



## Concise Consumer Communication through Robust Labels for Bio-based Systems

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## Report

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## Table of contents

<b>Table of contents</b>	<b>4</b>
<b>1 Introduction</b>	<b>7</b>
1.1 Objectives of 3-CO	7
1.2 Objectives of WP1	7
1.3 Scope of the report	7
<b>2 Selection criteria development</b>	<b>8</b>
2.1 Step 1: Selection criteria as provided in the DoA	8
2.2 Step 2: Additional selection criteria from online Task 1.1 meeting	8
2.3 Step 3: Interactive workshop as part of the 3-CO kick-off meeting	9
2.4 Step 4: Final set of selection criteria	11
<b>3 Selection of 10 bio-based value chains</b>	<b>13</b>
3.1 Step 1: Product categories as found in DoA	13
3.2 Step 2: Long list based on systematic classification	13
3.3 Step 3: Shortlist with inputs from consortium members	14
3.4 Step 4: Final selection & checks using selection criteria	15
3.5 Step 5: Check on available LCS covering the top 10 bio-based products	18
<b>4 Conclusion</b>	<b>21</b>
<b>5 List of abbreviations</b>	<b>22</b>
<b>Annex 1: long list of bio-based products and their CN codes</b>	<b>23</b>
<b>Annex 2: Scoring of the 40 shortlisted bio-based products at the sub-category level</b>	<b>27</b>
<b>Annex 3: Scoring by household room, consumables/durables, and feedstock</b>	<b>29</b>



## Publishable executive summary

The main goal of the 3-CO project is to support consumers in making more sustainable purchasing choices by providing a supportive framework for Label and Certification Schemes on Business-to-Consumers communication for industrial bio-based products. The scope of this report is the selection of ten bio-based value chains based on a number of selection criteria, including current and future market size, their contribution to the bioeconomy, and their potential environmental and social impacts. The selected value chains remain the focus of several 3-CO activities, such as the assessment of Labels and Certification Schemes (LCS), research on impacting consumer behaviour, and developing smart solutions to support sustainable consumption.

### Development of selection criteria

Selection criteria were developed in four steps. The starting point was an initial list of possible selection criteria provided in the project DoA. In their online meeting on 10 February 2023, all project partners listed additional potential selection criteria, offering further inputs in the following weeks. At an interactive workshop during the 3-CO kick-off meeting on 10 March 2023, partners' online voting ranked this long list of selection criteria. Their "liking" could provide and promote further selection criteria during the vote.

Based on this input, BTG, as the responsible partner, prepared a final set of scoring criteria consisting of the following:

1. The current and future *market potential* of the sustainable bio-based product;
2. *Environmental and social benefits* of the bio-based product compared to the standard (fossil or unsustainable bio-based) alternative;
3. Consumer *purchase frequency and costs*;
4. Consumer *recognisability and appeal*.

The first two criteria above: market potential and environmental and social benefits, establish the market-related impacts of consumers switching to sustainable bio-based products. The last two criteria, purchase frequency, costs, and recognizability, broadly signify the consumer demand and preference and are the target of the 3-CO project research, i.e. , i.e. on consumer behaviour towards sustainable products and development of smart solutions to support sustainable solutions.

Further criteria were introduced to assess consumer utility or the satisfaction consumers receive from using a product. BTG first prepared a list of rooms that may appear in a typical European household to indicate a product's function. For assessment of the time span of the consumer utility, the products were next categorized as "consumables" or "durables." Thirdly, the 40 shortlisted bio-based products were categorized by the "product feedstock," or their primary production material, to establish the utilities within the diversity of bio-based products in the market.



### Selection of 10 bio-based value chains

The ten bio-based value chains were selected in a stepwise process. First, a long list of potential value chains was established using “Combined Nomenclature,” a classification of goods that European customs use to determine import duties. This selection resulted in a list of **86** bio-based consumer products.

After an early screening of this list, considering the product categories described in the project DoA, a shortlist of **23** bio-based products was established. During the 3-CO kick-off meeting in Helsinki on 10 March 2023 in a workshop dedicated to selecting the bio-based value chains, the participating consortium members could score the initial list of products, suggest new ones anonymously, and vote the new suggestions with “likes.” The participants added 17 products to the initial shortlist, increasing its length to **40**.

The final selection was made by BTG expert scoring and sorting, using the selection criteria and sub-criteria. Finally, the scoring was compared with the recorded preferences of the Helsinki 10 March workshop participants.

The finally selected bio-based products are:

1. Baby clothing
2. T-Shirts
3. Shampoo
4. Wooden houses (Cross Laminated Timber or wooden frame houses)
5. Furniture
6. Cosmetics (make-up, etc.)
7. Biodegradable plant pots
8. Bio-based plastic toys
9. Bio-based PET/PEF bottles
10. Mattresses.

The level of specification of the selected bio-based products is expected to be suitable for further assessment of LCSs. 3-CO partners may need to further specify the products for the purpose of consumer research and development of smart solutions, e.g. selecting a specific piece of furniture or a specific bio-based toy.



## 1 Introduction

### 1.1 Objectives of 3-CO

The main goal of the 3-CO project is to develop and demonstrate the viability of a supportive framework for Label and Certification Schemes (LCSs) on Business-to-Consumers (B2C) communication for industrial bio-based products (BBPs) that enables and supports consumers to make more sustainable purchasing choices.

The project aims to improve sustainability performance and competitiveness in bio-based systems. The focus is on consumer-oriented labelling options for industrial BBPs that are sustainable and circular in using resources, processes, and materials during their entire lifecycle. The supportive framework will consist of actionable guidelines for LCS owners that reflect consumers' and other stakeholders' needs, digital solutions to support better-informed decision-making processes of consumers, and policy recommendations on deploying social measures.

### 1.2 Objectives of WP1

The objective of WP1 is to thoroughly understand existing LCSs for the bioeconomy through pre- and co-normative research. It will assess the existing and lacking coverage of environmental, social, and economic aspects and their robustness and effectiveness. Ultimately, the objective is to derive a science-based supportive framework for further developing bioeconomy LCSs.

### 1.3 Scope of the report

This report describes the selection of ten bio-based value chains based on chosen selection criteria, including current and future market size and their potential environmental and social impacts as their contribution to the bioeconomy. The selected value chains become the focus of several 3-CO activities, such as assessing their LCSs (WP1) and experiments targeting consumer behaviour and developing smart solutions to support bio-based product consumption (WP2). The selection has been carried out in close collaboration with all project partners. The criteria development details are described in Chapter 2, and the final selection is presented step-by-step in Chapter 3.

## 2 Selection criteria development

Criteria for selecting bio-based value chains have been developed in multiple steps.

1. The starting point is the selection criteria list provided in the project DoA.
2. During an online meeting on 10 February 2023, all project partners contributed to the list of additional selection criteria, with the option to provide further inputs in the weeks thereafter.
3. During an interactive workshop as part of the 3-CO kick-off meeting on 10 March 2023, the workshop participants ranked a long list of selection criteria by online voting. Moreover, they could provide and promote additional selection criteria.
4. Based on this input, BTG has prepared the final selection criteria.

The following sections discuss these four steps further.

### 2.1 Step 1: Selection criteria as provided in the DoA

The project DoA presents the following selection criteria, forming the initial list for further criteria development:

- current and future market size (growth potential)
- their contribution to a resource-efficient and circular bioeconomy
- consumer purchase frequency and costs, and
- the anticipated (avoided) environmental and social impacts of displacing incumbent, unsustainable products.

The last criterion is vast and may include, e.g., impacts during production, use phase, and end-of-life. Further, the impact may lie, for instance, in the potential for reduced waste and material inputs (design for durability and circularity) and biodegradability in selected strategic applications.

### 2.2 Step 2: Additional selection criteria from online Task 1.1 meeting

The online Task 1.1 meeting on 10 February 2023 with the 3-CO consortium members established that the earlier criteria presented in the DoA concerning relevance of LCS, market size and product availability remain relevant. To further emphasise the focus in consumer choice, the meeting made the following remarks and suggestions for additional selection criteria:

- The value chain should result in a clearly defined consumer product (that can also be targeted in later consumer research in the other 3-CO project Tasks, e.g. T2.1-2.5);
- These products should be such that the change in consumer behaviour matters;
  - Products where consumers can deliberately choose to switch from non-bio to bio-based products;
  - Products where the certified product has a much better sustainability performance.
- These products should be such that the end consumer is the final decision maker;
- These were proposed to be very durable products, rather than consumable products. Bio-based materials should be first employed for long-lasting products, to make the most of natural resources



without creating disproportionate pressure on the environment. For many short-lived products, there is more value in reducing or eliminating their use, rather than changing their material for resources that would be better employed in long lasting products. This is typically the case of packaging, where in addition, in most cases, consumers do not choose a packaging but the product itself. However, as packaging plays and will play an important role the coming years and is the focus of EU policies to improve its sustainability, participants opposed ruling out this product type. Suggestion was made to target packaging as one component of the product selected, as is done in the criteria of the EU Ecolabel. It was therefore observed that the selection should be a good mix of durable and consumable products.

- The legislative context was discussed, and especially the upcoming European Commission’s proposal for a Green Claims Directive<sup>1</sup>. New regulations on certification schemes and labels are expected to be relevant for the outputs of the project (notably policy recommendations). At this stage however, it was considered that these legislations do not have elements to influence the choice of value chains.

### 2.3 Step 3: Interactive workshop as part of the 3-CO kick-off meeting

Based on the results of steps 1 and 2, BTG prepared a list of selection criteria for a dedicated internal workshop during the 3-CO kick-off meeting in Helsinki. UU and BTG designed a survey in Whooclap software<sup>2</sup> that allowed the 19 workshop participants - all 3-CO consortium members - to anonymously rank the importance of the listed selection criteria (1 = not important; 5 = very important) and to propose and “like” additional selection criteria. Table 1 shows the final ranking for criteria for selecting the final bio-based value chains. Table 1 suggests that (1) contribution to resource-efficient and circular bioeconomy, (2) anticipated environmental and social impacts of displacing incumbent unsustainable products, (3) current and future market size, and (4) coverage by LCS are perceived most valuable, while also the other three selection criteria require consideration. These scores confirm the importance of the selection criteria established in the previous step (Chapter 2.2).

Table 1: Importance of criteria for selecting bio-based value chains (1 = not important; 5 = very important). Input received from 19 of 19 participants present

Rank	Selection criterion	Score
1	Contribution to resource-efficient and circular bioeconomy	4.2
2	Anticipated environmental and social impacts of displacing incumbent unsustainable products	4.1
3	Current and future market size (growth potential)	4
4	Coverage by LCS	4
5	Relevance to EU bioeconomy policies	3.6
6	The selected set of value chains should cover a wide variety of biomass feedstocks and products	3.5
7	Purchase frequency and costs for consumers	3.2

<sup>1</sup> On 23 March the proposal for a directive of the European Parliament and of the Council for a directive on substantiation and communication of explicit environmental claims (COM(2023)0085) has been published.

<sup>2</sup> Whooclap is an interactive electronic platform used to create polls and questionnaires. The site's users answer questions anonymously through technology devices such as smartphones or laptops. See <https://www.wooclap.com/>

Next, the workshop advanced to collect opinions to further inform the selection of concrete consumer products according to the criteria discussed in Chapter 2.2. Table 2 presents the workshop participants' anonymously published free-form responses to the question "Which other selection criteria do you see as relevant," and the number of likes each additional selection criterion received from other participants. A few of these criteria give more nuance to the earlier criteria. Three suggestions: "impact on biodiversity," "land use impacts," and "weight of products affects transportation costs (example: plastic vs. glass bottles)," propose details to and refining of the earlier criterion, "Anticipated environmental and social impacts of displacing incumbent unsustainable products." Another suggested criterion, "relevance to supporting sustainable lifestyle," further guides the focus on "contribution to resource-efficient and circular bioeconomy."

Table 2: Other selection criteria perceived relevant and the number of likes. Input received from 11 of 19 participants present

Rank	Answers to the question "What other selection criteria do you see as relevant?"	Number of likes
1	Recognizability	10
2	Frequency	9
3	Used by different segments of consumers	9
4	Relevance to supporting sustainable lifestyle	5
5	overall volume instead of frequency or cost	5
6	Impact on biodiversity	4
7	Land use impacts	3
8	Relevance to consumer choice (e.g., packaging: will the consumer choose mainly the product or is packaging a choice option for this product)	2
9	Cost	1
10	Not just popular with early movers	1
11	The weight of products affects transportation costs (for example, plastic vs. glass bottles)	0

The results establish that selecting frequently used, recognisable products used by different segments of consumers across the European common market is advisable to cast a wide net over bio-based product consumption. "Recognizability," "(buying) frequency," and "used by different segments of consumers" received the three highest scores. The popularity of "(buying) frequency" suggest a focus more on this factor than only on "costs," or the consumers' budget constraint. This is highlighted in the suggestion "overall volume instead of frequency or cost," which also complements the earlier criteria "current and future market size." Further, focus on recognisable "iconic" products was suggested in the subsequent discussion, where the participants noted that establishing such products is essential in later 3-CO research considering consumer choice behaviour.

Finally, also the less "liked" suggestions guided the criteria for omissions. Considerations like "relevance to consumer choice (e.g., packaging: will consumer choose mainly the product or is packaging a choice option for this product)," and "not just popular with early movers" were mentioned but received little support by "likes." These two suggestions can be perceived as factors affecting consumer behaviour. Their unpopularity among the



workshop participants confirms that the selection criteria should focus directly on products and their related consumer behaviour, rather than secondary attributes.

## 2.4 Step 4: Final set of selection criteria

For a broad coverage of products, four main selection criteria were thus firmly established:

1. Current and future sustainable bio-based market size;
2. Environmental and social benefits compared to the incumbent (fossil or unsustainable bio-based) alternatives;
3. Purchase frequency and costs for consumers;
4. Consumer recognisability and appeal.

The first two criteria are related to the impact of consumers switching to sustainable bio-based products. In comparison, the last two criteria align the selection to the consumer utility and research performed within 3-CO, for example the designing and developing of smart solutions to support sustainable decision making. Table 3 details the sub-criteria behind the main criteria and the scoring scheme, where all sub-criteria can achieve ordinal values ranging from 1 to 3 (low to high). The main criteria are the averages of their sub-criteria. The final score was obtained by multiplication of the scores of the four main criteria.

The scoring is based on expert opinion. This procedure was chosen for time efficiencies, despite a risk of biased scoring, because collecting evidence for the established selection of 40 products times 7 sub-criteria requires evidence to complete 280 criteria. After scoring, the bio-based products were sorted based on their score, to establish the top ten from the 40 products. The scoring of the sub-criteria was performed by the main author (Martijn Vis), reviewed by John Vos (BTG) and Marjoriikka Ylisiurua (VTT), and submitted to the consortium partners for review.

For understanding the consumer utility of products, a set of nominal variables was also used to categorise the scored products by their consumer utility, or the type of satisfaction consumer gains from their use. Categories for product utility were established through three directions. First, each product was assigned a room within a typical European consumer household where the product is likely to be used. These are broad signifiers of the product use function. Next, the products were assigned to two sub-categories of consumables and durable products that signify the timespan for the utility and possibilities for recycling. The third category recorded the products' primary material, or "feedstock category," to establish diversity in the value chains of the bio-based products and the LSCs that cover these value chains.

Table 3: Criteria and sub-criteria used to score the bio-based products for selection

#	(Sub)criterion	Scoring
1	Current and future sustainable bio-based market	(Score 1a + score 1b)/2
1a	Current bio-based market size	1 = low; 2 = medium; 3 = high
1b	Possible future growth of the sustainable bio-based market	1 = low; 2 = medium; 3 = high
2	Environmental and social benefits compared to the common (fossil or unsustainable bio-based) alternative	1 = low; 2 = medium; 3 = high
3	Purchase frequency and costs for consumers	(Score 3a + score 3b + score 3c)/3
3a	Buying frequency	1 = less than once per three years 2 = between once a month and once per three years 3 = more than once a month
3b	Cost of product for the consumer	1 = less than 10 Euro 2 = between 10 – 100 Euro 3 = more than 100 Euro
3c	Size of buyers' group, % of households	1 = less than 5% 2 = between 5 – 50% 3 = more than 50%
4	Consumer recognisability and appeal	(Score 4a + score 4b)/2
4a	Recognisability of the product for consumers	1 = low; 2 = medium; 3 = high
4b	Appealing product, relevant for supporting sustainable lifestyle	1 = low; 2 = medium; 3 = high
	<b>Total score</b>	<b>Score 1 * score 2 * score 3 * score 4</b>

As the final boundary condition, the availability of sufficient LCSs to indicate the sustainability of these bio-based products was checked. It was concluded that the scoring and additional comparisons with selection criteria sub-lists indeed guarantee a broad distribution of products and thus applicable LCSs.

### 3 Selection of 10 bio-based value chains

The selection of 10 bio-based value chains has been performed in four steps:

1. Assessment of product categories provided in the DoA
2. Preparation of a long list (of 86 bio-based products) from a statistical CN classification
3. Establishment of a short list of 40 products with inputs from consortium members
4. Final selection of 10 products by scoring the 40 products using the developed selection criteria and procedures.

#### 3.1 Step 1: Product categories as found in DoA

The project DoA mentions that ten bio-based value chains are selected for further scrutiny, listing industry sectors such as:

- Textiles (e.g., clothing, shoes, carpets, furniture)
- Household and personal care (detergents, cosmetics, cleaning agents)
- Packaging (paper and bio-based plastic packaging)
- Plastic bio-based consumer goods (e.g., toys, stationery, cutlery)
- Paint, coatings, and ink (bio-based solvents, bio-based monomers)
- Traditional and novel bio-based building materials, furniture, and 3D-printing material.

It was decided to broaden the scope and explore the range of possible bio-based products in the following steps to increase coverage of considered categories.

#### 3.2 Step 2: Long list based on systematic classification

The “Combined Nomenclature” (CN list) classification is a World Customs Organization’s Harmonized Systems nomenclature, a systematic list of products used by customs to determine the import duties of products imported to the EU. The 1097-page document consists of 21 sections and 99 chapters containing different types of products, and thus a good starting point for obtaining a broad overview of (bio-based) consumer products that are traded in significant quantities. An initial screening of the CN list resulted in 244 possible bio-based product groups in 6 sections and 22 chapters. In this initial screening all non-biobased products were excluded (e.g. metals) As a second step, all intermediary bio-based products, e.g., chemicals and wood pulp, were excluded. Consequently, **86 bio-based consumer products** were selected. All these products have a CN code, which is assumed to indicate a considerable market size. The resulting list and the CN codes are presented in Annex 1.

### 3.3 Step 3: Shortlist with inputs from consortium members

Combining the products mentioned in the DoA, and the long list obtained from CN list, a shortlist of 23 bio-based products was established. The main selection criteria, market size, anticipated environmental and social impacts of displacing incumbent unsustainable products, buying frequency and costs, and consumer recognisability & appeal were considered at this point. During the Helsinki workshop of 10 March 2023, this list of 23 products was presented with Whooclap (See Chapter 2) to the consortium members, allowing them to vote whether they would like to have it included in the final selection (1 = no, not at all, 3 = maybe; 5 = yes, absolutely). Table 4 shows the result of this voting.

Table 4: Preference of consortium members for bio-based products from a shortlist of 23 bio-based products (1 = no, not at all, 3 = maybe; 5 = yes, absolutely). Input received from 16 of 19 participants present.

#	Product	Score	#	Product	Score
1	Biobased plastic toys	4.4	13	Biobased glue	3.0
2	T-Shirts	4.2	14	Block soap	3.0
3	Biobased packaging	4.1	15	Table and bed linen	2.9
4	Shampoo	4.1	16	Rubber tires	2.9
5	Biobased insulation material	4.0	17	Biobased synthetic leather (e.g. apple leather)	2.9
6	Biobased paint & coatings	3.7	18	Biodegradable plant pots	2.9
7	biobased PET/PEF bottles	3.6	19	Biobased lubricants (chainsaw)	2.8
8	Wooden construction material (particle board, OSB, MDF, etc.)	3.6	20	Biobased carpets	2.7
9	Biodegradable kitchen& garden waste packaging	3.3	21	Coffins	2.6
10	Furniture	3.2	22	Cork (for bottles)	2.1
11	biodegradable plant pots	3.1	23	Wooden Table and kitchenware	2.1
12	Wooden houses (CLT or wooden frame houses)	3.1			

Secondly, during the workshop, consortium members were allowed to suggest additional bio-based products and to provide likings to the suggestions of others. Table 5 lists these suggestions and their number of votes (“likes”). Table 4 and the entries in Table 5 with at least one “like” form a shortlist: the pool of 40 bio-based products from which the final selection of 10 bio-based value chains will be selected.

Table 5: Additional bio-based products as suggested by consortium members participating in the workshop and the number of likes. Input received from 18 of 19 participants present

#	Product	Number of likes	#	Product	Number of likes
1	Household cleaning products	13	13	Non-plastic toys: make the category wider (fabric, wood toys)	5
2	cosmetics (make-up, etc.)	12	14	Multi-use drinking bottles	4
3	Condoms	8	15	book	3
4	Mattress	7	16	Kid's clothing	3
5	Reusable packaging	7	17	Work clothing	2
6	sports clothing/textiles from artificial fibres	7	18	Technical clothing	0
7	Diapers	6	19	Plastic tableware	0
8	Skin care	6	20	Some sports hobby equipment like tennis rack	0
9	Baby clothing	5	21	Coffee capsules	0

### 3.4 Step 4: Final selection & checks using selection criteria

Table 6 shows the 40 shortlisted bio-based products sorted in order of their total scores. Table 13 in Annex 2 provides the scores at the level of the sub-criteria. The shortlisted bio-based products were next sorted according to their score within the household room category (signifying product utility), feedstock category (ensuring value chain and LCS diversity), and the consumables or durables category (signifying the time span and potential recyclability of product utility). The orders of scores by category are presented in Annex 3. This list forms the basis for the selection in the final step.

Next, the top 15 bio-based products in Table 6 were assessed by their appearance in these categories:

- The top product of one of the nine household rooms
- Top 5 durable products
- Top 5 consumables
- Top 2 of each feedstock category
- The top 15 products scored in Whooclap during the project workshop (Table 4)
- Top 5 additional products that received the most “likes” during the project workshop (Table 5).

Table 6: 40 shortlisted bio-based products sorted in order of their total score

#	Product	Current and future sustainable bio-based market	Environmental and social benefits compared to alternative	Buying frequency and costs	Consumer recognisability and appeal	Total score (by multiplication of the four main topics)
1	Baby clothing	3	3	2.0	3.0	54
2	T-Shirts	3	3	2.3	2.0	42
3	Table and bed linen	3	3	2.3	2.0	42
4	Wooden houses (CLT or wooden frame houses)	2.5	3	1.7	3.0	38
5	Shampoo	2.5	3	2.0	2.5	38
6	Furniture	2.5	2	2.3	3.0	35
7	cosmetics (make-up, etc.)	2.5	2	2.0	3.0	30
8	Kid's clothing	3	2	2.0	2.5	30
9	biodegradable plant pots	2	3	2.0	2.5	30
10	Biobased plastic toys	2	2	2.0	3.0	24
11	Reusable packaging	2	3	2.0	2.0	24
12	Biobased packaging	2.5	2	2.3	2.0	23
13	biobased PET/PEF bottles	2	2	2.3	2.5	23
14	Mattress	2	2	2.3	2.5	23
15	Coffins	2	2	2.3	2.5	23
16	Multi-use drinking bottles	1.5	3	1.7	3.0	23
17	Work clothing	3	2	2.0	1.5	18
18	Biobased synthetic leather (e.g., apple leather) (wallet)	2	2	1.7	2.5	17
19	Non-plastic toys: make the category wider (fabric, wood toys)	2	2	1.7	2.5	17
20	Block soap	2	2	2.0	2.0	16
21	Household cleaning products (dishwater tabs & liquids)	2	2	2.0	2.0	16
22	sports clothing/textiles from artificial fibres	2	2	2.0	2.0	16
23	Biodegradable kitchen& garden waste packaging	2	3	1.7	1.5	15
24	Skin care	1.5	2	2.0	2.5	15
25	Biobased lubricants (chainsaw)	2	3	1.7	1.5	15
26	Technical clothing	3	2	1.7	1.5	15
27	Coffee capsules	1.5	2	2.0	2.5	15
28	Biobased glue	1.5	2	2.0	2.0	12
29	book	2.5	1	2.3	2.0	12
30	Biobased insulation material	2	3	1.7	1.0	10
31	Wooden construction material (particle board, OSB, MDF, etc.)	2.5	2	2.0	1.0	10
32	Rubber tires	2.5	1	2.0	2.0	10
33	Diapers	2	1	2.3	2.0	9
34	Biobased paint & coatings	1.5	2	2.0	1.5	9
35	Biobased carpets	1.5	2	2.0	1.5	9
36	Cork (for bottles)	2	1	2.0	2.0	8
37	Condoms	1.5	1	1.7	3.0	8
38	Some sports hobby equipment like tennis rack	1	1	2.3	2.5	6
39	Wooden Table and kitchenware	1.5	1	1.3	2.0	4
40	Plastic tableware	1	1	1.7	2.0	3

After the final consideration of the distribution of products, Table 7 shows the top 10 bio-based products that are proposed, sorted by their score, and with the indication of whether they appear in the other top lists.. As indicated in the last column, the top 10 of bio-based products consists of maximally two products per CN chapter, indicating a proper distribution between the statistical categories.



Table 7: Top 10 of finally selected products (y = “yes, appears in this top list”)

#	Product	Score	In the top 1 per room	In the top 5 consumables	In the top 5 durables	In the top 2 of the feedstock category	In the workshop top 15 or additional top 5	CN chapter
1	Baby clothing	54	y		y	y		61
2	T-Shirts	42	y		y		y	61
3	Shampoo	38	y	y		y	y	33
4	Wooden houses (CLT or wooden frame houses)	38	y		y	y	y	44
5	Furniture	35	y		y	y	y	94
6	Cosmetics (make-up, etc.)	30		y		y	y	33
7	Biodegradable plant pots	30	y	y			y	39
8	Biobased plastic toys	24				y	y	95
9	Bio-based PET/PEF bottles	23		y			y	39
10	Mattress	23						94

Table 8 shows the five products that were omitted despite high scores. Especially “table and bed linen” scored very well, but since baby clothing and T-shirts were already chosen, they were omitted to avoid including too many textile products. Instead, bio-based bottles were chosen to represent consumers’ kitchen-related utility, and mattress to represent bedroom-related utility.

Table 8: Products in the top 15 of best-scoring products that were finally not selected (y = “yes, appears in this top list”)

#	Finally not selected	Score	In the top 1 per room	In top 5 consumables	In the top 5 durables	In the top 2 of the feedstock category	In the workshop top 15 or additional top 5	CN chapter	Reason for omission
12	Table and bed linen	42	y		y	y	y	63	Already two textile products included
13	Kid’s clothing	30	y					61	Very similar to baby clothing, already two textile products included
14	Reusable packaging	24	y			y		39	Already two products of CN chapter 39 included
15	Biobased packaging	23		y			y	39	Already two products of CN chapter 39 included
11	Multi-use drinking bottles	23						39	Already two products of CN chapter 39 included



### 3.5 Step 5: Check on available LCS covering the top 10 bio-based products

After establishing the Top 10 of products, an initial mapping of labelling and certification schemes was done to assess their coverage among available LCSs (Table 9). The mapping focused on those schemes that certify the final product itself, but we also included schemes that certify part of the product, such as natural fibre. All products in the list are covered in LCSs at least for certain aspects. For example, biodegradable plant pots do not have a specific certification scheme as a product, but the certification covers biodegradability in soil.



Table 9: LCS covering the selected bio-based value chains

#	Name of the Labelling / Certification scheme	URL	Baby clothing	T-Shirts	Wooden houses (CLT or wooden frame)	Furniture	Shampoo	Cosmetics (make-up, etc.)	Biodegradable plant pots	Bio-based plastic toys	Bio-based PET/PEF bottles	Mattress
<b>TOTAL LCS COVERAGE (# at least)</b>			<b>2</b>	<b>6</b>	<b>6</b>	<b>8</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
1	Oeko-tex (Made in Green, 100, etc.)	<a href="#">OEKO-TEX® - Tailor-made solutions for the textile and leather industry</a>	x	x								
2	Nordic Swan Ecolabel	<a href="#">The official ecolabel of the Nordic countries   Nordic Ecolabel (nordic-ecolabel.org)</a>		x	x	x		x		x		
3	USDA Certified Biobased Product	<a href="https://www.biopreferred.gov/BioPreferred/">https://www.biopreferred.gov/BioPreferred/</a>									x	
4	TUV Austria OK biobased	<a href="https://www.tuv.at/ok-biobased/">https://www.tuv.at/ok-biobased/</a>									x	
5	Blue Angel	<a href="#">Blue Angel   The German Ecolabel (blauer-engel.de)</a>		x		x						
6	EU Ecolabel	<a href="#">EU Ecolabel Product Groups and Criteria (europa.eu)</a>	x	x		x	x	x				x
7	Austrian Ecolabel	<a href="#">The Austrian Ecolabel ← Home ← Umweltzeichen.at</a>				x	x					x
8	GOTs - global organic textile standard	<a href="https://global-standard.org/the-standard/gots-key-features/ecological-and-social-criteria">https://global-standard.org/the-standard/gots-key-features/ecological-and-social-criteria</a>		x								



9	Bluesign (chemicals)	<a href="https://www.bluesign.com/en/criteria">https://www.bluesign.com/en/criteria</a>																
10	NaturePlus	<a href="#">natureplus e.V. - Climate-protecting, resource-saving and healthy living construction</a>			x													
11	Forest Stewardship Council	<a href="#">Home   Forest Stewardship Council (fsc.org)</a>			x	x												
12	Programme for the Endorsement of Forestry Certification (PEFC)	<a href="https://pefc.org/">https://pefc.org/</a>			x	x												
13	GreenGuard Certification	<a href="#">GREENGUARD Certification   UL</a>			x	x												
14	Living Building Challenge	<a href="https://living-future.org/lbc/">https://living-future.org/lbc/</a>			x	x												
15	Roundtable for Sustainable Biomaterials	<a href="#">Global Advanced Products Certification   Non-Energy Products (rsb.org)</a>	?	x	?	?	?	x			x	?	?					
16	Canopy (viscose)	<a href="https://canopyplanet.org/">https://canopyplanet.org/</a>	part	part					part									part
17	BCI (Better Cotton initiative)	<a href="https://bettercotton.org/">https://bettercotton.org/</a>	part	part					part									part
18	US cotton trust protocol	<a href="https://trustuscotton.org/">https://trustuscotton.org/</a>	part	part					part									part
19	Cotton Made in Africa (CmiA)	<a href="https://cottonmadeinafrica.org/en/">https://cottonmadeinafrica.org/en/</a>	part	part					part									part
20	Fairtrade cotton	<a href="https://www.fairtrade.net/product/cotton">https://www.fairtrade.net/product/cotton</a>	part	part					part									part
21	TUV Austria OK biodegradable	<a href="https://www.tuv-at.be/green-marks/certifications/ok-biodegradable/">https://www.tuv-at.be/green-marks/certifications/ok-biodegradable/</a>											x					
22	DIN-Geprüft Biodegradable in soil	<a href="https://www.dincertco.de/din-certco/en/main-navigation/products-and-services/certification-of-products/environmental-field/biodegradable-in-soil/">https://www.dincertco.de/din-certco/en/main-navigation/products-and-services/certification-of-products/environmental-field/biodegradable-in-soil/</a>												x				

## 4 Conclusion

Starting with a long list of possible bio-based products supported by CN nomenclature and inputs of 3-CO project participants, a short list of 40 relevant bio-based products was established. Ten bio-based value chains were finally selected based on a set of selection criteria, including (1) current and future sustainable bio-based market, (2) environmental and social benefits compared to the incumbent (fossil or unsustainable bio-based) alternative, (3) purchase frequency and cost for consumers and (4) consumer recognisability and appeal. In addition, a broad diversity of value chains was established through a focus on consumer utility. Specifically, the project further screened the household room where the product is regularly used. It established the time span and recycling potential of said utility through the division between durables/consumables. The diversity between the products' primary material, or "feedstock category," was screened, to establish diversity in the value chains of the bio-based products and the LSCs that cover these value chains. Finally, the screening returned to review the expert preferences submitted during the 3-CO kick-off meeting dedicated workshop. The finally selected products and their CN chapter, code and description are presented in Table 10.

Table 10: Top 10 of selected bio-based products, their CN chapter, code and description

#	Product	CN chapter	CN code	CN category description
1	Baby clothing	61	6111	Baby garment and clothing accessories, knitted or crocheted
2	T-Shirts	61	6109	T-shirts, singlets and other vests, knitted or crocheted
3	Shampoo	33	3305 10 00	Shampoos
4	Wooden houses (CLT or wooden frame houses)	44	4418 79 00	Engineered structural timber products, cross-laminated timber (CLT or X-lam)
5	Furniture	94	9403 60 10	Wooden furniture of a kind used in the dining room and the living room
6	Cosmetics (make-up, etc.)	33	3304	Beauty or make-up preparations and preparations for the care of the skin (other than medicaments), including sunscreen or suntan preparations; manicure or pedicure preparations
7	Biodegradable plant pots	39	3926 90 97	Other articles of plastics and articles of other materials of headings 3901 to 3914, other, other
8	Biobased plastic toys	95	9503 00 35	Other constructional toys of plastics
9	Bio-based PET/PEF bottles	39	3923 30 10	Carboys, bottles, flasks and similar articles, of a capacity not exceeding two litres
10	Mattress	94	9404 29 90	Mattresses, of other materials, other

The level of specification of the selected bio-based products is expected to be suitable for further assessment of LCSs. 3-CO partners may need to further specify the products for the purpose of consumer research and development of smart solutions, e.g. selecting a specific piece of furniture or a specific biobased toy.

## 5 List of abbreviations

Abbreviation	Description
B2C	Business-to-Consumers
BBPs	Bio-based products
CLT	Cross Laminated Timber
CN	Combined Nomenclature (statistical classification of goods used by EU customs)
DoA	Description of Activities (as found in the 3-CO Grant Agreement)
LCS	Label and Certification Schemes
PC	Project coordinator
PO	Project officer
WP	Work package

## Annex 1: long list of bio-based products and their CN codes

Table 11 and Table 12 show a long list of products that are bio-based, or have potential bio-based alternatives. The darker green, the more relevant, following a further screening of products.

Table 11: Long list of 4-digit CN product categories

3506	Prepared glues and other prepared adhesives, not elsewhere specified or included; products suitable for use as glues or adhesives, put up for retail sale as glues or adhesives, not exceeding a net weight of 1 kg:
3918	Floor coverings of plastics, whether or not self-adhesive, in rolls or in the form of tiles; wall or ceiling coverings of plastics, as defined in note 9 to this chapter:
3922	Baths, shower-baths, sinks, washbasins, bidets, lavatory pans, seats and covers, flushing cisterns and similar sanitary ware, of plastics:
3923	Articles for the conveyance or packing of goods, of plastics; stoppers, lids, caps and other closures, of plastics:
3924	Tableware, kitchenware, other household articles and hygienic or toilet articles, of plastics:
4011	New pneumatic tyres, of rubber
4015	Articles of apparel and clothing accessories (including gloves, mittens and mitts), for all purposes, of vulcanised rubber other than hard rubber:
4405	Wood wool; wood flour
4408	Sheets for veneering (including those obtained by slicing laminated wood), for plywood or for similar laminated wood and other wood, sawn lengthwise, sliced or peeled, whether or not planed, sanded, spliced or end-jointed, of a thickness not exceeding 6 mm:
4409	Wood (including strips and friezes for parquet flooring, not assembled) continuously shaped (tongued, grooved, rebated, chamfered, V-jointed, beaded, moulded, rounded or the like) along any of its edges, ends or faces, whether or not planed, sanded or end-jointed:
4410	Particle board, oriented strand board (OSB) and similar board (for example, waferboard) of wood or other ligneous materials, whether or not agglomerated with resins or other organic binding substances:
4411	Fibreboard of wood or other ligneous materials, whether or not bonded with resins or other organic substances:
4412	Plywood, veneered panels and similar laminated wood:
4414	Wooden frames for paintings, photographs, mirrors or similar objects:
4415	Packing cases, boxes, crates, drums and similar packings, of wood; cable- drums of wood; pallets, box pallets and other load boards, of wood; pallet collars of wood:
4419	Tableware and kitchenware, of wood:
4421	Other articles of wood:
4814	Wallpaper and similar wallcoverings; window transparencies of paper
4817	Envelopes, letter cards, plain postcards and correspondence cards, of paper or paperboard; boxes, pouches, wallets and writing compendiums, of paper or paperboard, containing an assortment of <u>paper stationery</u> :
4818	Toilet paper and similar paper, cellulose wadding or webs of cellulose fibres, of a kind used for household or sanitary purposes, in rolls of a width not exceeding 36 cm, or cut to size or shape; handkerchiefs, cleansing tissues, towels, tablecloths, serviettes,

4819	bedsheets and similar household, sanitary or hospital articles, articles of apparel and clothing accessories, of paper pulp, paper, cellulose wadding or webs of cellulose fibres: Cartons, boxes, cases, bags and other packing containers, of paper, paperboard, cellulose wadding or webs of cellulose fibres; box files, letter trays, and similar articles, of paper or paperboard, of a kind used in offices, shops or the like:
4820	Registers, account books, notebooks, order books, receipt books, letter pads, memorandum pads, diaries and similar articles, exercise books, blotting pads, binders (loose-leaf or other), folders, file covers, manifold business forms, interleaved carbon sets and other articles of stationery, of paper or paperboard; albums for samples or for collections and book covers, of paper or paperboard
4821	Paper or paperboard labels of all kinds, whether or not printed
4901	Printed books, brochures, leaflets and similar printed matter, whether or not in single sheets
4902	Newspapers, journals and periodicals, whether or not illustrated or containing advertising material
4903	Children's picture, drawing or colouring books
4904	Music, printed or in manuscript, whether or not bound or illustrated;
4905	Maps and hydrographic or similar charts of all kinds, including atlases, wall maps, topographical plans and globes, printed:
4906	Plans and drawings for architectural, engineering, industrial, commercial, topographical or similar purposes, being originals drawn by hand; handwritten texts; photographic reproductions on sensitised paper and carbon copies of the foregoing;
4909	Printed or illustrated postcards; printed cards bearing personal greetings, messages or announcements, whether or not illustrated, with or without envelopes or trimmings
4910	Calendars of any kind, printed, including calendar blocks
4911	Other printed matter, including printed pictures and photographs:
6101	Men's or boys' overcoats, car coats, capes, cloaks, anoraks (including ski jackets), windcheaters, wind-jackets and similar articles, knitted or crocheted, other than those of heading 6103
6102	Women's or girls' overcoats, car coats, capes, cloaks, anoraks (including ski jackets), windcheaters, wind-jackets and similar articles, knitted or crocheted, other than those of heading 6104
6103	Men's or boys' suits, ensembles, jackets, blazers, trousers, bib and brace overalls, breeches and shorts (other than swimwear), knitted or crocheted
6104	Women's or girls' suits, ensembles, jackets, blazers, dresses, skirts, divided skirts, trousers, bib and brace overalls, breeches and shorts (other than swimwear), knitted or crocheted
6105	Men's or boys' shirts, knitted or crocheted
6106	Women's or girls' blouses, shirts and shirt-blouses, knitted or crocheted
6107	Men's or boys' underpants, briefs, nightshirts, pyjamas, bathrobes, dressing gowns and similar articles, knitted or crocheted
6108	Women's or girls' slips, petticoats, briefs, panties, nightdresses, pyjamas, négligés, bathrobes, dressing gowns and similar articles, knitted or crocheted
6109	T-shirts, singlets and other vests, knitted or crocheted
6110	Jerseys, pullovers, cardigans, waistcoats and similar articles, knitted or crocheted
6111	Babies' garments and clothing accessories, knitted or crocheted
6112	Tracksuits, ski suits and swimwear, knitted or crocheted
6113	Garments, made up of knitted or crocheted fabrics of heading 5903, 5906 or 5907



6115	Pantyhose, tights, stockings, socks and other hosiery, including graduated compression hosiery (for example, stockings for varicose veins) and footwear without applied soles, knitted or crocheted
6116	Gloves, mittens and mitts, knitted or crocheted
6301	Blanketes and travelling rugs
6403	Footwear with outer soles of rubber, plastics, leather or composition leather and uppers of leather:

Table 12: Overview of products and their 6 to 8 digit CN codes

33051000	Shampoos
48234000	Trays, dishes, plates, cups and the like, of paper or paperboard: Soap and organic surface-active products and preparations, in the form of bars, cakes, molded pieces or shapes, and paper, wadding, felt and nonwovens, impregnated, coated or covered with soap or detergent: —For toilet use (including medicated products)
3401 11 00	
3505 20	Glues, containing x% starches or dextrans or other modified starches
4011 10 00	New pneumatic tyres of rubber, of a kind used on motor cars (including station wagons and racing cars)
4410 11	Particle board
4410 12	Oriented strand board (OSB):
4411 12	MDF of a thickness not exceeding 5 mm
4411 13	Of a thickness exceeding 5 mm but not exceeding 9 mm:
4411 14	Of a thickness exceeding 9 mm:
4419 11 00	Bread boards, chopping boards and similar boards - of bamboo
4419 12 00	Chopsticks - of bamboo
4421 10 00	Cloth hangers
4421 20	Coffins
4503 10 10	Corks and stoppers: Cylindrical
4602 19 10	straw envelopes for bottles
4817 10 00	Envelopes
4817 10 00	toilet paper
5408 10 00	Woven fabrics obtained from high-tenacity yarn of viscose rayon
5601 21 10	Wadding of textile materials and articles thereof -- of cotton - absorbent
5701 10	carpets and other textile floor coverings, knotted of wool or fine animal hair
6302 21 00	Other bedlinen, printed: of cotton
6302 60 00	Toilet linen and kitchen linen, of terry towelling or similar terry fabrics, of cotton
9201 10 10	New upright pianos
9202 90 30	Guitars
9401 31 00	Swivel seats with variable height adjustment: Of wood
9401 41 00	Seats other than garden seats or camping equipment, convertible into beds
9403 30	Wooden furniture of a kind used in offices:
9403 40	Wooden furniture of a kind used in the kitchen:
9403 50 00	Wooden furniture of a kind used in the bedroom
9403 60 10	Wooden furniture of a kind used in the dining room and the living room
9503 00 35	Other constructional toys of plastics



9503 00 61 Puzzles of wood  
9603 21 00 Toothbrushes, including dental-plate brushes  
9603 29 30 Hair brushes  
9404 29 90 Mattresses, of other materials, other  
9608 10 10 Ballpoint pens with ink  
Sanitary towels (pads) and tampons, napkins (diapers), napkin liners and similar  
9619 00 articles, of any material:

## Annex 2: Scoring of the 40 shortlisted bio-based products at the sub-category level

Table 13: Scoring of the 40 shortlisted bio-based products at the sub-category level

#	Product	Market size		Impacts	Purchase frequency and costs for consumers			Consumer recognisability and appeal	
		Current market size (bio-based)(1=low; 3=high)	Possible future growth of the sustainable bio-based market (1=low; 3=high)		Environmental and social benefits compared to the main alternative (1=low; 3=high)	Buying frequency (1 = less than once per 3 years; 3 = more than once a month)	Cost for consumer (1= less than 10 Euro; 3 = more than 100 euro)	Size of buyers' group (small= less than 5%; large=more than 50% of consumers)	Recognisability of the product for consumers
1	Baby clothing	3	3	3	2	2	2	3	3
2	T-Shirts	3	3	3	2	2	3	2	2
3	Table and bed linen	3	3	3	2	2	3	3	1
4	Wooden houses (CLT or wooden frame houses)	2	3	3	1	3	1	3	3
5	Shampoo	2	3	3	2	1	3	3	2
6	Furniture	3	2	2	1	3	3	3	3
7	cosmetics (make-up, etc.)	2	3	2	2	2	2	3	3
8	Kid's clothing	3	3	2	2	2	2	3	2
9	biodegradable plant pots	1	3	3	2	2	2	3	2
10	Biobased plastic toys	1	3	2	2	2	2	3	3
11	Reusable packaging	1	3	3	2	1	3	2	2
12	Biobased packaging	2	3	2	3	1	3	2	2
13	biobased PET/PEF bottles	1	3	2	3	1	3	3	2
14	Mattress	2	2	2	1	3	3	3	2
15	Coffins	2	2	2	1	3	3	3	2
16	Multi-use drinking bottles	1	2	3	1	2	2	3	3
17	Work clothing	3	3	2	2	3	1	2	1
18	Biobased synthetic leather (e.g. apple leather) (wallet)	1	3	2	2	2	1	2	3
19	Non plastic toys: make the category wider (fabric, wood toys)	2	2	2	2	2	1	2	3
20	Block soap	2	2	2	2	1	3	3	1

Table 14: Scoring of the 40 shortlisted bio-based products at the sub-category level (continued)

#	Product	Market size		Impacts	Purchase frequency and costs for consumers			Consumer recognisability and appeal	
		Current market size (bio-based) (1=low; 3=high)	Possible future growth of the sustainable bio-based market (1=low; 3=high)		Environmental and social benefits compared to the main alternative (1=low; 3=high)	Buying frequency (1 = less than once per 3 years; 3 = more than once a month)	Cost for consumer (1= less than 10 Euro; 3 = more than 100 euro)	Size of buyers' group (small= less than 5%; large=more than 50% of consumers)	Recognisability of the product for consumers
21	Household cleaning products (dishwater tabs & liquids)	2	2	2	2	1	3	2	2
22	Sports clothing/textiles from artificial fibres	1	3	2	2	2	2	2	2
23	Biodegradable kitchen& garden waste packaging	2	2	3	2	1	2	2	1
24	Skin care	1	2	2	2	2	2	2	3
25	Biobased lubricants (chainsaw)	2	2	3	2	2	1	2	1
26	Technical clothing	3	3	2	1	3	1	2	1
27	Coffee capsules	1	2	2	3	1	2	3	2
28	Biobased glue	1	2	2	2	2	2	2	2
29	Book	3	2	1	2	2	3	3	1
30	Biobased insulation material	1	3	3	1	3	1	1	1
31	Wooden construction material (particle board, OSB, MDF, etc.)	3	2	2	2	2	2	1	1
32	Rubber tires	3	2	1	1	3	2	3	1
33	Diapers	2	2	1	3	2	2	3	1
34	Biobased paint & coatings	1	2	2	2	2	2	2	1
35	Biobased carpets	1	2	2	1	3	2	2	1
36	Cork (for bottles)	2	2	1	3	1	2	3	1
37	Condoms	1	2	1	2	1	2	3	3
38	Some sports hobby equipment like tennis rack	1	1	1	2	3	2	3	2
39	Wooden Table and kitchenware	1	2	1	2	1	1	2	2
40	Plastic tableware	1	1	1	2	1	2	3	1

## Annex 3: Scoring by household room, consumables/durables, and feedstock

Table 15: The best-scoring products per household room (9 rooms in total)

Room	Product	Score
Babyroom	Baby clothing	54
Bathroom	Shampoo	38
Bedroom	Table and bed linen	42
Cloakroom	T-shirts	42
Garage	Wooden houses (CLT or wooden frame houses)	38
Garden	Biodegradable plant pots	30
Kids room	Kids clothing	30
Kitchen	Reusable packaging	24
Living room	Furniture	35

Table 16: Top 10 best-scoring consumables

#	Product	Score
1	Shampoo	38
2	Cosmetics (make-up, etc.)	30
3	Biodegradable plant pots	30
4	Biobased packaging	23
5	biobased PET/PEF bottles	23
6	Multi-use drinking bottles	23
7	Biodegradable kitchen& garden waste packaging	18
8	Skin care	18
9	Block soap	16
10	Household cleaning products (dishwater tabs & liquids)	16

Table 17: Top 10 best-scoring durable goods

#	Product	Score
1	Baby clothing	54
2	Table and bed linen	42
3	T-Shirts	42
4	Wooden houses (CLT or wooden frame)	38
5	Furniture	35
6	Kid's clothing	30
7	Biobased plastic toys	24
8	Reusable packaging	24
9	Mattress	23
10	Coffins	23

Table 18: The two best-scoring products of each main feedstock category (5 categories in total)

<b>feedstock category</b>	<b>Product</b>	<b>Score</b>
Fibres	Baby clothing	54
Fibres	Table and bed linen	42
Oils and fats	Shampoo	38
Oils and fats	Cosmetics (make-up, etc.)	30
Rubber	Rubber tires	10
Rubber	Condoms	8
Sugar and starch	Biobased plastic toys	24
Sugar and starch	Reusable packaging	24
Wood	Wooden houses (CLT or wooden frame)	38
Wood	Furniture	35