

# Iceland Liechtenstein Norway grants

**(De)construct for Circular Economy**  
*(Des)construir para a Economia Circular*

## WP 3 – Material passports

Instruction manual

## Final Report

July 2022

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Promotor:



Parceiros:



### Authors:

Cristina Rocha  
David Camocho

LNEG – National Laboratory of  
Energy and Geology (Portugal).  
Resource Economics Unit



### With the contribution from:

Mário Ramos  
Graça Martinho

FCT NOVA



Luísa Magalhães

Smartwaste Portugal



Ricardo Santos  
Pedro Honório

RDF Construções



Katarzyna Anna Kazimierczuk

IDN Norway



Pavel Růžicka

Enviros, s.r.o.



Aida Szilagyi

NCSPC - National Centre for  
Sustainable Production and  
Consumption



### Manual reviewed by

CIMBAL – Comunidade Intermunicipal do Baixo Alentejo



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## WP 3 – Material passports

### Instruction manual

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## 1. Introduction

A building materials passport is a digital document consisting of the compilation and display of materials that are included in a product or construction. It consists of a set of data describing defined characteristics of materials in products, which give them value for recovery, recycling and re-use. The core idea behind the concept is that a material passport will contribute to a circular economy", promoting the recovery, recycling and/or re-use of materials and components in a dedicated market.

Material passport is a tool that addresses questions often not covered by other documents or certifications related to building products, especially concerning the potential of circularity of products. Material passports do not assess the data output and do not include an evaluation of data. Instead, they provide relevant information that can be used for several purposes at different stages of the life cycle of the building. The passports also support the assessment and certification by other parties and allow existing assessments and certifications to be entered into the passport as uploaded documents.

The scope of a materials passport can be focused on different levels and have different structures and ways or hierarchy levels to present the information. According to the needs of the users, a single passport can include the level of materials, components, products and systems that constitute a building.

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## 2. Objectives

Through the transparency and the relevance of the information recorded and made available, the passports not only operationalize circular potential but to put it into practice, they provide incentives for businesses in more than one way:

- **Guidance.** The passport does not have a normative or a certification purpose and having a passport does not necessarily make the product or building good for the Circular Economy. The collection and sharing of information provides guidance throughout the life cycle of materials, products, systems and buildings.
- **Recognition.** The development and availability of passports promote the differentiation from competitors through transparent communication of the characteristics of materials and products and their circularity potential.
- **Innovation and knowledge.** This approach promotes companies to have a more active knowledge about their products and the materials that compose them. This knowledge also promotes innovation and the development of new and more efficient solutions for the entire life cycle.

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## 3. How to use the tool

### 3.1 Overview

The (De)Construct for Circular Economy materials passport template is an Excel file composed by eight spreadsheets:

1. Introduction
2. Building
3. P\_Site
4. P\_Structure
5. P\_Skin
6. P\_Services
7. P\_Space plan
8. Global information

All the “P\_” spreadsheets have the same structure and type of information. They correspond to building layers (see 3.4) and it is at this level that users fill in the products and materials data. The “Global information” spreadsheet does not require any action from the users, as it corresponds to the automatic calculations performed by the tool, displayed in tables and graphs.

### 3.2 Spreadsheet ‘Introduction’

In the first spreadsheet (Figure 1), the user gets general information regarding the tool. A short introduction, the objectives of the tool and the disclaimer are presented here.



Figure 1 - Material Passport - Introduction

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### 3.3 Spreadsheet 'Building'

The purpose of this page (Figure 2) is to register general information about the building, as follows:

- **Passport reference:** A reference code of the passport, as provided by the entity responsible to register and store the passport.
- **Publishing date:** Date of the publication of the passport by the entity responsible for the registration.
- **Building name:** Name or the reference of the building.
- **Building type:** Public or private (drop-down list).
- **Usage:** Services or housing, Single-family building or multifamily building (drop-down list).
- **Year of construction:** Year in which the building was concluded.
- **Year of renovation:** Year in which the renovation (if performed) was concluded.
- **Description of renovation:** If the passport is being applied for a renovation in a building, a short description of what and how is being/has been renovated.
- **Status:** New construction, a renovation or an existing building (drop-down list).  
The passports can be used for any of these situations; however, the feasibility of the process depends on the availability of data regarding the products and materials applied in the construction.
- **Total area:** Total area of the building under registration
- **Sustainability certifications:** This is an open field in which the user should insert certification of the building on what concerns sustainability or related aspects. Several certifications can be included here, such as Cradle2Cradle, Building Research Establishment Environmental Assessment Method (BREEAM), Green Building initiative – GBI, Leadership in Energy and Environmental Design (LEED), Passive House Institute US, NZEB.
- **Energy label:** This is also an open field to insert the energy label of the building.
- **Address:** Full address of the building.
- **Remarks:** Other relevant information not covered by the above-mentioned topics
- **Author(s) responsible for the data:** Names and contacts of the authors of the filling in process and registration.
- **Images:** To illustrate the passport, one or more images should be inserted in this field.

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Material passport for a Circular Economy in buildings

General information


|                                    |                      |   |                      |
|------------------------------------|----------------------|---|----------------------|
| Passport reference                 | <input type="text"/> | Publishing date   | <input type="text"/> |
| Building name                      | <input type="text"/> | <div style="border: 1px solid #ccc; height: 150px; margin-bottom: 5px;">Insert image(s) of the building</div> |                      |
| Building type                      | <input type="text"/> |   |                      |
| Usage                              | <input type="text"/> |   |                      |
| Year of construction               | <input type="text"/> |   |                      |
| Year of renovation                 | <input type="text"/> |   |                      |
| Description of renovation          | <input type="text"/> |   |                      |
| Status                             | <input type="text"/> |   |                      |
| Total area                         | <input type="text"/> |   |                      |
| Sustainability certifications      | <input type="text"/> |   |                      |
| Energy label                       | <input type="text"/> |   |                      |
| Address                            | <input type="text"/> |   |                      |
| Remarks                            | <input type="text"/> |   |                      |
| Author(s) responsible for the data | <input type="text"/> |   |                      |




Building layers  
Site




Skin



Structure



Services



Space plan

Figure 2 - Material Passport - General information – Building

### 3.4 Layers of the building ('P\_spreadsheets')

The MP includes information regarding general data about the product, information regarding the use and potential conditions of the products after their useful life in the current building and information regarding the recycling of the materials and products.

The passport is structured in 5 layers (Table 1), adapted from the shearing layers concept developed initially by the architect Frank Duffy and later improved by Stewart Brand in his book, "How buildings Learn (1994). This concept refers to buildings as composed of several layers of change that evolve in different timescales.

In each layer, the user should register and quantify the products and respective materials used in the building. The first step is to choose the product type, which depends on the layer, as shown in Table 1. There is always the possibility of choosing "Others/Unknown" for products that are not pre-defined or not known.

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Table 1- Building layers

| Building layers  | Description   | Main products   |
|--|---|---|
| <br><b>Site</b>         | <b>Site:</b> This is the geographical setting, the urban location, and the legally defined lot, whose boundaries and context outlast generations of ephemeral buildings (Carmona & Tiesdell, 2007).   | <ul style="list-style-type: none"> <li>• Outdoor Pavement</li> <li>• Walls</li> <li>• Fencing, railing</li> <li>• Technical installations (drainage system, lighting, others)</li> </ul>  |
| <br><b>Skin</b>         | <b>Skin:</b> The skin layer refers to building components, such as façades and roofs, that separate the outer space from the inner space. Exterior surfaces now change every twenty years or so, to keep up with fashion or technology (adapted from Training the Arc, 2020).   | <ul style="list-style-type: none"> <li>• Façade systems</li> <li>• External cladding</li> <li>• Shading devices</li> <li>• Façade openings (including windows and external doors)</li> <li>• Roof</li> <li>• Insulation</li> </ul>  |
| <br><b>Structure</b>    | <b>Structure:</b> The structure corresponds to the foundation and load-bearing elements. Structural life ranges from thirty to three hundred years (but few buildings make it past sixty for other reasons) (Brand, 1994).  | <ul style="list-style-type: none"> <li>• Foundations (piles, basements, retaining walls)</li> <li>• Loadbearing external walls</li> <li>• Beams, columns, slabs</li> <li>• Roof structure</li> </ul>  |
| <br><b>Services</b>   | <b>Services:</b> The services consist of all the mechanical and electrotechnical installations of a building: communications wiring, electrical wiring, plumbing, fire sprinkler systems, HVAC (heating, ventilating, and air conditioning), telecom and data installations, and moving parts like elevators and escalators. They wear out or obsolesce every seven to fifteen years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily (adapted from Brand, 1994; Training the Arc, 2020; and De Graaf & Gruis, 2022). | <ul style="list-style-type: none"> <li>• In-built lighting systems</li> <li>• Energy systems</li> <li>• Ventilation systems</li> <li>• Sanitary Systems</li> </ul>  |
| <br><b>Space plan</b> | <b>Space plan:</b> All architectural and all fixed components of a building that are not included in the structure, skin, and services layers, belong to the space plan layer (Training the Arc, 2020).   | <ul style="list-style-type: none"> <li>• Inner walls</li> <li>• Ceilings</li> <li>• Floor covering</li> <li>• Wall covering</li> <li>• Skirting</li> <li>• Staircases and balustrades</li> <li>• Ceiling panelling and coating</li> <li>• Sanitaryware</li> <li>• Cupboards and wardrobes</li> <li>• Worktops</li> <li>• Insulation products</li> </ul> |

By filling in the information needed, the tool calculates the total quantity of different materials per layer and in total, the recycling potential of each product and the total products, the reuse potential and the circularity indicator of each product within the building.

In each 'P\_' spreadsheet, corresponding to each layer, the tool calculates the total amount of materials and different indicators: circularity potential, reuse potential and recycling potential.

As a general rule, cells in white are to be filled in by the user, whereas cells in grey are automatically calculated.

### 3.5 Filling in the data for the passport

Each layer spreadsheet has two big sections:

- Products and materials registration – Core section: this allows the user to describe the products and respective materials and quantify them. Besides the material sourcing and potential certifications, this section has no environmental-related information and consists of the minimum information to be included in the passport.
- Circularity assessment – Additional section: here, circularity-related information about the products and materials is inserted, which leads to the automatic calculation of the circularity indicators (see 3.5.2).

The structure of each spreadsheet is given in Figure 3.

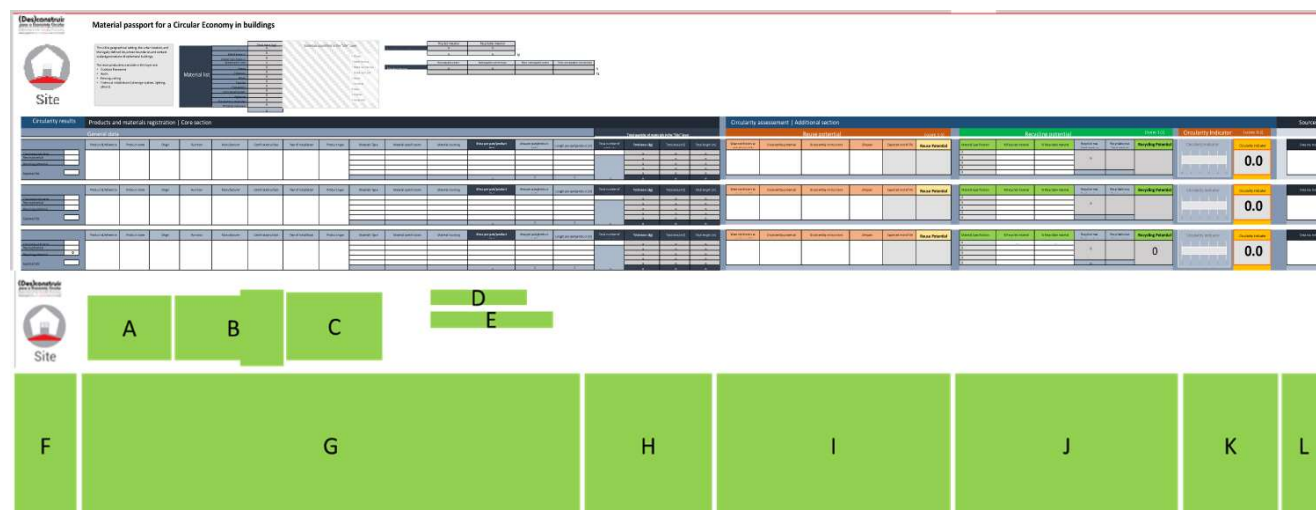


Figure 3 – Material Passport – Spreadsheet structure – 'Site' example

A – Description of the layer

B – Mass of the different materials registered in the current layer

C – Chart reflecting the percentage of materials (mass) registered in the current layer

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D – Recycling potential: quantification recycled material and recyclable material in the layer, displayed in percentage and kilograms

E – Material source: quantification of the materials registered by source (renewable virgin, renewable secondary, non-renewable virgin and non-renewable secondary), displayed in kilograms.

F – Circularity results: Circularity Potential, Reuse Potential, Recycling Potential, and Expected End-of-life (year), calculated automatically if the additional section of the spreadsheet is filled in.

L – Data sources – The results of the tool are based on the quality and reliability of the information inserted by the user(s) and there isn't any verification feature. Transparency and reliability should be assured by providing the sources of the data used in the registration of each product.

### Products and materials registration – Core section:

G – General data – this block includes the identification of the product and its materials in terms of basic characteristics and quantification.

H – Total quantity of materials in the “P\_layer” – the tool automatically calculates the total quantities in mass, area and linear meters. Mass is always calculated, the area and linear meters are relevant for specific types of products (e.g., area for pavements, linear meters for cables).

### Circularity assessment – Additional section:

I – Reuse potential – evaluation of the characteristics of a product in terms of potential reuse after the initial application in the building. The reuse can be for building or other purposes. In this block, the duration and wear of the product and the process and conditions of disassembly/removal are considered.

J – Recycling potential. In this block, the recycling potential is calculated based on the content of recycled materials in the product and the recyclability of the product and its materials.

K – Circularity indicator – Based on the previous considerations, the tool calculates the circularity indicator of each product scoring the product from 0 – no circularity potential, to 5 – high potential of circularity in the product.

The areas F to L allow for 50 entries, each one corresponding to one type of product or system (in the case of services). If there are 5 identical doors in the building, they correspond to one entry. If they are different (e.g., in terms of dimensions), different entries should be inserted by the user.

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### 3.5.1 Products and materials registration – Core section

| Products and materials registration   Core section |              |        |          |              |                      |                        |              |                |                        |                   |                            |                            |                             |   |                 |                 |                  |
|--|--------------|--------|----------|--------------|----------------------|------------------------|--------------|----------------|------------------------|-------------------|----------------------------|----------------------------|-----------------------------|---|-----------------|-----------------|------------------|
| General data                                       |              |        |          |              |                      |                        |              |                |                        |                   |                            |                            |                             | Total quantity of materials in the "Site" layer |                 |                 |                  |
| Product reference                                  | Product name | Origin | Function | Manufacturer | Certifications/class | Installation date/year | Product type | Materials Type | Material specification | Material sourcing | Mass per part/product (Kg) | Area per part/product (m2) | Length per part/product (m) | Total number of product                         | Total mass (kg) | Total area (m2) | Total length (m) |
|  |              |        |          |              |                      |                        |              |                |                        |                   | 5                          |                            |                             |   |                 |                 |                  |
|  |              |        |          |              |                      |                        |              |                |                        |                   | 5                          |                            |                             |   |                 |                 |                  |
|  |              |        |          |              |                      |                        |              |                |                        |                   | 5                          |                            |                             |   |                 |                 |                  |
|  |              |        |          |              |                      |                        |              |                |                        |                   | 5                          |                            |                             |   |                 |                 |                  |
|  |              |        |          |              |                      |                        |              |                |                        |                   | 5                          |                            |                             |   |                 |                 |                  |
|  |              |        |          |              |                      |                        |              |                |                        |                   | 50                         | 5                          | 5                           | 50  | 2690            | 0               | 0                |
| A  | B            | C      | D        | E            | F                    | G                      | H            | I              | J                      | K                 | L                          | M                          | N                           | O   | P               | Q               | R                |

Figure 4 - Material Passport - General data

The general data area requires a set of information that is provided and inserted by the user. In some cells, the values are calculated by the tool. In the next list, a short explanation of each cell is provided.

**A – Product Id/Reference.** Insert the reference or an identification of the product.

**B – Product name.** Insert the designation of the product (e.g., front door or ceramic tile).

**C – Origin.** Insert here the indication of the origin of the product. If the product is produced in the same country as the installation select "National" from the drop-down list. If not, select "EU" if the origin is the European Union or "Non-EU" for rest of the world.

**D – Function.** Describe the function of the product (e.g., insulation, security, lighting, et.).

**E – Manufacturer.** Insert information about the manufacturer and/or responsible for the placement of the product in the market.

**F – Certifications/class.** Insert environmental or relevant certification of the product. This is an open-cell, and the user can add several certifications of the product if applicable (e.g., Cradle2Cradle certifications, Ecolabel, Energy Label class "x", Environmental product declarations, etc.); a link to a website, for instance, can also be inserted here.

**G – Year of installation.** Insert the year of the installation of the product.

**H – Product type.** Select the type of product from the dropdown list. The types of products are specific for each layer of the building. The types of products available in each layer were indicated in Table 1.

**I – Materials type.** Here the user must indicate the types of materials used in the product per category. The identification of the type of material is selected from the dropdown list available in the cell, where the option "others/unknown" is possible:

- Plastic
- Metal ferrous
- Metal non-ferrous
- Wood and cork
- Stone
- Ceramics
- Glass
- Textiles

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- Composites
- Concrete/Cement
- Gypsum
- Bituminous mixtures
- Others/Unknown

**J – Material specification.** After the selection of the type of material in the previous cells, the user should specify the material. For example, if the material selected for a door was Non-ferrous metal, in this step the user indicates that the material is Aluminium, or if for a floor, the user indicates Stone, here he can add that the product is Estremoz Anticline marble.

**K – Material sourcing.** Indicate the origin of the material by selecting from the dropdown list available. Here the selection is done from:

- Renewable virgin
- Renewable secondary
- Non-renewable virgin
- Non-renewable secondary

**L – Mass per part/product (kg).** Add the quantity in kg, of each material per product. Unlike the area and length, the mass is mandatory, otherwise the tool cannot make any calculations. If the product is monomaterial, this value will refer to the whole product. Otherwise, the masses of the different parts should be declared here.

**M – Area per part/product (m<sup>2</sup>).** For some types of products, the area of the product is relevant. For example, if the product is a kitchen countertop, the user can indicate that the area is 1,5 m<sup>2</sup>.

**N – Length per part/product (m).** As in the previous cell, in some product types, the information on the length can be relevant. For example, if the product is a PVC pipe, the length of the product can be relevant.

**O – Total number of products.** Insert how the number of products from the same reference available in the layer, that are accounted for in the same entry to the passport.

**P – Total mass (kg).** Automatic calculation of the total quantity of material considering all the registered products.

**Q – Total area (m<sup>2</sup>).** The same, for the area, if relevant.

**R – Total length (m).** The same, for the length, if relevant.

### 3.5.2 Circularity assessment – Additional section

#### Reuse potential

Aiming for an increase in the reuse of products and materials towards more dematerialized and circular solutions for the building industry, the material passport tool includes features to calculate the reuse potential of the products and their materials applied in the building.

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For this purpose, the user, in the registration of the product, should include data on its characteristics and way of use.

| Reuse potential (score 1-5)            |                       |                          |          |                      |                 |
|--|-----------------------|--------------------------|----------|----------------------|-----------------|
| Wear conditions at end of initial life | Disassembly potential | Disassembly instructions | Lifespan | Expected end of life | Reuse Potential |
|  |                       |                          |          |                      |                 |
| A                                      | B                     | C                        | D        | E                    | F               |

Figure 5 - Material Passport - Reuse potential

**A – Wear conditions the end of initial life.** In this cell the user, according to their knowledge and data, studies or tests provided by the manufacturer or other, should select from the drop-down list provided in the cell, which is the expected situation of the product at the end of the first life. Here the options are:

- Good conditions - Low wear
- Medium conditions - Medium wear
- Poor conditions - High wear

**NOTE: If the product cannot be reused because it contains hazardous materials such as e.g. asbestos, the option “Poor conditions” should ALWAYS be chosen.**

**B – Disassembly potential.** The effort to remove the products from the building at the end of their useful life and the conditions of it after the removal is a fundamental aspect of the reuse potential of the products for the same purpose or other applications. In this stage, the user must select from the list available which is the situation that suits the current situation of the product. Here the options are:

- The product can be easily disassembled without damage
- Damage-free disassembly requires extra effort
- Part of the product is damaged in its removal
- Dismantling damages the product but does not prevent its recovery
- Disassembly damages the product and makes its reuse difficult

**NOTE: If the product cannot be reused because it contains hazardous materials such as e.g. asbestos, the option “Disassembly damages the product and makes its reuse difficult” should ALWAYS be chosen.**

**C – Disassembly instructions.** Insert detailed instructions on how to disassemble the product. Specific procedures and tools should be indicated, if applicable.

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**D – Lifespan.** According to the characteristics of the product and the specific application in the building, insert the expected lifespan of the product.

**E – Expected end of life.** Based on the information provided in the General data area (Year of installation), the tool calculates the year in which there is a probable removal of the product.

**F – Reuse potential.** Based on the data inserted by the user, the tool calculates the potential for reuse of each registered product in the building. The score ranges from 1 – Low potential for reuse to 5 – High potential for reuse. The accuracy of the value is determined by the reliability of the data inserted, which should be based on robust and verifiable information.

The indicator is defined based on the classification of the wear conditions at the end of initial life and the disassembly potential.

### Recycling potential

Aiming for an increase in the recycling rate of products and materials towards more dematerialized and circular solutions for the building industry, the material passport tool includes features to calculate the recycling potential of the materials applied in the building.

For this purpose, the user, in the registration of the product, should include data on the characteristics of the different materials.

| Recycling potential (Score 1-5) |                     |                       |                                |                                  |                     |
|---------------------------------|---------------------|-----------------------|--------------------------------|----------------------------------|---------------------|
| Material Specification          | % Recycled material | % Recyclable material | Recycled mat.<br>Total product | Recyclable mat.<br>Total product | Recycling Potential |
| 0                               |                     |                       | 0                              | 0                                |                     |
| 0                               |                     |                       |                                |                                  |                     |
| 0                               |                     |                       |                                |                                  |                     |
| 0                               |                     |                       |                                |                                  |                     |
| 0                               |                     |                       |                                |                                  |                     |
|                                 |                     |                       |                                |                                  |                     |

A

B

C

D

E

F

Figure 6- Recycling potential

**A – Material specification.** This is an automatic cell. It replicates the information provided in the General data.

**B – Percentage of recycled material.** Insert the percentage of recycled material for each material/part/product. This information should be provided by the manufacturer.

**C – Percentage of recyclable material.** Insert the percentage of recyclable material for each material/part/product, based on characteristics and the information available for each material concerning the recycling methods and recycling systems available.

**D – Recycled material – total product.** The tool calculates the total percentage of recycled material in the product, considering the different materials in its composition.

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**E – Recyclable material – total product.** The tool calculates the total percentage of recyclable material in the product, considering the different materials in its composition.

**F – Recycling potential.** Based on the data inserted by the user, the tool calculates the potential for recycling each registered product in the building. As the previous indicator, the score ranges from 1 – Low potential for recycling to 5 – High potential for recycling. The accuracy of the value is determined by the reliability of the data inserted, which should be based on robust and verifiable information.

The evaluation of recycled and recyclable material in the product is accounted in 5 levels:

- Level 1 – 0% - 10 %
- Level 2 – 11% - 40%
- Level 3 – 41% - 60%
- Level 4 – 61% - 90%
- Level 5 – 91%-100%

### Circularity indicator

In order to provide relevant information for the various stakeholders engaged in the process, the tool, based on the information inserted by the user, calculates the circularity indicator of the products in the building. The adoption of improved products will lead to an increase in the performance of the entire building.

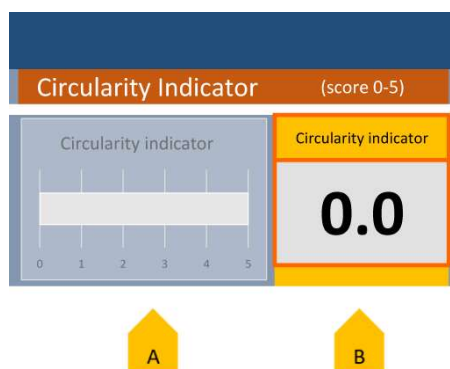


Figure 7 - Circularity potential

**A – Circularity indicator – Chart.** Result of the calculation of the circularity indicator (see B) displayed in a chart.

**B – Circularity indicator.** Based on the scoring of the recycling potential and the reuse potential, the tool calculates the potential of circularity of the product from a score between 0, in which the potential for circularity in the product is low, and 5, in which the potential is high, meaning that the product has the potential to be reused after the initial function in the building, and the materials are recyclable and recycled.

In the calculation of the circularity indicator, the reuse potential is considered of higher importance in terms of circularity because it preserves the integrity of the product at higher value and therefore the final score is the weighted average of the reuse potential (weight: 60%) and the recycling potential (weight: 40%).

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### 3.6 Spreadsheet 'Global information'

This page displays the results for the entire building in aggregated form, i.e., the quantification of all materials registered in the passport. All figures are automatically calculated by the tool.

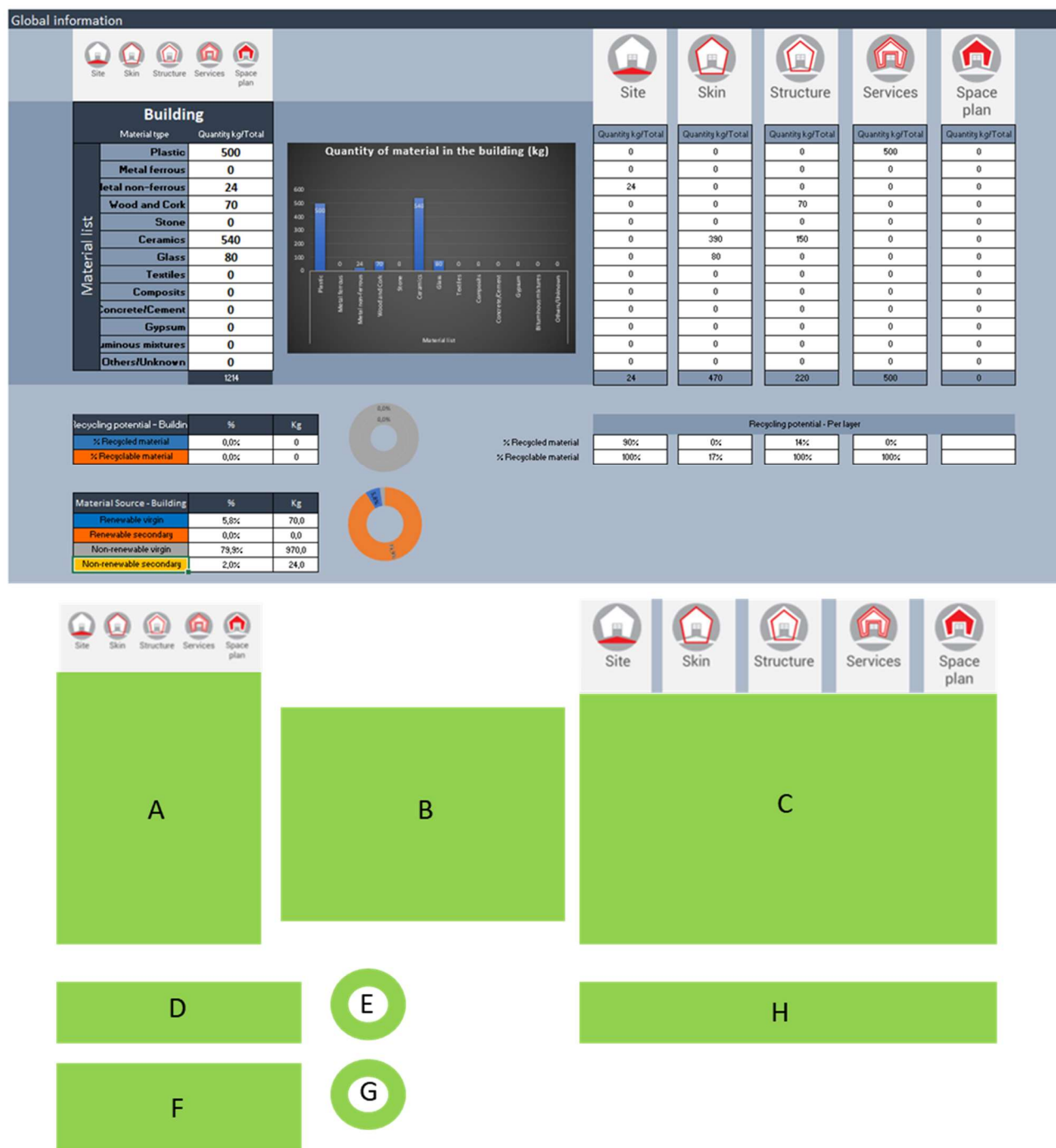


Figure 8 - Results spreadsheet: Global information

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A – Total mass (in kg) of the materials registered in the passport per typology and in total, in a table:

- Plastic
- Metal ferrous
- Metal non-ferrous
- Wood and cork
- Stone
- Ceramics
- Glass
- Textiles
- Composites
- Concrete/Cement
- Gypsum
- Bituminous mixtures
- Others/Unknown

B – The same, displayed in a chart.

C – The mass (kg) of materials per layer (per typology and in total).

D – Recycling potential for the entire building, in percentage and kg (total mass of recycled and recyclable material), in a table.

E – The same, displayed in a chart.

F – The mass of materials of the entire building per source (renewable and non-renewable, virgin and secondary), in percentage and kg.

G – The same, displayed in a chart.

H – Recycling potential per layer, in percentage and kg.

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## 4. Disclaimer

This passport template was developed within the (De)Construct for Circular Economy project.

The quantity of materials presented in the “Global information” spreadsheet refers only to the materials registered in the passport and not necessarily to the total quantity of materials in the building. In order to have the total quantity of materials accounted for, all products and materials must be registered in the passport.

The quality and veracity of the results shown in the passport are the sole responsibility of the person(s) who collect(s) and insert(s) the data.

The authors of the passport and the partners of the ((De)Construct for Circular Economy project are not responsible in any circumstance for the data registered in passports that use this template.

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Parceiros:



## References

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Operador do Programa:



Promotor:



Parceiros:

