegradable?) | component MLCA, building MLCA | |

### 2.1.3 Additional Data Points for MLCA/MLCC

In the context of building-level MLCA, each component is assigned an EPD (or in case of the Drastic solutions, the product LCA performed during the project), containing all environmental key performance indicators (KPIs) for all or most life cycle stages according to EN 15804 needed for the assessment. However, since within the Drastic project, components are developed to have an improved environmental performance compared to currently existing ones of the same type, for example

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containing more secondary materials than current EPDs typically cover, a more refined assessment is needed to fully show the potential of the developments.

The definition of a multi-cycle life cycle of a component for building MLCA is based on the one described in D2.1. The main principle of this definition is the prolongation and preservation of the service life of buildings and components, and therefore its sustainability, by encouraging the implementation of cascading scenarios based on the R-strategies. In the context of the data collection protocol and the digital platform, the implementation of this approach on the component level will be divided into two parts. The first part concerns any additional life cycle of a component as long as it stays in its original shape, being reused, repaired, refurbished, but not remanufactured or recycled. The second part covers the latter two cases, where the component cannot be restored to its original shape, but could enter a new life, as a secondary material in the initial life cycle of a different component.

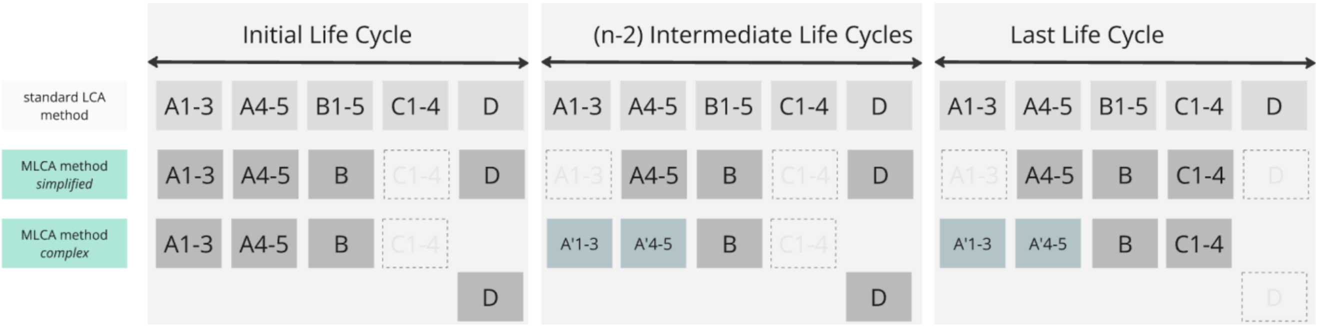


*Figure 1: Overview on MLCA methods*

Figure 1 gives an overview of the two options for an MLCA calculation (de Wolf et al., 2020) that can be used in the digital platform and how they differ from the standard LCA method based on EN 15804. The simplified MLCA method follows the cut-off methodology as applied in the EN 15804, and can be used when no additional data points on the environmental impact of secondary materials in the intermediate life cycles are given (e.g. in case of current EPDs conform EN 15804). The complex methodology, which relies heavily on the component-level LCA assessment that has included a multi-cycle life cycle approach as defined within Drastic. Depending on whether the component is in the initial, intermediate or last life cycle, the stages C1-4, A1-3 and A4-5 or D should be included, altered, or excluded, as shown in Figure 1. For a component in its initial life cycle, provided it can be reused or in other ways restored to its original shape, the phases C1-4 can be reduced or ignored entirely, as no demolition and waste treatment would be necessary in that case. A component in an intermediate life cycle has a significantly reduced or no impact in the initial stages A1-A3, as it would not need to be produced from scratch. In its final life cycle as this type of product, it would then have, similarly to the intermediate life cycle, reduced A1-A3, but a full C1-C4 impact, since it has to be demolished, and then ideally recycled.

In order to include this benefit for using secondary materials, the building MLCA can use the simplified approach if no data is provided (see the second row in Figure 1). A more detailed approach is shown in the last row of Figure 1, indicating that alternative values for A1-3 and A4-5 should be provided in case a component is in its intermediate or last life cycle and hence, does not need to be manufactured

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from scratch. As a base for the list of KPIs, the A2 dataset structure as it is defined in EN 15804:2012+A2:2019 is used and can be found in Appendix B. Environmental KPIs. These KPIs can be calculated based on the data points mentioned in Table 3.

## 2.2 Data Management

### 2.2.1 Data Collection Methods

This section outlines the key methods and tools used to gather the necessary data, ensuring a harmonized approach across all demonstrators and stakeholders. It will describe the currently available data sources and their development throughout the project, a rough schedule, and a brief outlook on the planned development on this topic.

As explained in 2.1.2, there are generally three sources for the data collection: geometry, decision tree and form. Geometry data is assessed on building-level and can be used as the basis for assessments on other levels (such as element or component). It can either be collected manually for each element within the building, or from an IFC file. Both methods are not bound to national standards of modelling and categorization, and can therefore be applied across all Drastic demonstrators. To support the demonstrators in the product development and data collection process, a decision tree has been developed within tasks 2.1 and 2.2, which also serves as an important data source for some specific, product-level data assessment points. Finally, all other required data points will be included in forms on the digital platform or in questionnaires for direct interviews to ensure a guided, step-by-step data collection process.

The data collection will not follow a strict schedule, but will be happening regularly throughout the project timeline, whenever a re-assessment is necessary. The first session for all demonstrators is planned for the last quarter of 2024.

With additional development during the project timeline, demonstrators will eventually be able to skip an excel-based template entirely, being able to input data directly in the respective assessment software.

### 2.2.2 Data Storage and Transfer

Data storage and transfer in this project are designed to ensure secure, organized, and efficient handling of all collected information. The systems used for storing and processing data are chosen to maintain high levels of security while allowing smooth collaboration between project partners.

Due to the number of different formats for data collection, a general data collection template including all data points will be used to keep an overview of the types of data collected per each component and demonstrator, as well as for archive purposed. It will be stored in a shared environment, specifically using SharePoint in Teams, where team members can securely upload and access data. This shared platform enables real-time collaboration and ensures that data is easily accessible to all authorized users throughout the project. In addition to the shared platform, two primary databases will handle

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long-term storage and data processing: the CAALA and Madaster databases, all of which are hosted on servers located in Europe. These servers adhere to strict data protection regulations, ensuring that the data is stored securely and complies with all relevant privacy and security standards.

Access to the stored data is strictly controlled through a user-based login system. Each user is provided with credentials that determine their level of access, ensuring that only authorized personnel can view or modify specific datasets. This controlled access helps maintain data integrity and security, limiting exposure to unauthorized users.

In terms of data format, the collection process primarily uses Excel or CSV files. These formats allow for easy data input and sharing during the initial stages of data collection. The communication between the CAALA and Madaster platforms will happen through an Application Programming Interface (API-)connection, therefore allowing for a seamless and secure data transfer.

## 2.3 Quality Assurance and Monitoring

Ensuring the quality and reliability of the collected data is a key aspect of this project. A combination of automated checks, pilot testing, training, and continuous feedback will help maintain high standards throughout the data collection process.

Quality control will be partially automated, with systems in place to verify that all mandatory data points have been collected. This automated check ensures that the essential information is captured, reducing the chance of incomplete datasets. Any missing or incorrect data points will be flagged for review, allowing the team to address issues promptly and maintain the accuracy of the collected data.

Before full implementation, it is important to run a pilot test to identify any potential issues with the data collection procedures. This pilot phase will allow to test the protocol in a controlled environment, highlighting areas where adjustments may be needed and ensuring that the system functions as intended. By identifying these issues early, the project can avoid larger setbacks at a later stage.

To further ensure the quality of the process, training and support sessions will be provided to all individuals involved in data collection. These sessions will ensure that everyone understands the protocol, their specific responsibilities, and how to use the tools effectively. Well-trained data collectors will reduce the likelihood of errors and inconsistencies, contributing to a smoother and more reliable data collection process.

In addition, a feedback loop will be established, allowing data collectors to report any issues they encounter during the data collection process. This loop will also serve as a platform for suggesting improvements to the protocol, making the system more adaptive and responsive. By continuously gathering feedback, the project will be able to fine-tune the protocol, enhancing both the data quality and the overall effectiveness of the collection process.

## 2.4 Roles and Responsibilities

The successful implementation of the data collection protocol requires the coordinated efforts of several key stakeholders. Each partner plays a critical role in ensuring the protocol is effective, secure, and

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capable of supporting comprehensive sustainability assessments. This section outlines the roles and responsibilities of the project participants.

The demonstrators are applying the data collection protocol in real-world scenarios. Their primary contribution is to provide data for the environmental assessments. In doing so, they can test the guidelines provided by the data collection protocol on their respective cases, sharing insights and practical feedback to improve the protocol based on their experiences.

VITO, being project coordinator, the leader of work package 2, and task lead of the development of the assessment framework and in supporting the demonstrators with performing the assessments, plays a central role in overseeing the quality and consistency of the data collection process. They will both review the protocol based on the requirements outlined in D2.1 and provide feedback for improvements, as well as coordinate the data collection activities on the demonstrator side and ensuring alignment with the project's goals. VITO will also assist in monitoring the quality and completeness of the data to ensure it meets the standards necessary for accurate sustainability assessments.

CAALA and Madaster develop and provide the applications for data assessments, and are therefore responsible for managing the technical aspects of the data collection process, ensuring the data is properly structured and secure. They define the data points that are required for a comprehensive assessment and are responsible for developing a clear framework for how data is organized and shared between stakeholders. Within their applications, they ensure that all data handling processes comply with security standards and analyse the collected data to provide insights into the environmental impacts and overall sustainability metrics.

Tecnalia contributes to the data collection process with a focus on the necessary data points from the perspective of traceable information and data, as defined in the data requirements identified in work package 4 (whole life cycle digital platform), as well as participating in the data collection process from the demonstrators.

To ensure that all contributing parties are up-to-date, regular meetings for feedback on both data quality and the efficiency of the data collection protocol will be held. Any smaller updates will be handled through the respective Teams or e-mail channels.

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# 3 Conclusion

The data collection process in the Drastic project is complex due to the involvement of multiple stakeholders and the variety of applications, some of which are still under development. Given these factors, this protocol serves as the foundation for data collection, but is subject to change and will be updated regularly throughout the project to reflect the evolving needs and technical advancements.

As developments continue on both the demonstrators' and the digital platforms' sides, the protocol will be adapted accordingly—both in terms of the data collected and the methods and formats used for the collection process. Further advancements in the MLCA/MLCC methodology may introduce new data points into the process. Additionally, the pilot phase of data collection and the feedback loops will provide insight into the useability of the protocol.

The forthcoming phase involves disseminating and presenting the data collection protocol to all relevant stakeholders. Regular meetings will be conducted to monitor progress, facilitate discussion, and provide opportunities for feedback. The initial phase of data collection is planned to commence in the last quarter of 2024, starting with maximum of two demonstrators enabling a phased process from which we can learn and further evolve the data collection process. Once the test run is completed, a first assessment meeting between the partners involved in the data collection process will be held to align on any improvements in the process, as well as to establish a regular meeting schedule to constantly monitor progress.

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# References

CEN. (2011). *EN 15978:2011—Sustainability of construction works—Assessment of environmental performance of buildings—Calculation method (EN 15978:2011).* European Committee for Standardization.

CEN. (2019). *EN 15804:2012+A2:2019—Sustainability of construction works—Environmental product declarations—Core rules for the product category of construction products (EN 15804:2012+A2:2019).* European Committee for Standardization.

De Wolf C., Hoxha E., Fivet C. (2020). Comparison of environmental assessment methods when reusing building components: a case study. *Sustainable Cities and Society.* https://doi.org/10.1016/j.scs.2020.102322

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# Appendix A. Pre-defined Selections

## A1. Building Types

| |
|---|
| Single-family house |
| Multi-family house |
| Office / Administration |
| Education |
| Retail |
| Hotel |
| Warehouse / Logistics Hall |

## A2. Element Types

| Thermal envelope | Thermally non-relevant elements |
|---|---|
| Exterior wall load-bearing | Ceilings |
| Exterior wall non-load bearing | Inner wall load-bearing |
| Roof | Inner wall non-load bearing |
| Ceiling against unheated Space | Exterior wall of unheated rooms |
| Wall to unheated Space | Adiabatic Wall |
| Wall to ground | Column |
| Floor over outside air | Beam |
| Floor to unheated Space | Roof of unheated spaces |
| Floor to ground | Interior window |
| Window | Interior door |
| Door | Balcony |
| | Floor of unheated spaces |
| | Window of unheated space |
| | Exterior door of unheated space |
| | Sun protection |
| | Footing / Foundation |

## A3. Element Orientation

| | |
|---|---|
| North | North-East |
| South | North-West |
| East | South-East |

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| | |
|---|---|
| West | South-West |

## A4. Component Type

| |
|---|
| Interior |
| Core |
| Exterior |

## A5. Connection Type

| |
|---|
| Dry connection |
| Dry connection-Loose (no fixing material) |
| Dry connection-Click connection |
| Dry connection-Velcro connection |
| Dry connection-Magnetic connection |
| Connection with added elements |
| Connection with added elements-Bolt and nut connection |
| Connection with added elements-Spring connection |
| Connection with added elements-Corner joints |
| Connection with added elements-Screw joint |
| Direct integral connection |
| Direct integral connection-Peg connection |
| Direct integral connection-Nailing |
| Soft chemical compound |
| Soft chemical compound-Sealant |
| Soft chemical compound-Foam joint (PUR) |
| Hard chemical compound |
| Hard chemical compound-Adhesive bonding |
| Hard chemical compound-Poured |
| Hard chemical compound-Weld joint |
| Hard chemical compound-Cementitious bond |
| Hard chemical compound-Chemical anchors |

## A6. Accessibility of Connection

| |
|---|
| Freely accessible without additional actions |
| Accessible with additional actions that do not cause damage |
| Accessible with additional operations with fully repairable damage |

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| |
|---|
| Accessible with additional operations with partially repairable damage |
| Not accessible – irreparable damage to the product or surrounding products |

## A7. Intersections

| |
|---|
| No intersections – modular zoning of products or elements from different layers |
| Occasional intersections of products or elements from different layers |
| Full integration of products or elements from different layers |

## A8. Product Edges Inclusion

| |
|---|
| Open – no obstacle to the (intermediate) removal of products or elements |
| Overlap – partial obstruction to (intermediate) removal of products or elements |
| Closed – complete obstruction to (intermediate) removal of products or elements |

## A9. Material Classification Types

| |
|---|
| BB-SfB |
| BIM7AA |
| DIN 276 |
| eBKP |
| Level(s) |
| NL-SfB |
| NRM 1 |
| NS 3451 |
| Omniclass |
| Önorm |
| RICS |
| Shearing Layers (Layers of Brand) |
| Uniclass |
| Uniformat |

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# Appendix B. Environmental KPIs

| Indicator | Unit |
|---|---|
| Use of renewable primary energy (PERE) | MJ |
| Use of renewable primary energy resources used as raw materials (PERM) | MJ |
| Total use of renewable primary energy resources (PERT) | MJ |
| Use of non renewable primary energy (PENRE) | MJ |
| Use of non renewable primary energy resources used as raw materials (PENRM) | MJ |
| Total use of non renewable primary energy resource (PENRT) | MJ |
| Use of secondary material (SM) | kg |
| Use of renewable secondary fuels (RSF) | MJ |
| Use of non renewable secondary fuels (NRSF) | MJ |
| Use of net fresh water (FW) | $m^3$ |

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