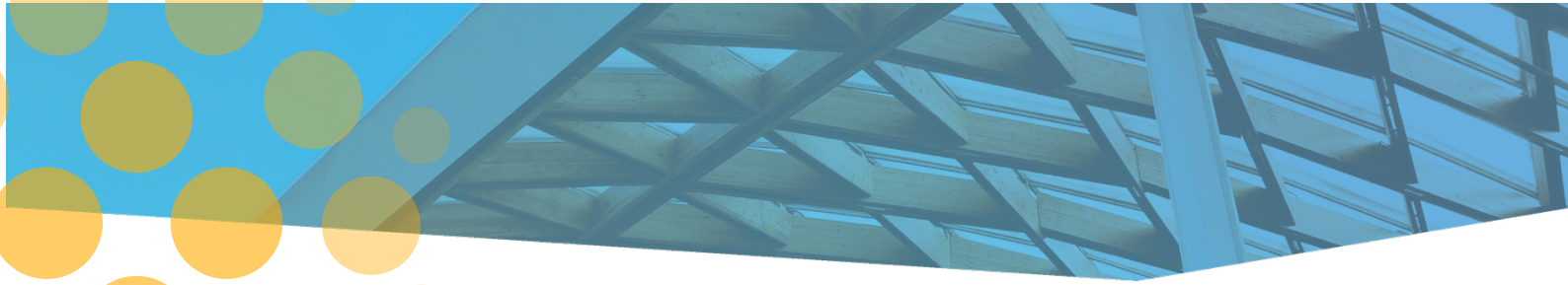


UPCYCLEA

# CIRCULAR SIGNATURE

Version 2 - March 2023

# Details of the circular signature indicators

This document is aimed at giving an understanding of the circular signature indicators calculations as well as keeping tracks of the reasons of the made choices. It refers to the Version 2 of the circular signature, that is to say the update of the calculations made in March 2023 based on experience feedbacks and analysis of the first version results.





UPCYCLEA

# I. Material Health Indicator

## A. Principles of the indicator

This indicator is aimed at underlying the degree of toxicity of considered products – for example the degree of toxicity of products composing a building.

It is based on the Cradle to Cradle Certified™ Products Standard, the reference label in the field of the circular economy for which material health is one of the analysed criteria.

More precisely, it is linked to:

- **The respect of the "Banned list of chemicals" of the standard:** does the product contain any of the substances listed in the banned list of chemicals of the Cradle to Cradle Certified® Products Standard, beyond the defined threshold?

  The « Banned list of Chemicals » is accessible here: https://c2ccertified.org/resources

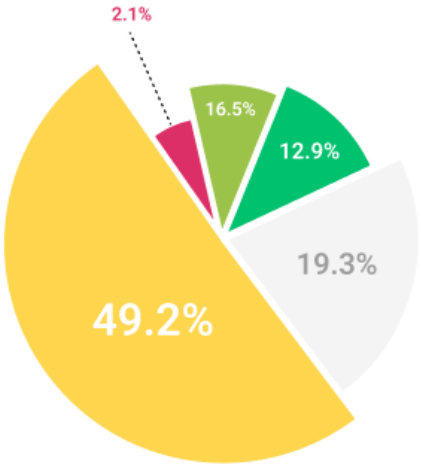
  The Cradle to Cradle Certified® Products Standard bans these substances because of their tendency to accumulate in the biosphere and to have irreversible effects on human health, or because of the hazardous characteristics associated with their manufacture, use and disposal.

  The list of banned chemicals includes cadmium, chromium VI, mercury, phthalates, brominated flame retardants, halogenated polymers (including PVC) and chlorinated hydrocarbons. The notion of toxicity in a Cradle to Cradle® approach is therefore more demanding than the REACH regulations.

- **The capacity to demonstrate the absence of CMR substances as well as VOC emissions;** here only C2C-certified products can be counted as respecting this criterion, as it is the only frame considered at the moment.

## B. Details of the calculation

Based on the information about composition entered by the manufacturers and the associated supporting documents provided, the products are classified into five categories:




*Visualization of the percentages of the five categories of products on myUpcyclea*

### > HEALTHY PRODUCTS

The product contains only substances validated as healthy: in addition to verifying the C2C Certified Standard® banned list, it does not contain any substances evaluated as CMR (Carcinogenic, Mutagenic, Reprotoxic) and their VOC (Volatile Organic Compounds) emissions are controlled for better indoor air quality. This corresponds, for example, to product that has obtained a Silver, Gold or Platinum level in the Material Health category of the C2C Certified Standard ™ Version 4.0 (Gold or Platinum in Version 3.1)

- ⇨ The product is C2C-certified / has a C2C Material Health Certificate with
  - a Gold or Platinum Material Health level according to the version 3.1 of the standard
  - **OR** a Silver, Gold or Platinum Material Health level according to the version 4.0 of the standard

### > PRODUCTS WITH CONTROLLED AND VERIFIED TOXICITY

The manufacturer declares that its product does not contain any substance from the C2C Certified Standard® banned list above the tolerated thresholds and this has been verified by an independent third party.

- ⇨ The product manufacturer answered "Yes" to the question " I certify that none of the components of the C2C banned substances list are included in the composition of my product, above the thresholds defined in the list " in the circular passport of its product
  **AND**
  the manufacturer obtained a colored myUpcyclea Material Health pictogram.

- ⇨ **OR** the product is C2C-certified / has a C2C Material Health Certificate with:
  - a Basic, Bronze or Silver Material Health level according to the version 3.1 of the standard
  - **OR** a Bronze Material Health level according to the version 4.0 of the standard

### > PRODUCTS WITH CONTROLLED TOXICITY

The manufacturer declares that its product does not contain any substance from the C2C Certified Standard® banned list above the tolerated thresholds but this claim has not been verified by an independent third party.

- ⇨ The product manufacturer answered "Yes" to the question " I certify that none of the components of the C2C banned substances list are included in the composition of my product, above the thresholds defined in the list " in the circular passport of its product.

### > PRODUCTS WITH UNKNOWN TOXICITY

The manufacturer has not provided sufficient information regarding the toxicity of its product.

- ⇨ The product manufacturer answered "I don't know" to the question "I certify that none of the components of the C2C banned substances list are included in the composition of my product, above the thresholds defined in the list" in the circular passport of its product.

### > PRODUCTS WITH KNOWN TOXICITY

The manufacturer has stated that its product contains substances from the C2C Certified Standard's banned list above the tolerated thresholds.

- ⇨ The product manufacturer answered "No" to the question "I certify that none of the components of the C2C banned substances list are included in the composition of my product, above the thresholds defined in the list" in the circular passport of its product.

## C. Accessible results

Material Health results are accessible at two different levels:

- Total deposits level: this is the sum of all deposits grade weighted by their weight.
- Product category level

The reports also provide information regarding:

- The level achieved by the biggest product category (in mass)
- The level achieved by the healthiest product category
- The level achieved by the most toxic product categories

## D. Warnings and Errors

When data is missing or not accurate, the user receives:

- **Warnings**: a data is missing – the concerced deposit has been taken into account but the result of the indicator for this deposit may be non-representative or partial
- **Errors:** an important data is missing – the concerned deposit could not be taken into account in the calculation of the indicator.

For this indicator, there isn't any warning or error.

## E. Summary of changes with regards to the Circular Signature V1

The updates from the V1 of the circular signature have been made in March 2023.

| Type of change | Details and justification |
|---|---|
| **Distinction of "unknown" and "know toxicity" categories** | The two categories were at first only one.<br>As users needed to understand which part of products really contained toxic chemicals compared to the part of products for which the information was missing, the unique category was split. |
| **Consideration of the level of Material Health obtained for C2C-certified products** | Previously, for C2C-certified products, only the general level obtained was considered.<br>As the Material Health level can be higher than the general, new fields were added to the circular passport to fill each category level obtained, so that the Material health level could be taken into account in the circular signature. |
| **Update of the indicator according to the new version of the C2C-certified standard V4.0** | The version V4.0 sees the Material Health criteria evolving. Thus, what is achieved through V3.1 levels is different than through V4.0 levels.<br><br>Thus, updates have been made to consider these differences: only V4.0 Bronze products will be integrated in the "Products with controlled and verified toxicity" CS category, while the other V4.0 levels will be integrated into the "Healthy products" category. |

# II. Circularity indicator

## A. Principles of the indicator

This indicator is aimed at underlying the degree of circularity of considered products – for example the degree of circularity of products composing a building.

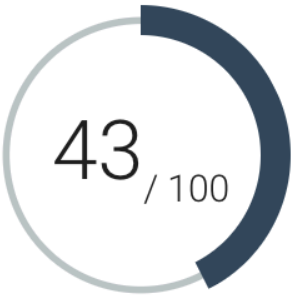
It examines for each product if its design contributes to making it circular:

- Does it integrate recycled content or reused material?
- Is it designed to be disassembled? Do its fixings allow an easy dismantling?
- Is the product recyclable/compostable/repairable/…?

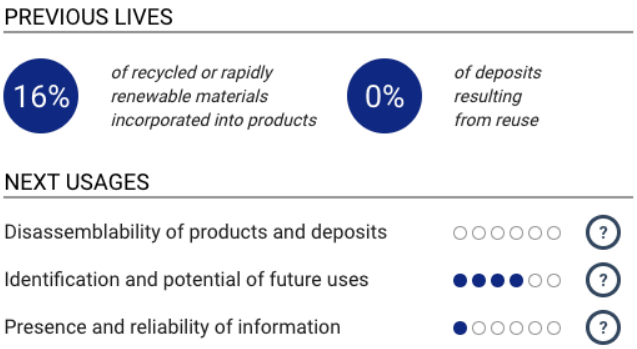
## B. Details of the calculation

### 1. Circularity grade

The circularity grade is presented as a score out of a hundred, which takes into account both data on the past lives of the materials constituting the deposits under consideration, and the possible future uses for these deposits.




**77 / 77** deposits considered
**1 109** tons of deposits in total
*See pdf for more details*




Previous lives account for 1/3 of circularity grade, and future uses for 2/3[1]:

$$\textbf{Circularity grade} = \frac{1}{3}\,\textbf{Previous lives grade} + \frac{2}{3}\,\textbf{Next usages grade}$$

### a) "Previous lives" grade of one deposit

The "Previous lives" grade corresponds to:

- **100% of the quantity of the deposit in case the deposit is from reuse** (has already had a previous life)

  ⇨ The "source" of the deposit indicated in the "Deposit origin & potential becoming" section of the deposit is:
  "From destocking" **OR** "From a construction site surplus" **OR** "From reconditioning" **OR** "From a construction site removal" **OR** "Other"
  (thus, different from "New product") [2]

  **OR**

- **the percentage of recycled or rapidly renewable content incorporated in the product.**
  *A material is considered as rapidly renewable if it regenerates in relatively short cycles, from a few days to a decade - this also includes wood if it comes from sustainably managed forests.*

### b) "Next usages" grade of one deposit

The "Next usages" grade takes into account several parameters: the disassemblability of products and deposits, the potential of future uses and the reliability of information.

$$\text{Next usages grade} = \text{Next\_usage\_potential\_grade} \times \text{Deposit\_Demountability}_{\text{factor}} \times \text{Product\_Demountability}_{\text{factor}} \times \text{Reliability}_{\text{factor}}$$

### > Next_usage_potential_grade

This grade represents and rewards the possibility for the deposit to be valorized after its end of use. It takes into account, for each next life indicated in the product passport of the product, the percentage of the product falling into this next life.

- **IF the product has a recycling/upcycling, composting or methanisation next life**
    - IF recycling/upcycling or composting:
      the basic grade is 100 x $\text{Percentage}_{\text{of the product concerned by this next life}}$
      **OR**
      IF methanisation[3] : 80 x $\text{Percentage}_{\text{of the product concerned by this next life}}$
    - If no stakeholder has been identified as capable to perform the next life, the grade is weighted by a factor of 0,8[4]
    - If there is more than one next life, we take the best grade obtained among them.
    - If for these next lives, an additional “repair” life also exists, the grade is weighted by 1,1. [5]
- **IF the product has a repair next life BUT NO recycling/upcycling, composting or methanisation next life**
    - The basic grade is 30 x $\text{Percentage}_{\text{of the product concerned by this next life}}$ [6]
    - If no stakeholder has been identified as capable to perform the next life, the grade is weighted by a factor of 0,8
- **IF the product has ONLY a “energy recovery” next life**
    - The grade is 2
- **IF no next life is indicated**
    - The grade is 0

### > Deposit_Demountability$_{factor}$

This factor aims at weighting the next_usage_potential_grade by taking into consideration the way the product is installed, and thus aims at reflecting the impossibility of getting the product into its planned next life if it cannot be recovered properly.

It is based on the “demountability” settings of the deposit.

- ⇨ **IF deposit demountability is "Already separated”:** Deposit_Demountability$_{factor}$ = 1,2
- ⇨ **IF deposit demountability is "Easily separable”:** Deposit_Demountability$_{factor}$ = 1
- ⇨ **IF deposit demountability is "Hardly separable”:** Deposit_Demountability$_{factor}$ = 0,75
- ⇨ **IF deposit demountability is "Inseparable”:** Deposit_Demountability$_{factor}$ = 0,3
- ⇨ **IF deposit demountability is "Unknown”:** Deposit_Demountability$_{factor}$ = 0,3[7]

**Exception:** for the products pertaining in the “Paintings and decoration products" or “Preparation and implementation products” categories, Deposit_Demountability$_{factor}$ = 1[8]

### > Product_Demountabilityfactor

This factor aims at weighting the next_usage_potential_grade by taking into consideration the way the product is designed and by evaluating if it is designed for disassembly, which would allow each component to be recovered in the best possible way.

- ⇨ **IF the sum of the weight percentages of all components that are “not easily demountable” or “undemountable” or “null” is >10%** *(except for Set of materials not attached to a component):* Product_Demountability$_{factor}$ = 0.75 [9]

  Otherwise, Product_Demountability$_{factor}$ = 1

### > $Reliability_{factor}$

This factor aims at weighting the next_usage_potential_grade according to the reliability of the information linked to circularity given in the circular passport. The more the information has been verified, the more it guarantees that the next lives pathways indicated are real and will be followed.

This factor is based on the C2C certification as well as the circularity pictogram of myUpcyclea:

- ⇨ **IF the product is C2C Certified and has reached in the Product Circularity category the level Gold or Platinum in V3.1 OR the level silver or gold or platinum in V4.0:** $Reliability_{factor} = 1,1$
- ⇨ **If the product got a colored Circularity rating**: $Reliability_{factor} = 1,1$
- ⇨ **If the product got a black Circularity rating:** $Reliability_{factor} = 1,05$
- ⇨ **If the product did not get a Circularity rating:** $Reliability_{factor} = 1$

## c) Aggregation for the total grade

The total grade is a sum of each deposit grade weighted by the weight of the deposit.

## d) Explanations of the choices made for the circularity grade

| Text reference | Explanation |
|---|---|
| 1 | **Why has this weighting been chosen between previous lives and future lives?** This logic, inspired from the C2C-Certified Program™, is chosen to more valorize products designed to integrate closed-loops of valorization and remain a resource instead of becoming a waste. |
| 2 | **Why are all these product categories considered as "from reuse"?** All these categories are considered as reused products because if not in the concerned path they would have been waste. This is in conformity with the French building environmental legislation as well as with the French "Loi AGEC". |
| 3 | **Why is methanisation set as lower than the other next lives?** Methanisation is set as lower than composting because the ecological, social and economic impacts of methanisation are lower than composting. |
| 4 | **Why is there a weighting when no stakeholder?** If no stakeholder has been identified, this underlines that the product manufacturer is less engaged in circularity and that the potential next life of the product has not been dug into, thus not verified. |
| 5 | **Why is there a specific weight when there are REPAIR + (UPCYCLING or COMPOSTING or METHANISATION) next lives?** This is to encourage the use of products for which the manufacturer, in addition to preparing the material valorization, has created the product so that it might be repaired, and thus so that its first life might be longer. |

| | |
|---|---|
| 6 | **Why is the grade lower when only REPAIR?**<br>The grade is here lower because in this case, the materials are eventually not recoverable, meaning it is possible to extend the product first life, but not possible to give a new life to materials after that. |
| 7 | **How has this Deposit_Demountability$_{factor}$ been set?**<br>This grade has been tuned based on lots of feedbacks.<br>The goal is to decrease the future life grade when the product is not easily recoverable regarding its environment, because it decreases its potentials. However, even when it is installed through an “inseparable” manner, part of the materials will still be recyclable after an operation of destruction is realized. This is why the factor doesn’t fall under 0,3. |
| 8 | **Why is there an exception for these two categories?**<br>This is not relevant to talk about demountability for products pertaining to “Paintings and decoration products" or “Preparation and implementation products” categories. As there is no “irrelevant” demountability category, an exception has been created so that these products don’t have a penalizing impact on the grade. |
| 9 | **How has this Product_Demountability$_{factor}$ been set?**<br>A 10% bar has been set up to avoid penalizing the whole grade for the undemountability of really small components. |

## 2. Three indicators linked to Next usages

Three additional indicators specifically related to "Next usages" are defined:

- Disassemblability of products and deposits
- Identification and potential of future uses
- Presence and reliability of information

These three indicators allow for a more detailed analysis of those parameters influencing the overall circularity of the deposits.

**Each of these parameters is individually scored out of 100 for each deposit before aggregation.**

### a) Disassemblability of products and deposits – grade for one deposit

In order to be easily recovered at the end of its use, the product must be dismountable.

Two levels of demountability are observed and evaluated through this grade:

- On the one hand, the **level of disassemblability of the components of the product** itself
- And on a second hand **the demountability of the deposit**, at the place where it is installed/implemented.

$$\text{Disassemblability of products and deposits}_{\text{Deposit level}} = \frac{1}{3}\,\text{Product\_dem\_grade} + \frac{2}{3}\,\text{Deposit\_dem\_grade}$$ [1]

*Where:*
*Product_dem_grade represents the subscore for the disassemblability of the products components*
*Deposit_dem_grade represents the subscore for the demountability of deposit.*

**Exceptions:**

- IF Product_dem_grade AND Deposit_dem_grade is null, then the deposit is not considered for this grade aggregation
- IF either Product_dem_grade OR Deposit_dem_grade is null, then the other one is taken as 3/3.

#### > Product_dem_grade

This grade analyses the level of disassemblability of each component in the product, which is indicated in the circular passport by the manufacturer in the description of the composition - easily demountable, not easily demountable or undemountable.

The default component is not considered for this grade.[2]

⇨ **If there is no other component than the default component**: Product_dem_grade is NULL

⇨ **IF every component apart from the default component has a "%mass of component":** Product_dem_grade is the weighted average of the score achieved by each component following its level of demountability:

- 100 if easily demountable
- 40 if hardly demountable
- 0 if undemountable

⇨ **IF not every component apart from the default component has a "%mass of component":** Product_dem_grade is the simple average of the score achieved by each component following its level of demountability [3]

**> Deposit_dem_grade**

This grade analyses the level of disassemblability of the deposit regarding its environment. It is based on the "demountability" settings of the deposit.

⇨ **IF deposit demountability is "Already separated":** Deposit_dem_grade = 100

⇨ **IF deposit demountability is "Easily separable":** Deposit_dem_grade = 90

⇨ **IF deposit demountability is "Hardly separable":** Deposit_dem_grade = 40

⇨ **IF deposit demountability is "Inseparable":** Deposit_dem_grade = 0

⇨ **IF deposit demountability is "Unknown":** Deposit_dem_grade = 0 [4]

**Exception:** for the products pertaining in the "Paintings and decoration products" or "Preparation and implementation products" categories, the Deposit_dem_grade is NULL[5]

### b) Identification and potential of future uses – grade for one deposit

This grade aims at underlying the potential of future uses for the products and valorizing the product manufacturers who took the time to either create a take back system or verify that their product can really be recovered by some industrials.

This grade is calculated exactly in the same way that the "Next_usage_potential_grade" is for the Circularity grade. The calculation is thus explained above. [6]

### c) Presence and reliability of information – grade for one deposit

This indicator makes it possible to qualify the degree of circularity obtained by the presence and reliability of the information entered in the passports, and thus to evaluate the real representativeness of the global indicator.

It takes into consideration two things:

- **The presence of circularity information in the passport:** if a lot of information is missing, then the grades might not be representative
- **The presence of rating:** when a product got a rating, that means that the given information has been enriched by proof document, thus more confidence can be put in the information

$$\text{Presence and reliability of information}_{\text{Deposit level}} = \frac{1}{2}\,\text{Rating\_grade} + \frac{1}{2}\,\text{Filling \_grade}$$

### > Rating_grade

- ⇨ **If the product got a colored Circularity rating:** Rating_grade = 100
- ⇨ **If the product got a black Circularity rating:** Rating_grade = 60
- ⇨ **If the product did not get a Circularity rating:** Rating_grade = 0

### > Filling_grade

The filling grade is the percentage of non-null fields between:

- components' demountability (except for the default component)
- deposit demountability (null if=" Unknown")
- next usage stakeholder
- next usage mass percentage
- share of recycled material

**Exception:** If there is no next usage listed, consider as if there was one next usage with 3 empty fields (stakeholder, mass percentage and type) [7]

## d) Aggregation and visualization

Like the global circularity degree, the impact of the deposits on these three scores is weighted by their weight.

For the visualization of each of the 3 indicators a scale has been defined:

○○○○○ from 0 to 14
●○○○○ from 15 to 29
●●○○○ from 30 to 44
●●●○○ from 45 to 59
●●●●○ from 60 to 74
●●●●●○ from 75 to 89
●●●●● from 90 to 100

## e) Explanations of the choices made for the three indicators

| Text reference | Explanation |
|---|---|
| 1 | **Why has deposit demountability more impact than product demountability?**<br>The users calculating the circular signature are products consumers who install the considered products. Thus, their impact on deposit demountability is direct as they are the ones choosing how to install the products, while their impact on product disassemblability is indirect through their purchase policy. These weightings underline this and encourage to think particularly the deposit demountability. |
| 2 | **Why is the default component not considered in the Product_dem_grade?**<br>The default component is usually used to inventory materials not associated to a component. This is thus not relevant to talk about component demountability for this one. |
| 3 | **Why is a simple average calculated when some mass percentages are missing?**<br>This solution was the best way to consider every component demountability even if mass percentages are missing.<br>The work is done through myUpcyclea support to make sure these percentages are filled in, so that this solution is not often applied. |
| 4 | **How has this Deposit_Dem_grade been set?**<br>The approach is here different than for the Deposit_Demountabilityfactor. Indeed, the goal of the Deposit_dem_grade is to evaluate the level of demountability itself. Thus, here, having inseparable or unknown demountability is considered as not acceptable in a circular approach, therefore these levels get 0. |
| 5 | **Why is there an exception for these two categories?**<br>This is not relevant to talk about demountability for products pertaining to "Paintings and decoration products" or "Preparation and implementation products" categories. As there is no "irrelevant" demountability category, an exception has been created so that these products don't have a penalizing impact on the grade. |
| 6 | The choice has been made to directly use the "Identification and potential of future uses" grade to calculate the circularity grade in order to make a link between the different grades.<br>See complementary explanation in II.D. |
| 7 | **Why is there an exception when no next life is indicated?**<br>If no next life is indicated, that means that probably the product cannot be recovered at all. But if the main approach of the filling grade was taken in that case, this product without next life would get a better grade than a product with a next life but no stakeholder or percentage indicated. As it was not coherent with a circular approach, this exception has been created to penalize more products with no next life. |

## C. Accessible results

Circularity results are accessible at two different levels:

- Total deposits level: this is the sum of all deposits grade weighted by their weight.
- Product category level

The reports also provide information regarding:

- The level achieved by the biggest product category (in mass)
- The level achieved by the most circular product category
- The level achieved by the least circular product categories

## D. Warnings and errors

When data is missing or not accurate, the user receives:

- **Warnings**: a data is missing – the concerced deposit has been taken into account but the result of the indicator for this deposit may be non-representative or partial
- **Errors:** an important data is missing – the concerned deposit could not be taken into account in the calculation of the indicator.

For this indicator, the only possible warning is:

| WARNING |
| --- |
| Share of recycled material is not filled. It will be considered as null. |

## E. Summary of changes with regards to the Circular Signature V1

The updates have been made in March 2023.

| Type of change | Details and justification |
|---|---|
| **Integration of a "Percentage of product concerned by each next life" field** | In the version 1 of the circular signature, as long as a next life was declared in the circular passport, it was considered that 100% of the product was recoverable through this pathway.<br>However, it is often not the case.<br><br>Examples:<br>- A product which contains metal and plastic: only the metal might be recyclable<br>- Products pertaining to the Electrical and electronical category: not all components of those products are recoverable<br>This is why a new field has been added to the next lives part of the circular passport, enabling to take into consideration this granularity of information in the circularity grade.<br><br>Moreover, to avoid any combination difficulties between percentages, only one percentage can be added to each type of next life.<br><br>Examples of different combinations we could have had if we had one percentage by pathway:<br>- Case of a PVC window: it could have been indicated that 30% of the product is recyclable through PVC recycling facility, and 70% of the product recyclable among the glass industry. The total would have been that 100% of the product is recyclable<br>- Case of product containing wood: it could have been declared that 50% of the product, representing the wood part, is recyclable through the creation of new furniture, and that this same 50% is recyclable through particular panels industry. The total would still have been that 50% of the product is recyclable, and not 100% |

| | |
|---|---|
| **Update of the Disassemblability of products and deposits grade** | In the Deposit_dem_grade:<br>- The "Unknown" level of demountability was not taken into account previously. This was unfair as users got a lower grade when the demountability was known and "bad" than when they did not make the effort to know how the product is installed. Thus "Unknown" impact has been set up as equal as "inseparable" impact.<br>- There is now an exception for the "Paintings and decoration products" or "Preparation and implementation products" categories, for which it is not relevant to consider demountabilities. Thus, the deposits of products from these categories are not considered anymore in this grade.<br><br>In the Product_dem_grade:<br>- The "%mass of component" is now considered, so that bigger components impact more on the grade that really small – maybe inseparable – components<br>- The "component by default" is now not considered in the calculation, as it is not relevant to talk about demountability for this component<br><br>The total grade calculation has also been updated: while in the first version deposit and product demountabilities had the same weight, the ratio is now 2/3 – 1/3 in order to take into account the fact that circular signature users can have more impact on deposit demountabilities to ensure the circularity of the already bought products. |
| **Update of the Identification and potential of future uses grade** | The main change is linked to the new field of the passport "% of product concerned by each next life".<br>It was previously automatically considered that 100% of the product was concerned by the next life, yet it was not reflecting the reality.<br>Thus, the indicator now takes into account this new field, and takes the best results between each next life.<br><br>Moreover, the next life "repair" is now considered differently.<br>When alone, this next usage impact has been lowered, because it does not enable to recover the materials after the new life it offers to the product. On the contrary, when associated to a recycling pathway, it enables to get a better grade, as it shows that the product manufacturer has made effort to make it reparable before recycling.<br><br>The Reuse pathway is no longer considered (has been removed from the next lives choices) as it was not really relevant to declare a reuse next life possible for a product: any product could be reused. |
| **Update of the Presence and reliability of information grade** | In the Filling_grade, the new field "mass percentage concerned by the next life" have been added to the ones considered, while the default component demountability is not considered anymore (see explanation in II.B.2.e).<br><br>The total grade calculation has also been updated: the calculation is now the average of the rating and filling grade, instead of a 1/3 – 2/3 ratio. This is to give more importance to the rating here, as its |

| | |
|---|---|
| | importance has been lowered in the global circularity grade calculation. |
| **Update of the global circularity grade** | A major update has been made on the “next usages” part of the circularity grade.<br>In version 1 of the circular signature, this grade was mainly based on the presence of a circular rating / C2C certification or not:<br>- If the product was C2C certified at a platinum or gold level, the basis grade if recycling declared as next life was 100 – then weighted by presence of stakeholders and demountability levels<br>- If the product had a colored rating, the basis grade if recycling declared as next life was 80 – then weighted by presence of stakeholders and demountability levels<br>- If the product had a black rating, the basis grade if recycling declared as next life was 70 – then weighted by presence of stakeholders and demountability levels<br>- If the product had no rating, the basis grade if recycling declared as next life was 60 – then weighted by presence of stakeholders and demountability levels<br>This gave too much impact to ratings, not accessible to all manufacturers.<br>Thus the choice has been made to give the greater impact to the next usages filled in, and to have the impact of rating as a slight weighting.<br>As the “Identification and potential of future uses grade” was already having this approach, it is now the basis of the next usages part of the circularity grade. |
| **Update of the indicator according to the new version of the C2C-certified standard V4.0** | The version V4.0 sees the product circularity criteria evolve. Thus, what is achieved through V3.1 levels is different than through V4.0 levels.<br>The reliability factor of the circularity grade has been updated accordingly. |

# III. Carbon footprint indicator

## A. Principles of the indicator

The Carbon Footprint indicator proposes to calculate different carbon footprints of characterized deposits (the carbon footprint of a deposit corresponds to the carbon footprint of its products multiplied by the quantity of the product):

1. **The production carbon footprint**: includes the extraction of raw materials, the transport of these raw materials to the production site, and the production process of the product. However, transportation to the final implementation site, installation of the product, use and end of life are not counted.

2. **The production & construction carbon footprint:** includes the extraction of raw materials, the transportation of these raw materials to the production site, the production process of the product, the transportation to the final implementation site and the installation of the product. However, use and end of life are not counted.

3. **Embodied carbon:** includes extraction of raw materials, transportation of those raw materials to the production site, the product production process, transportation to the final implementation site, product installation, use (excluding operational energy and water use) and end of life.

4. **$IC_{component\ -\ static}$:** based on the new French environmental regulation RE2020 and applicable only in the case of building product deposits; accounts for emissions related to the production of building components, their transportation, installation, use (excluding operational energy and water use), maintenance, repair, replacement and end of life. It is measured in $kg_{eqCO2}/m^2$, based on the living area and for 50 years. This is the static version of the indicator.
   NB: The calculation does not take into account the exceptions proposed by the RE2020. Moreover, if he wants to stick to the regulation, the user will have to consider only products whose data are issued from FDES.

5. **$IC_{component\ -\ dynamic}$ -** To be developed: same logic as the $IC_{component\ -\ static}$ but through a dynamic vision.

6. **The $IC_{construction}$:** based on the new French environmental regulation RE2020 and applicable only in the case of product deposits of a building; characterizes the impact on climate change of the components (materials and equipment) of the building and the construction site. $IC_{construction} = IC_{component} + IC_{works}$
   NB: The calculation does not take into account the exceptions proposed by the RE2020. Moreover, if he wants to comply with the regulation, the user will have to consider only products whose data are issued from FDES.

The LCA data from a FDES or EPD is the most reliable - here we consider the "contribution to global warming" data of the different stages of a Life Cycle Assessment according to the ISO 14040 standard.

## B. Details of the calculation

The carbon footprint data comes from the one filled in the circular passport. As the carbon footprint is indicated in the circular passport for one functional unit, a parallel is made between this functional unit and the unit of the passport through conversion factors to calculate the exact carbon footprint of the deposit.

### 1. Production (A1-A3) indicator

This indicator sums up **all the product stage carbon footprints** of the characterised deposits:

$$\sum_{All\ deposits} Quantity\ of\ deposit * Product\ stage\ carbon\ footprint\ (A1-A3\ \ module)$$

Exception: when the deposit is coming from reuse, the carbon footprint is considered as null. [1]

### 2. Production & Construction (A1-A5) indicator

This indicator sums up all **the product stage & Construction process stage carbon footprints** of the characterised deposits:

$$\sum_{All\ deposits} Quantity\ of\ deposit * [Product\ stage\ (A1-A3\ \ module) + Construction\ process\ stage\ \ (A4-A5\ module)\ carbon\ footprints]$$

Exception: when the deposit is coming from reuse, the carbon footprints are considered as null[1].

### 3. Embodied (A1-A5 + B1-B5 + C) indicator

This indicator sums up **all product carbon footprints** of the characterised deposits, except from Operation energy use and Resource recovery stage:

$$\sum_{All\ deposits} Quantity\ of\ deposit * [Product\ stage\ (A1-A3\ \ module) + Construction\ process\ stage\ \ (A4-A5\ module) + Use\ stage\ (B1-B5\ module) + End\ of\ life\ stage\ (C1-C4\ module)\ carbon\ footprints\ ]$$

Exception: when the deposit is coming from reuse, the carbon footprints are considered as null[1].

## 4. $Ic_{Component}$ (static) indicator

This indicator is based on the French environmental regulation RE2020 and applicable only in the case of product deposits of a building.[2]

As it is measured in $kg_{eqCO2}/m2$, is based on the living area and for 50 years, it introduces new variables:

$$R = \max\left(1, \frac{PER}{DVE}\right) = \max(1, \frac{50}{Period\ of\ use\ of\ the\ product})$$

*With*
*PER representing the reference period of study of the building, which is set at 50 years*
*DVE representing the period of use of the product*

$$ICcomponent - static = \sum_{All\ deposits} Quantity\ of\ deposit * \frac{1}{Living\ area\ of\ the\ building} * [R * (Product\ stage\ (A1 - A3\ module) + Construction\ process\ stage\ (A4 - A5\ module) + End\ of\ life\ stage\ (C1 - C4\ module) + resoource\ Recovery\ stage\ (D\ module)) + \frac{PER}{DVE} * Use\ stage\ (B1 - B5\ module)\ ]$$

To follow the RE2020 logic, the period of use indicated in the passport must be the same as the one indicated in the FDES.
There are some differences between the $IC_{component\ -\ static}$ of the RE2020 and the one calculated on myUpcyclea[3]:

- B5 module is considered in myUpcyclea while not taken into account in RE2020[4]
- In the RE2020, if B6 and B7 modules are included in the whole B module, then B module should be set at 0 (but still considering refrigerant pipes). On myUpcyclea the B module is always considered.[5]
- Some special cases linked to refrigerant pipes, multi-use building or co-generation facilities at a minimum are not considered in myUpcyclea calculations.[6]

Exception: when the deposit is coming from reuse, the carbon footprints are considered as null[1].

## 5. $Ic_{Component}$ (dynamic) indicator (to be developed)

The French RE2020 has created a dynamic indicator to consider in a more realistic way how the greenhouse gas emission will occur when chemically reacting in the atmosphere, as well as to take into consideration uncertainty of end-of-life scenarios and the climate urgency. [2]

As in the static calculation, it introduces

$$\mathrm{R} = \max\left(1, \frac{\mathrm{PER}}{\mathrm{DVE}}\right) = \max(1, \frac{50}{\mathrm{Period\ of\ use\ of\ the\ product}})$$

*with*
*PER representing the reference period of study of the building, which is set at 50 years*
*DVE representing the period of use of the product*

It also introduces a ponderation factor $f_{CO2}$ which depends on how many years the products are installed:

| Years | $f_{CO2}$ | Years | $f_{CO2}$ | Years | $f_{CO2}$ |
|---|---|---|---|---|---|
| **0** | 1,000 | **18** | 0,856 | **36** | 0,704 |
| **1** | 0,992 | **19** | 0,848 | **37** | 0,695 |
| **2** | 0,984 | **20** | 0,840 | **38** | 0,686 |
| **3** | 0,976 | **21** | 0,831 | **39** | 0,678 |
| **4** | 0,969 | **22** | 0,823 | **40** | 0,669 |
| **5** | 0,961 | **23** | 0,815 | **41** | 0,660 |
| **6** | 0,953 | **24** | 0,806 | **42** | 0,651 |
| **7** | 0,945 | **25** | 0,798 | **43** | 0,642 |
| **8** | 0,937 | **26** | 0,790 | **44** | 0,633 |
| **9** | 0,929 | **27** | 0,781 | **45** | 0,624 |
| **10** | 0,921 | **28** | 0,773 | **46** | 0,615 |
| **11** | 0,913 | **29** | 0,764 | **47** | 0,606 |
| **12** | 0,905 | **30** | 0,756 | **48** | 0,597 |
| **13** | 0,897 | **31** | 0,747 | **49** | 0,587 |
| **14** | 0,889 | **32** | 0,739 | **50** | 0,578 |
| **15** | 0,880 | **33** | 0,730 | | |
| **16** | 0,872 | **34** | 0,721 | | |
| **17** | 0,864 | **35** | 0,713 | | |

Two cases are considered in the calculation:

**> IF DVE >= PER**

$$IC component - dynamic = \sum_{All\ deposits} Quantity\ of\ deposit * \frac{1}{Living\ area\ of\ the\ building} * [Product\ stage\ (A1 - A3\ \ module) + Construction\ process\ stage\ \ (A4 - A5\ module) + \sum_{a=1}^{PER} \frac{B1 - B5\ module}{DVE} * fCO2(a) + \ C1\text{-}C4\ module * fCO2(PER) + \ D\ module * fCO2(PER)\ ]$$

**> IF DVE < PER**

Additional figures are introduced:

$$\alpha = \text{integer part } (\frac{PER}{DVE}) \text{ and } Futil = \frac{PER}{DVE} - \alpha$$

$$IC component - dynamic = \sum_{All\ deposits} Quantity\ of\ deposit * \frac{1}{Living\ area\ of\ the\ building} * [\ A1 - A3\ module\ +\ A4 - A5\ module\ + \sum_{a=1}^{PER} \frac{module\ B1 - B5}{DVEp} * fCO2(a) + (\ A1 - A3\ module + \ A4 - A5\ module + \ C1 - C4\ module) * (\sum_{r=1}^{\alpha-1} fCO2(DVE * r) + Futil * fCO2(DVE * \alpha) + \ C1 - C4\ module * FCO2(PER) + \ D\ module * (\sum_{r=1}^{\alpha-1} fCO2(DVE * r) + Futil * fCO2(DVE * \alpha) + fCO2(PER)]$$

Exception: when the deposit is coming from reuse, the carbon footprints are considered as null[1].

The same differences as for the static indicator exist between myUpcyclea calculations and the RE2020 one.

**This indicator is not, in March 2023, developed yet. It should replace the static version in the coming months.**

## 6. IcConstruction indicator

The $Ic_{Construction}$ indicator characterizes the climate change impact of components (materials and equipment) of the building and of the work site.

$$IC_{construction} = IC_{component} + IC_{works}$$

NB: As myUpcyclea is not able to calculate $IC_{works}$, it must be added manually by the user (in kgCO2eq/m2)

## 7. Explanations of the choices made for these indicators

| Text reference | Explanation |
|---|---|
| 1 | **Why are all carbon footprints considered as null is case of reuse origin?**<br>This is a convention in the RE2020 as well as in several labels, thus it has been applied here.<br>Moreover, considering the production footprint as null is logical as the product has not been produced before being implemented, it already had a previous life for which the production footprint was considered. For the other footprints, this is more a convention to encourage reuse. |
| 2 | The details of the RE2020 calculations are available here: https://www.legifrance.gouv.fr/download/pdf?id=LBxKOX3Duk3h0j_ck_WBwvf9HBYDu3aSYhPKEIm97w4= |
| 3 | It has been chosen to implement this indicator even if there are slight differences with the exact RE2020 calculation, as it still gives the user an overview of its ICcomponent indicator. Thus the user can generate circular signature indicators during design phase of the building and see what could be reached and how to improve before doing the real calculation. |
| 4 | **Why is B5 considered in the calculation?**<br>When implementing this indicator, the circular passport only had one B1-B5 module field. The goal is to create two separate fields not to count B5 anymore. Should be done in 2023. |
| 5 | **Why is the B module always considered on myUpcyclea?**<br>We have no way, through information filled in the passport, to know, when B6 in null, if this is because it IS null or because it has been integrated to the other B fields. Thus it was chosen to always consider the B module. |
| 6 | **Why are the exceptions not considered?**<br>This is impossible to get through passport or deposit information which would lead to apply the exceptions. |

## C. Accessible results

Each carbon indicator results are accessible at two different levels:

- Total deposits level: this is the sum of all deposits grade weighted by their weight.
- Product category level

The reports also provide information regarding the three highest carbon footprints (by category of products).

## D. Warnings and errors

When data is missing or not accurate, the user receives:

- **Warnings**: a data is missing – the concerced deposit has been taken into account but the result of the indicator for this deposit may be non-representative or partial
- **Errors:** an important data is missing – the concerned deposit could not be taken into account in the calculation of the indicator.

For this indicator, the possible warnings and errors are:

| **WARNINGS** | |
|---|---|
| **Production & Construction indicators** | The carbon footprint of raw material and manufacturing (product stage - A1-A3) is missing |
| | The carbon footprint of construction process stage (A4-A5) is missing |
| **Embodied indicator** | The carbon footprint of raw material and manufacturing (product stage - A1-A3) is missing |
| | The carbon footprint of construction process stage (A4-A5) is missing |
| | The carbon footprint of Use Stage (B1-B5) is missing |
| | The carbon footprint of End-of-life stage (C1-C4) is missing |
| **$IC_{component}$ indicator** | The carbon footprint of raw material and manufacturing (product stage - A1-A3) is missing |
| | The carbon footprint of construction process stage (A4-A5) is missing |
| | The carbon footprint of Use Stage (B1-B5) is missing |
| | The carbon footprint of End-of-life stage (C1-C4) is missing |
| | The carbon footprint of Resource Recovery Stage (D module) is missing |
| | The period of use has not been set |

| **ERRORS** | |
|---|---|
| **Production & Construction indicators** | The conversion factor of functional unit is not set |
| | Could not determine the Production/Construction Carbon Footprint of this deposit: No Information |
| **Embodied indicator** | The conversion factor of functional unit is not set |
| | Could not determine the Embodied Carbon Footprint of this deposit: No Information |
| **$IC_{component}$ indicator** | The conversion factor of functional unit is not set |
| | Could not determine the $IC_{component}$ Carbon Footprint of this deposit: No Information |
| | No living area |

## E. Summary of changes with regards to the Circular Signature V1

| Type of change | Details and justification |
|---|---|
| **New carbon indicators** | New carbon indicators have been introduced to answer the market needs:<br>- Production & construction carbon footprint<br>- Embodied carbon<br>- $IC_{component - static}$<br>- $IC_{construction}$<br>- $IC_{component - dynamic}$ (to be developed soon) |

# IV. Residual value indicator

## A. Principles of the indicator

This indicator aims at calculating the financial residual value which can be recovered when managing the resources in a circular way at their end of use instead of through a linear path.

For now, it can only calculate residual value of building materials and products.

It is given in percentage of the original purchase price of the material or product.[1]

It takes into consideration:

- **The achievable resale price**: through recycling or reuse, how much can be recovered / need to be paid, depending on demontability and state of the product – a high range as well as low range is considered;
- **The treatment cost:** how much it would cost to treat the materials through a linear path;
- **The extra cost for clean removal**: an extra cost is required to perform a clean removal so that the material can be valorised in the proper way;
- **The purchase value:** how much the product cost when first bought;
- **The real recoverability:** what percentage of the material or product is really recoverable depending on how it is implemented.

Two scenarios are considered:

- **A profit oriented scenario:** only are considered the materials for which management in the circular economy is more economically profitable than the conventional scenario, and the other materials are eliminated via conventional channels.
- **An environment oriented scenario:** the "most circular" recovery scenario is considered. For each component, even if it is not economically favourable. In this scenario, the residual value (usually only the low hypothesis) can be negative, which means that it could in this case be more expensive to manage the resources in a circular way than through traditional waste management.

This residual value can be calculated in three cases:

- **Deconstruction:** as if all products and materials, including structure, were deconstructed and valorised once, at signature generation
- **Renovation:** as if all products and materials but structure, were deconstructed and valorised once, at signature generation
- **Renewal over 30 years:** as if all products and materials, including structure, were deconstructed and valorised several times over the next 30 years, depending on their nature

This indicator can be calculated for buildings located in several geographical areas: France, Spain (Catalonia and outside Catalonia), England and Belgium.

## B. Details of the V1 calculation

The details of the V1 way to calculate residual value is accessible here:

- **Matching algorithm:** https://docs.google.com/document/d/1fedYw0Nj7dssfKekLA2nmF5WSuUUZLXQRxnPALh9GuY/edit?usp=sharing
- **Calculation by deposit:** https://docs.google.com/document/d/1JHhQyNW27uE0NC4a3f4ZoLxKmAjRBLFx3HoknOxC9dc/edit?usp=sharing
- **Aggregation of Results for data visualization:** https://docs.google.com/document/d/1DcK5gCjgNG2N2SdGxRoelRo77gpqGPgytZy8-SIj5Z4/edit?usp=sharing

## C. Details of the V2 calculation (to be developed)

### 1. Passport matches

For several years, Upcyclea has built up a database of all the above parameters (purchase price, resale price, extra cost of clean disposal, treatment cost, recovery rate) through its feedback and R&D work.

This database is directly implemented in myUpcyclea, thus allowing the evaluation of the residual value of a building, and continues to be enriched over the years.

The financial data is organised by product and is entered into myUpcyclea in "System Passports". Each system passport therefore lists all the parameters required to calculate the residual value of a "generic" product.

When calculating the indicator, the circular passports of the deposits under consideration are compared with the system passports of myUpcyclea: if there is a "match", i.e. if a system passport corresponds to the circular passport in question (in terms of name, materials and product category), the data of this system passport are associated with the deposit under consideration to assess its residual value.

A system of synonyms has been implemented to make this algorithm more accurate.
For example, the product "carpentry" is a synonym for "window". Thus, whatever the name given to the product by the manufacturer in his circular passport, the association can be made with the system passport.

If no financial data is currently available for a specific type of product, the deposit of this type of product is not considered: it does not appear in the residual value balance.

**The matching algorithm remains the same as in the version 1 of the circular signature – it can be consulted through the link of the previous part of the document.**

## 2. Calculations for one deposit

### a) Calculation principles

$$Residual\ Value = \frac{Added\ value}{Purchase\ value}$$

$$= \frac{\frac{Real\ Recoverability}{100} * (Adjusted\ Resale\ Price + Treatment\ cost) - Extra\ cost\ for\ clean\ removal}{Purchase\ value}$$

The following variables are calculated separately, and eventually compared so that the best ones are selected for the final results:

- Reuse_Residual_value_up (%)
- Reuse_Residual_value_down (%)
- Upcycling_Residual_value_up (%)
- Upcycling_Residual_value_down (%)

### b) Real Recoverability rate

This represent the percentage of the product that can be recovered from the deconstruction work.

It depends on a Demontability_factor:

- 1 if the deposit is easily separable
- 0,75 if the deposit is hardy separable
- 0,3 if the deposit is inseparable or if its demontability is unknown

**Reuse scenario**

The Reuse_recoverability_average corresponds to a field integrated in the system passport and filled in manually based on experience.

⇨ **IF** the deposit_demountability is “Already Separated”:
Reuse_Real_Recoverability =100

⇨ **ELSE**
Reuse_Real_Recoverability = Reuse_recoverability_average*demountability_factor

**Upcycling scenario**

The Upcycling_recoverability_average corresponds to a field integrated in the system passport and filled in manually based on experience.

⇨ **IF** deposit_demountability is “Already Separated”:
Upcycling_Real_Recoverability =100

⇨ **ELSE**
Upcycling_Real_Recoverability =
Upcycling_recoverability_average*demountability_factor

### c) Adjusted Resale price

**Reuse scenario**

We start by calculating a ratio_reuse which enables to turn the resale price in €/System_passport_unit into a data in €/Circular_passport_unit.

- ⇨ **IF Circular_Passport_purchase_price IS NOT null:**
  ratio_reuse =
  Circular_passport_purchase_price/System_passport_purchase_cost; [2]

- ⇨ **ELSE**
  Ratio_reuse =
  Circular_passport_conversion_factor / (1000 * System_passport_conversion_factor)

Then we calculate the Reuse_adjusted_resale_price in €/Circular_passport_unit.

- Reuse_adjusted_resale_price_up = Reuse_resale_price_up*ratio_reuse
- Reuse_adjusted_resale_price_down = Reuse_resale_price_down *ratio_reuse

This price is then adjusted by weighting it by the state of the deposit, which influences the reuse potential and therefore the reuse value of the product:

- ⇨ **IF item_state = "Irrelevent" :** Reuse_deposit_Item_state_rate = 0,1
- ⇨ **IF item_state = "As new":** Reuse_deposit_Item_state_rate = 1,1
- ⇨ **IF item_state = "Slightly used":** Reuse_deposit_Item_state_rate = 0.9
- ⇨ **IF item_state = "Used":** Reuse_deposit_Item_state_rate = 0.5
- ⇨ **IF item_state = "Deteriorated":** Reuse_deposit_Item_state_rate = 0.1

We calculate the the final reuse adjusted resale prices:

- Reuse_adjusted_resale_price_up = Reuse_adjusted_resale_price_up *
  Reuse_deposit_Item_state_rate
- Reuse_adjusted_resale_price_down = Reuse_adjusted_resale_price_down *
  Reuse_deposit_Item_state_rate

**Upcycling scenario**

We start by calculating a ratio_reuse which enables to turn the resale price in €/T into a data in €/Circular_passport_unit.

ratio_upycling = PP_conversion_factor / 1000 [3]

Then we calculate the Upcycling_adjusted_resale_price in €/Circular_passport_unit.

- Upcycling_adjusted_resale_price_up = Upcycling _resale_price_up*ratio_ upcycling
- Upcycling _adjusted_resale_price_down = Upcycling _resale_price_down *ratio_ upcycling

This price is then adjusted by weighting it by the state of the deposit, which influences the recycling potential and therefore the recycling value of the product. In the recycling/upcycling case, only the "deteriorated" state has an impact on the recycling potential:

⇨ **IF item_state = "Irrelevent" :** Upcycling _deposit_Item_state_rate = 0,8

⇨ **IF item_state = "As new":** Upcycling _deposit_Item_state_rate = 1

⇨ **IF item_state = "Slightly used":** Upcycling _deposit_Item_state_rate = 1

⇨ **IF item_state = "Used":** Upcycling _deposit_Item_state_rate = 1

⇨ **IF item_state = "Deteriorated":** Upcycling_deposit_Item_state_rate = 0.8

We calculate the the final upcycling adjusted resale prices:

- Upcycling _adjusted_resale_price_up = Upcycling_adjusted_resale_price_up * Upcycling _deposit_Item_state_rate
- Upcycling_adjusted_resale_price_down = Upcycling_adjusted_resale_price_down * Upcycling_deposit_Item_state_rate

### d) Treatment cost (landfill cost)

In the system passport, the data is in €/T. The goal is to turn it into €/Circular_passport_unit:

landfill_cost = landfill_cost *Circular_passport_conversion_factor / 1000

### e) Extra cost for clean removal

In the system passport, the data is in €/System passport unit. The goal is to turn it into €/Circular_passport_unit:

**Reuse scenario**

**IF Circular_passport_unit IS DIFFERENT FROM System_passport_unit) THEN**
Reuse_Extra cost for clean removal = Reuse_Extra cost for clean removal *Circular_passport_conversion_factor / (1000 * System_passport_conversion_factor) ;

IF (type_of_reporting IS NOT "Deconstruction") THEN

Reuse_Extra cost for clean removal = Reuse_Extra cost for clean removal * coef_rehabilitation_makes_removal_expensive_anyway[4]

With coef_rehabilitation_makes_removal_expensive_anyway = 0,9

**Upcycling scenario**

**IF Circular_passport_unit IS DIFFERENT FROM System_passport_unit) THEN**
Upcycling_Extra cost for clean removal = Upcycling_Extra cost for clean removal *Circular_passport_conversion_factor / (1000 * System_passport_conversion_factor) ;

IF (type_of_reporting IS NOT "Deconstruction") THEN

Reuse_Extra cost for clean removal = Reuse_Extra cost for clean removal * coef_rehabilitation_makes_removal_expensive_anyway[4]

With coef_rehabilitation_makes_removal_expensive_anyway = 0,9

### f) Purchase value

if it exists, it is the circular passport purchase price that must be taken into account - so we update the value of the system passport cost for this calculation:

System_passport_purchase_cost = Circular passport_purchase_price

If none, the system passport purchase cost is only adapted to the circular passport unit:

System_passport_purchase_cost = System_passport_purchase_cost * Circular_passport_conversion_factor / (1000*System_passport _conversion_factor)

### g) Residual values calculation – one deposit

Once the variables calculated, they are used for the deposit final result.

**> deposit_weight (in ton)**

deposit_weight = deposit_quantity * Circular_passport_conversion_factor / 1000

**> number of renewal (integer)**

It depends on reporting_type and construction_layer.[5]

| | Structure / foundation | Facade / skin | technical equipment | Finishing work | furniture / decoration |
|---|---|---|---|---|---|
| Deconstruction | 1 | 1 | 1 | 1 | 1 |
| Rehabilitation | 0 | 1 | 1 | 1 | 1 |
| Over 30 years_commercial | 0 | 1 | 3 | 4.5 | 6 |
| over 30 years_residential | 0 | 0 | 1.5 | 2 | 2.5 |
| over 30 years_institutional | 0 | 0 | 1.5 | 1.5 | 2.5 |

*To come later: a "personalized" mode where the user will choose each renewal rate.*

### > deposit purchase value (€)

deposit_purchase_value = nb_renewal* deposit_quantity *System_passport_purchase_cost

### > Deposit_ adjusted_resale_price

For each considered case (reuse/upcycling and value up/value down), the adjusted price is calculated this way:

$$Deposit\_adjusted\_resale\_price = \frac{(Reuse\_real\_recovery)}{100} * nb\_of\_renewals * deposit\_quantity * adjusted\_resale\_price$$

### > deposit_avoided_cost_of_removal (€)

deposit_reuse_avoided_cost_of_removal (€)
= number_of_renewal * (reuse_real_recoverability/100) * landfill_cost * deposit_quantity

deposit_upcycling_avoided_cost_of_removal (€)
= number_of_renewal * (upcycling_real_recoverability/100) * landfill_cost * deposit_quantity

### > deposit_extra_cost_of_clean_removal (€)

deposit_reuse_extra_cost_of_clean_removal (€)
= number_of_renewal * reuse_extra_cost_for_clean_removal* deposit_quantity

deposit_upcycling_extra_cost_of_clean_removal (€)
= number_of_renewal * upcycling_extra_cost_for_clean_removal* deposit_quantity

### > Deposit added value

deposit_reuse_added_value_up (€)
= deposit_reuse_adjusted_resale_price_up + deposit_reuse_avoided_cost_of_removal - deposit_reuse_extra_cost_of_clean_removal

deposit_reuse_added_value_down (€)
= deposit_reuse_adjusted_resale_price_down + deposit_reuse_avoided_cost_of_removal - deposit_reuse_extra_cost_of_clean_removal

deposit_upcycling_added_value_up (€)
= deposit_ upcycling _adjusted_resale_price_up + deposit_ upcycling _avoided_cost_of_removal - deposit_ upcycling _extra_cost_of_clean_removal

deposit_ upcycling _added_value_down (€)
= deposit_ upcycling _adjusted_resale_price_down + deposit_ upcycling _avoided_cost_of_removal - deposit_ upcycling _extra_cost_of_clean_removal

### > Deposit residual value

$$Deposit\_Reuse\_Residual\_value\_up = \frac{Deposit\_Reuse\_Added\_Value\_up * 100}{Deposit\_Purchase\ value}$$

$$Deposit\_Reuse\_Residual\_value\_down = \frac{Deposit\_Reuse\_Added\_Value\_down * 100}{Deposit\_Purchase\ value}$$

$$Deposit\_Upcycling\_Residual\_value\_up = \frac{Deposit\_Upcycling\_Added\_Value\_up * 100}{Deposit\_Purchase\ value}$$

$$Deposit\_Reuse\_Residual\_value\_up = \frac{Deposit\_Upcycling\_Added\_Value\_up * 100}{Deposit\_Purchase\ value}$$

### > Choice of results to use

For both residual value up and residual value down, the two scenarios reuse and upcycling are considered, and:

- The highest “residual value up” is saved
- The highest “residual value down” is saved

This is possible then that value up and value down don’t correspond to the same scenario.

### > Choice between profit oriented and environment oriented scenarios

The considered deposit is counted in the profit oriented scenario if both residual value up and residual value down are positive.

## 3. Aggregation and visualization

The impact of the deposits is weighted by their weight.

## 4. Explanations of the choices made for these indicators

| Text reference | Explanation |
|---|---|
| 1 | **Why is the residual value only given in percentage of purchase cost?**<br>As residual value is calculated based on average purchase prices for some deposits, the percentage format enables to apply the results to the real purchase cost known by the owner of the building.<br>However, this is planned to add the result in euros as well, to get a more palpable indicator. |
| 2 | **Why is the ratio calculation based on purchase prices for reuse?**<br>The calculation is based on the purchase prices when possible and not on the conversion factors to be closer to the reality: in reuse a price is often fixed in relation to the initial purchase price and not in relation to the weight (for example: 20% of the original purchase price). |
| 3 | **Why is the ratio calculation based on conversion factors for upcycling?**<br>No need to consider the initial purchase costs because the costs of entering the upcycling paths are always based on the ton. |
| 4 | **Why is there a ponderation in case of rehabilitation?**<br>The cost of removal is reduced when rehabilitation is involved, as clean removal is always necessary and carried out in this case. |
| 5 | **How the renewal rates have been settled?**<br>They are based on Steward Brand work, described in his book “How Buildings Learn: What Happens After They're Built” (1994). |

## 5. Accessible results

Financial residual value results are accessible at two different levels:

- Total deposits level: this is the sum of all deposits grade weighted by their weight.
- Product category level for the profit oriented scenario

## 6. Warnings and errors

When data is missing or not accurate, the user receives:

- **Warnings**: a data is missing – the concerced deposit has been taken into account but the result of the indicator for this deposit may be non-representative or partial
- **Errors:** an important data is missing – the concerned deposit could not be taken into account in the calculation of the indicator.

For this indicator, the possible warnings and errors are:

| WARNINGS |
| --- |
| Purchase price is missing : it might affect the relevance of the financial data |
| Category is not precise: it might affect the relevance of our financial data and your data visualization |
| The product was considered as [name of the matched system passport]. Financial data might not be relevant |

| ERRORS |
| --- |
| This product doesn't match one of our references. Our team will improve shortly our database. Please make sure that your data are representative. |
| We lack financial data about this kind of products. Our team will improve shortly our database |

## D. Summary of changes with regards to the Circular Signature V1

| Type of change | Details and justification |
| --- | --- |
| **Update of the Real Recoverability Rate** | Until now, there was only one "real recoverability rate" for both scenarios.<br>Now the rates are distinguished according to the two scenarios Upcycling and Reuse.<br>This implies the addition of a field in the system passport (now one field in each section Upcycling and Reuse). |
| **Update of the "ratio_upcycling"** | Until now, the ratio_upcycling could be calculated in two different ways as in the reuse scenario. This has been simplified into one unique scenario, to be closer to the reality. |
| **Update of the deposit extra_cost_of_clean_removal** | In V1, the % of recoverability was weighting the extra cost for clean removal. This weighting has been deleted as clean removal will be performed for the entire deposit even if not everything is recovered at the end. |
| **Changes in the final considered values** | In V1, the approach to select values was the following:<br>- The highest "residual value up" was selected<br>- The concerned scenario was saved (reuse/upcycling)<br>- The associated "residual value down was selected<br>In V2, the highest of each residual value is selected even if they don't correspond to the same scenario. |