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A circular economy approach for lifecycles of products and services

Interaction in supply chain concerning consumers

Deliverable 1.4

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Summary

Deliverable 1.4 'Interaction in supply chain concerning consumers' is the result of Task 1.4 'Consumer-supply chain interactions' of Work package 1 'Co-creation of products/services.' Task 1.4 aims to involve the interactions between end-users and stakeholders within the supply chains. Furthermore, the manner in which products are created and consumer's needs are accommodated, will be approached through co-creation of products.

Firstly, consumers and stakeholders of the demonstrators are identified, their current interactions in the supply chain are also described. The analysis results show that, clear description of each demonstrator's consumers and stakeholders are essential for circular economy business model development, which offers a system perspective to identify opportunities for improving business performance and reducing environmental impacts, and to understand the underlying drivers, enablers, and barriers to the approaches that are provided by CIRC4Life project.

On the basis of these real-life descriptions of each demonstrator, we utilised the Living Lab approach for a series of development and validation activities for an innovative leasing service of industrial lighting product, recycling solutions for the meat product supply chain, and interacting with consumers for attitudes and understanding on organic vegetables. The data mining approach is used to mining consumer reviews, to improve product design specifications for domestic lighting products and meat products, in order to help business to manufacture more consumer preferred sustainable products.

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Acronyms and abbreviations

Abbreviation	Description
LIA	Lighting Industry Association
CEL	Circular Economy Ltd.
PDS	Product Design Specification
WEEE	Waste Electrical and Electronic Equipment
IARC	International Agency for Research on Cancer
CVD	Cardiovascular Diseases
AGP	Attitudes toward green purchase and recycling
GPB	Green Purchase Behaviour
PBC	Perceived Behavioural Control

Abbreviation	Description
APG	Attitudes towards green purchases and recycling
PCE	Perceived Consumer Effectiveness
GPI	Green Purchase Intention
EoL	End-of-Life
IRTA	Institute of Agrifood Research and Technology

1 Introduction

Sustainable and environmentally sound strategies are key for the long-term success of businesses. Good reputation, consumer loyalty and cost savings are common benefits the implementation of environmental activities brings about. Tougher market competition, globalisation of the economy, changing human and societal values, increasing transparency, and new forms of partnerships between businesses among their consumers, stakeholders are some trends that are expected to further change the playing fields of businesses in the circular economy. In terms of co-creation of products, the shift in environmental policies and consumers' demand for products puts further pressures on business to develop more environmentally friendly and consumer preferred products.

The Task 1.4 aims to involve the interactions between consumers and stakeholders within the supply chain for the five demonstrators. Furthermore, the manner in which products are created and consumer's needs are accommodated, will be approached through co-creation of products.

The results obtained will then be used to form the product specifications and production scope, which will largely reflect consumers' preferences. The product specification and production scope obtained from this Task are then tested by customers and end-user communities specified through the Living Labs. This Task also leads to identification of consumer-supply chain interactions, and a step change in the way in which products are created, produced and consumed which mainly contributes to the Task 1.5.

The activities conducted in this Task include:

- Defining the range of consumer- and end-user groups in the supply chains of the demonstrators.
- Supply chain typologies are described.
- Identifications of actors in supply chains and their relationship to end-users and consumers.
- Assessment of consumers' interactions with producers in the supply chain.
- Applying data mining technologies to mine online consumer reviews, identifying patterns of preferences via online stores.
- A user-group approach is applied to address the end-user's requirements, including end-user workshop, semi-structured interview, user feedback.

This Deliverable 1.4 presents the consumer groups (section 2), supply chain descriptions (section 3), interactions and relation identification for consumer groups (section 4), approaches for the implementation of co-creation of products among end-users, producers and stakeholders in the supply chain (section 5), and conclusions and recommendations (section 6).

2 Define the Consumer Groups in the Supply Chains

In supply chains, the final consumer is the source of value (Fearne, Garcia Martinez and Dent, 2012). In the marketplace, consumer perceptions of value are transformed into demand for a product or service. This demand then flows from the consumer towards the primary business actors in the flow of supply chain. For consumers, value is considered in the context of individual or collective utility, whereas for the other actors, value is measured in financial returns derived from the demand flow (Soosay, Fearne and Dent, 2012).

Supply chains are principally concerned with creation or maintenance of value, typically through innovation in the chain and/or the development of demand (Jüttner, Christopher and Baker, 2007). Innovation can create cost efficiencies and/or enhanced products and services, which translate into higher value or more competitive pricing. Successful and sustainable supply chains provide value to both consumers and chain actors. Meeting the requirements of circular economy context, it is firstly needed to identify the major consumer groups for each demonstrator in CIRC4Life project.

It is also necessary to clarify the company nature in order to provide an overview that there are distinguished differences for consumer groups from different business. One common way to classify companies is to differentiate between B2C (business-to-consumer) and B2B (Business-to-business) activities. In B2C activities, companies sell products to the end customer. On the other hand, B2B companies do not sell their products to the end customer directly. Instead, they sell to other companies, institutions, or organisations and therefore conduct business with other businesses. Hence, CIRC4Life business companies can be classified as:

- B2B: KOS (industrial lighting), IND (recycled tablets)
- B2C: ONA (domestic lighting), ALIA (meat products), JS (organic vegetables)

2.1 B2B business

Since B2B customers are more knowledgeable, require more information and the products or services are more complex, the involvement and complexity of the purchasing process require different communications than when dealing with consumers directly, which is one of the key differences between B2B and B2C consumer groups.

2.1.1 Industrial Lighting

Warehouse and shop owners: They expect the maximum value (best lighting result) with the minimum possible cost. They also expect that the lighting installation will be easily maintained, while it will be cost effective and low energy consuming. In addition, this type of consumer wants to ensure the longevity and safety of the installation, so that end users do not notice problems. Thus, they are interested in the lifetime of lighting products, the warranty provided by lighting manufacturers, the colour consistency between products, the availability of spare parts.

Industrial lighting installers (electricians) and lighting wholesalers: They usually are small companies, and their operations are integrated into the holding company's network. Their procurement and sales strategies cannot be conceived and conducted independently, and possibly locally. They are part of the network of supplier and buyer relationships of the holding company.

2.1.2 Recycled Tablets

The Waste Framework Directive defines ‘re-use’ as any operation by which products or components that are not waste are used again for the same purpose for which they were conceived. On the other hand, ‘preparation for re-use’ is described as checking, cleaning or repairing operations, by which products or

components of products that have become waste are prepared so that they can be re-used without any other pre-processing.

Regarding consumer group for the recycled tablets, it is necessary to point out that it is a low implementation process for electronic tablets throughout the EU. Currently, no electronic tablet reuse line works on its own, and its development happens hand in hand with:

- non-governmental organisations and/or social inclusion organisations: products usually donated by other users are offered for sale in second-hand stores located in cities, with common citizens as consumers. The process may have doubts regarding data protection. They usually also reuse other types of products (textiles, furniture), etc.
- Large distributors of new electronic products admit usually high-level tablets for repairing and reuse. They ship second-hand tablets on websites.
- Shops associated with collecting and/or recycling WEEE companies. Reusing is specifically possible when a big company or an exhibition fair disposes of significant quantities of tablets with a short period of use. Potential consumers are still common citizens.

2.2 B2C business

2.2.1 Domestic Lighting

The sales of the products are carried out through ONA's online shop. This shop provides products and services that are available for a wide range of consumers. Based on the operation experience of online customer services, three type of consumer groups can be described as:

- **Sustainable consumers**: they are usually familiar with the energy consumption, understand the various energy labels, and very clear the what kind of lumen range they look for, to fit the environmental where the product will be installed.
- **Aesthetic oriented consumers**: they are usually designers/architects, or consumers with design and interior interests. The designers/architects usually look for lightings for hotels and restaurants. Additionally, some consumers interest in products that are carefully designed, and think the product not only as a lighting source but also as a decoration. They are usually don't mind spending money if they like the product and its added value to the design of their home.
- **Price sensitive consumers**: they usually like conduct search for price comparison shopping, they have a broad sense for the price range of one or a few type lighting products. Additionally, they like to review previous customers' online comments, to see if the product was on sale before, and ask the same price through consumer services, even the product price is increased already.

2.2.2 Meat Products

European diets are characterised by a high intake of meat products, so its consumption is spread among the different population sectors and not just focused on one specific group. However, it is possible to study some differences between the whole variety of consumers. In the case of ALIA, the responsible partner for the demonstrator in the meat supply chain, the sales of their meat products are carried out in local shops, butcheries and big supermarkets. The products are available for a wide range of individual consumers.

Regarding the study of the different food consumption profiles, it is possible to differentiate between two main consumer groups: the sustainable consumers, those who are interested in the sustainability of food products because of different reasons, and non-sustainable consumers, those who are not interested in it.

Recent Eurobarometer research has shown that majority of EU citizens would be willing to pay more for green products, i.e. 37% respondents would be willing to pay 5% more, 28% respondents would be willing to pay 6-

10% more, 7% respondents would be willing to pay 11-20% more, 5% respondents would be willing to pay more than 20% extra, if they are confident that they are environmentally friendly (TNS Political & Social-European Commission, 2013). Furthermore, the EU's organic food market sales have increased from €20.8 billion in 2012 to €30.7 billion in 2016 and organic farmland has grown from 10,047,896 hectares in 2012 to 11,931,589 hectares in 2016, which equates increases of 47.7% and 18.7% respectively (European Parliament, 2018). This is clear evidence that consumers in the EU increasingly care more about the environmental impacts of the food they eat. This group could be described as 'sustainable consumers.'

In Spain, where the demonstration of the meat sector will be developed, sustainable consumers represent 29% of population. No gender relevance is observed. Mean age of sustainable consumer is 43.7 years old. Ecologic products represent 28% of their shopping basket and 25% of them consume these products on a daily basis. People's level of education seems to be one of the most relevant variables to identify sustainable consumers. The higher the level to which they study, the more access to information of environmental issues and more likely they are to want to be a part of the solution (Spanish Ministry of Agriculture, food and Environment, in collaboration with GFK, 2016).

Moreover, if we focus on the sustainable consumers, it is possible to differentiate between four main types consumer groups according to the reasons why they have these sustainable habits and which all of them should be considered. The four groups are described below:

- Ecologist: they are worried about the environment and try to follow responsible life and consumption habits. They acquire mostly locally produced products.
- Not implicated: acquires sustainable products because it is trendy. They are younger than the mean, their sustainable consumption is concentrated in hyper and supermarkets.
- Convinced: follows an environmentally respectful lifestyle. They are older than the mean, are used to buying sustainable products and they acquire them mostly in specialised stores.
- Healthy: they buy sustainable products because there are healthier, or 'free of'.

In addition, as some studies revealed (AECOC SHOPPERVIEW, 2018), nowadays there is a constant decrease in meat consumption, promoted, mainly, by social pressure and changes in consumer's lifestyles. In this scenario it is also possible to find lots of consumers who would like to consume meat again without regretting it, without thinking they are damaging the environment, eating more additives than desired or decreasing animal welfare.

In the EU, meat consumption is expected to gradually decline from 69.3 kg to 68.7 kg per capita per year in the period 2018-2030 and it is expected that this decreasing tendency will continue, especially in the EU-15, where this decreased in meat consumption is higher than in the rest of the countries (EC, 2018).

Besides, there is no doubt that, when analysing the different types of consumer of meat products, we must consider the increase of the European population with vegetarian and vegan habits (EDJNet, 2019), which definitely offer a challenge for the meat sector and will force companies to change their current processes.

2.2.3 Organic Vegetable Products

Scilly Organics is a sister business to Jonathan Smith Consulting (JS), which is a small organic fruit and vegetable farm based on the Isles of Scilly, UK. This is the industry partner in CIRC4Life for vegetable products. It is an example of a small farm producing fresh vegetables to local markets.

Consumers of these products are split in to two groups:

- Public – direct sales to both locals (who live on the island) and tourists on holiday on the island.

- Restaurants and cafes – supply of five businesses across three islands, producing meals for (mostly) tourists.

The types of consumers that make up the 'public' consumers is somewhat unclear. The motivations for buying product from Scilly Organics could include:

- Price
- Availability
- Freshness
- Local origin
- Organic

As an assessment of market trends, it is clear that there is a growth market in products with strong ethical (environmental and social) credentials seeing large increases in sales. The ethical food and drink market in the UK are worth over £11bn in 2017, with annual growth rates in excess of 16%. Organic products alone are worth over £2bn in the UK in 2018, with growth rates of over 10% (Ethical Consumer Research Asssociation, 2018).

The types of business customers are all SME's that are all very small business with just one business premises/outlet. These are restaurants and cafes that serve food and drinks to tourists on the Isles of Scilly during the tourist season from April to October.

3 Supply Chain Descriptions and Interactions for CIRC4Life Demonstrators

3.1 Overview of standardised supply chain

Supply chains are often referred to as systems. In its broadest sense, a system is a bounded entity or process comprised of two or more interrelated and interdependent components. The systems view of supply chains considers each chain actor as embedded within a series of interdependent vertical and horizontal relations (Da Silva and de Souza Filho, 2007). This perspective acknowledges that an actor's operational success is linked to the performance of other actors and the broader social and environmental context (Humphrey, 2005) and recognises that narrowly examining specific actors, activities, or institutions in isolation limits the ability to understand the various factors influencing their performance.

Supply chain analysis refers to the broad method of investigating the whole chain from a systems perspective to identify opportunities for improving performance. It is inherently inter-sectoral and requires the participation of a range of stakeholders. In this Deliverable, supply chain description and analysis are about understanding the underlying drivers, enablers, and barriers to particular behaviour in a chain. A standardised supply chain diagram describing lighting, electric and electronic, vegetable and meat sector is illustrated in Figure 3.1, in order to provide an overview of the key actors, common recycling and reuse practices in a circular economy context. However, there are some differences and features for supply chain interactions in these sectors, depending on the business model, company size, and regional legislation, which are detailed from each CIRC4Life demonstrator perspective in section 3.3 -3.6.

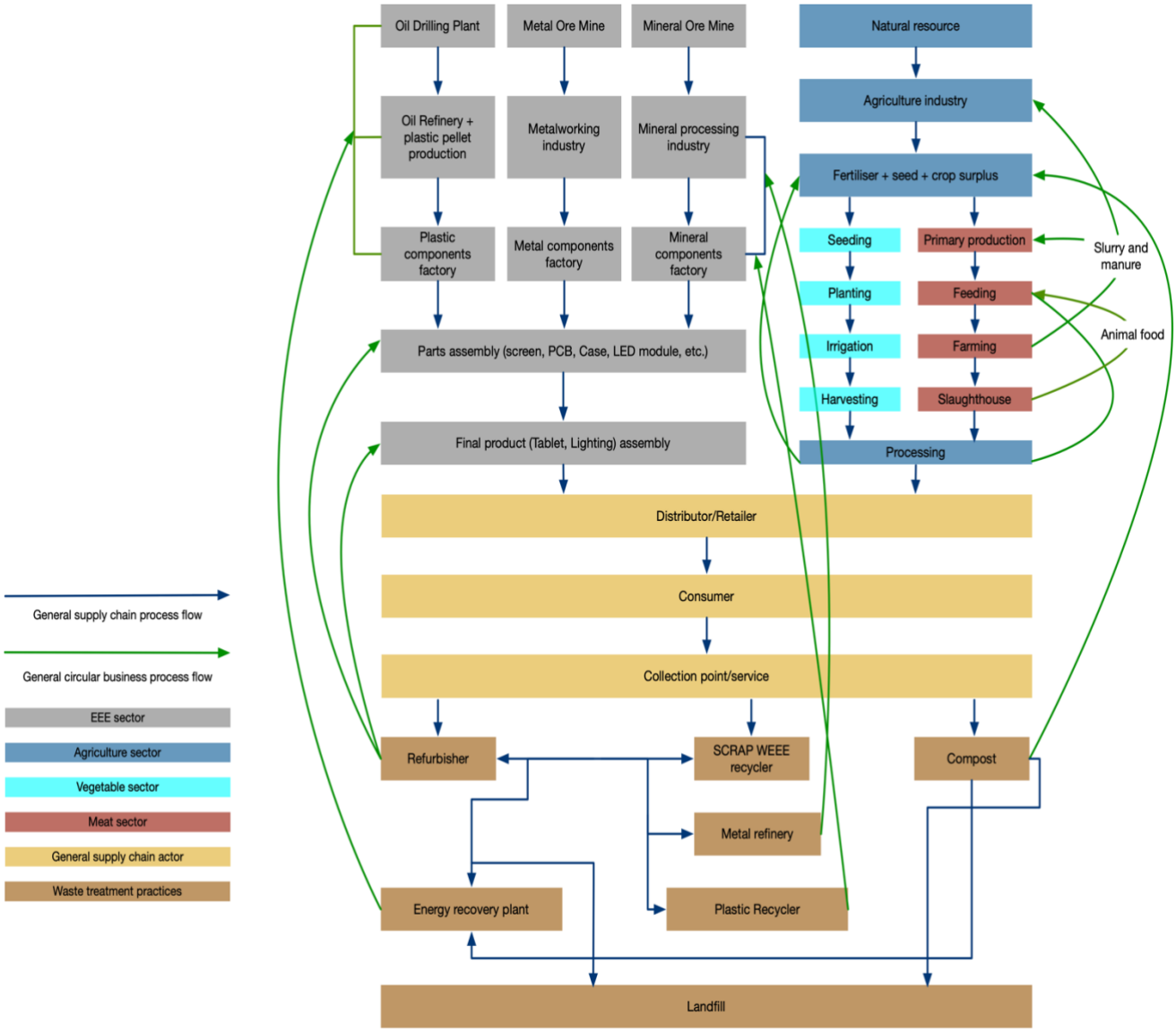


Figure 3.1 Schematic illustration of standardised supply chain for CIRC4Life demonstrator sectors in circular economy

3.2 CIRC4Life approach for interacting supply chains

The approach of interacting supply chains acknowledges that an actor‘s operational success is linked to the performance of other actors and the broader social and environmental context (Humphrey, 2005). Further, this broad sense proposes that because of the complex nature of the chain, there are places in the chain where a small change can have important consequences on everything (Hawkes, 2009). Current interactions for each demonstrator in CIRC4Life project are reported in the following sections, in order to identify business opportunities in supply chains, and barriers for solutions proposed by the project.

The CIRC4Life approach for interaction with end-users/consumers in the supply chain is shown in Figure 3.2.

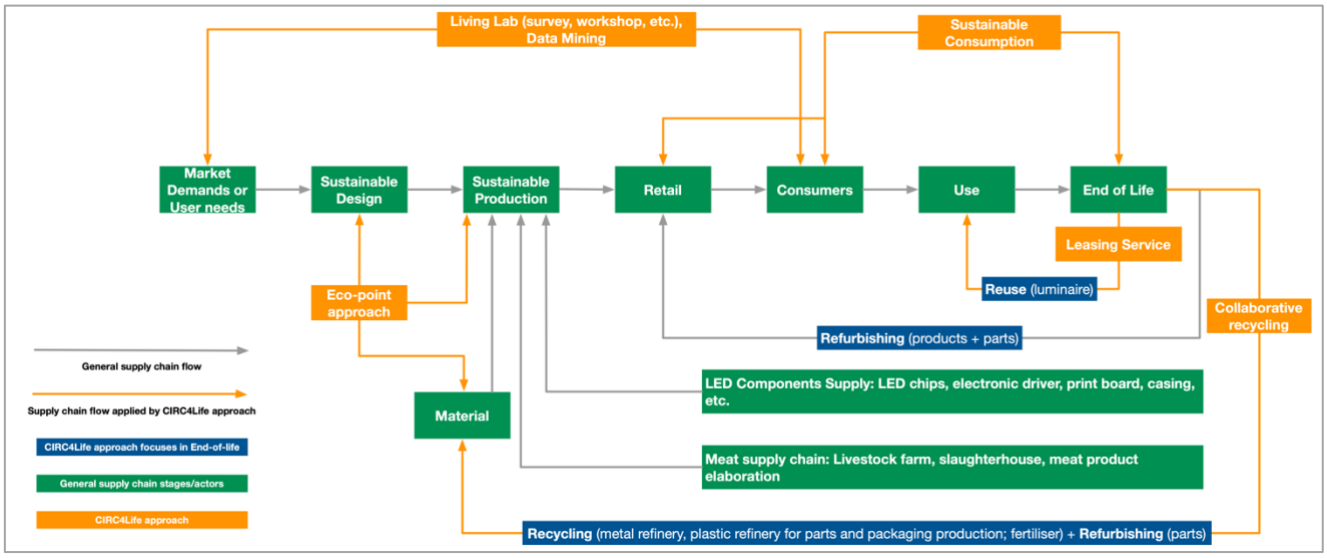


Figure 3.2 Schematic Approach for interacting supply chains

As shown in Figure 3.2, throughout the product supply chain, various actors are involved. In comparison with traditional approaches, CIRC4Life project has the following advanced features:

- Brings consumers closer to the beginning of the product development, which is achieved via co-creation activities with the means of Living Lab established in Work Package 7, online data mining method (T3.5), sustainable consumption tools (T3.1, T3.3).
- End-users/consumers are promoted/encouraged with sustainable consumption and collaborative recycling, with particular concern in the product use and EoL (end-of-life) stages to reduce the waste and improve the recycling and reuse performance by applying the tools and services developed in the project.
- Sustainable design and production are applied, with consideration to reduce the environmental and eco-points of the products, leasing services, together with other sustainable methods.

Current interactions for each demonstrator in CIRC4Life project are analysed in the following sections, in order to identify business opportunities in supply chains, and barriers for solutions proposed by the project.

3.3 LED Lighting

3.3.1 Industrial Lighting

The KOS supply chain is depicted in Figure 3.3. KOS's customers are mainly businesses which are described in section 2.1.1. The sales of KOS rely on the channel of the wholesale.

To implement the co-creation of products model, living lab methods will be applied to Identifying customer needs for selected B2B target groups, including such as end-user and key stakeholder workshop, semi-structured interview, user feedback via the customer service and product Website, and survey. Sustainable techniques developed by the project will be applied in the production of industrial lights, including eco-accounting, and sustainable design and manufacture.

With Collaborative Recycling/Reuse model, KOS aims to develop a leasing service for industrial LED lighting products, which is a solution not just a physical product. The whole solution package will enable businesses users to benefit from energy saving, productivity, flexible and financially beneficial for the end user. Additionally, the whole supply chain actors, e.g. manufacturer and maintenance contractors, will also be linked and be profitable. In this service, Kosnic with its partners will look after the lights throughout their

product life time, provide regular maintenance service to enable the product's performance, and take-back the products when it reaches the end of life (EoL), then the recycling, reuse and refurbish will be implemented with those EoL products. Those products with good conditions are usually cleaned and refurbished to other leasing service package or sold to wholesales with lower prices; for those products that are not repairable, are disposed by hired WEEE compliant recycling & collection service.

With the sustainable consumption model, the module design structure will be applied to make the faulty or end-of-life components easily be replaced or repaired at the use stage and, hence, to extend the product service life. Necessary information will be provided for the users to select more sustainable products, and, in particular, the product sustainability indicator, eco-points of the products, will be available for the user to make a purchase decision. Instructions will be provided to the users for sustainable consumption of the products (e.g. energy saving, longer service life).

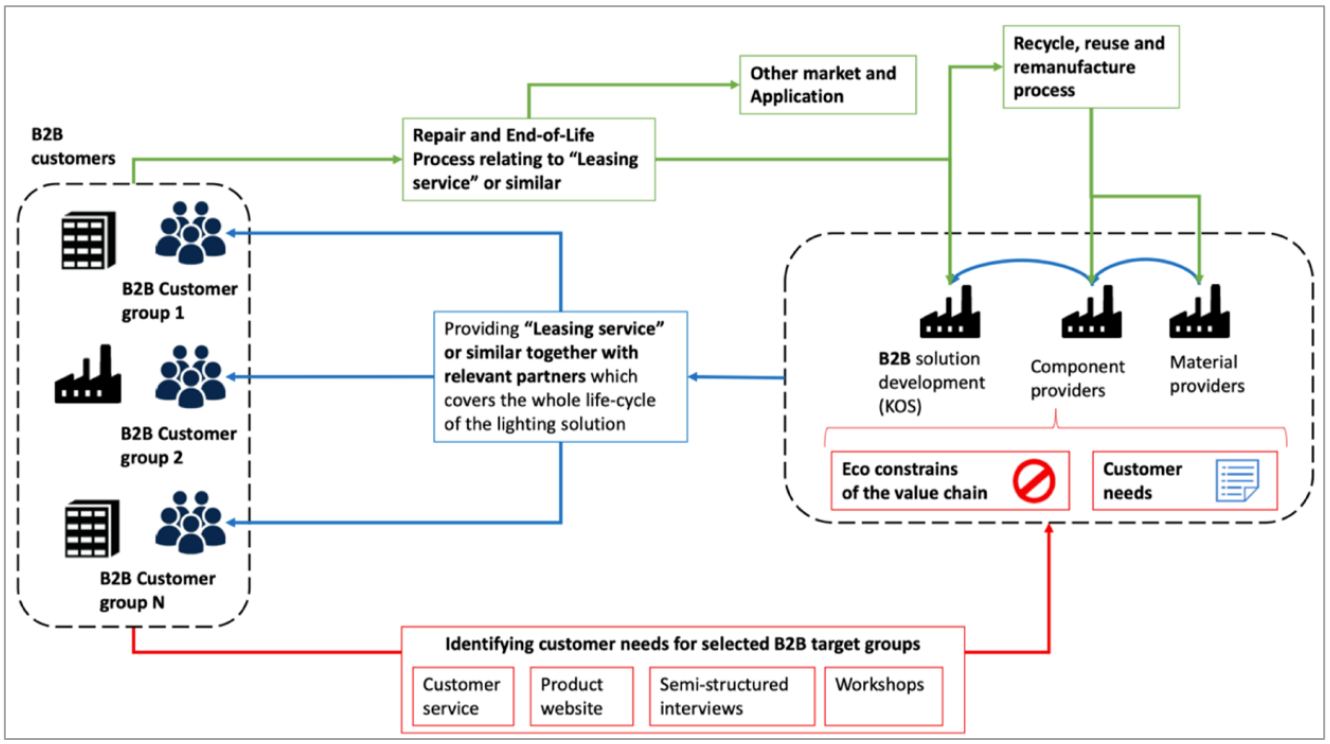


Figure 3.3 Schematic illustration of KOS supply chain

3.3.2 Domestic Lighting

Given that ONA lighting products are sold through their online store we count with and extended network in relation to consumers and supply chain actors (see Figure 3.4).

ONA apply the big data technique developed in the project to mine consumer preferences via large volumes of light products' reviews and comments through their own website. The findings are validated by Living Lab events, then applied into the sustainable production from the perspective of design for recycling.

ONA commercialise the luminaire via its on-line shop. Consumer will have access to all the eco-information related to the product which provide valuable input to help consumers on their sustainable purchase decisions. The consumer can decide the best choice based on their preferences, and once the product is sold online it will be sent to the consumer directly.

Collaborative recycling will be applied by extending the lighting products recycling practices to consumers, enabling consumers to separate and recycle the products via logistic recycling in which customer can recycle their products by sending them back to collection points or contacting the ONA for collection. ONA will also recycle these products by sending them to the recycling companies. Then, the recyclers will separate the materials they consider appropriate to have a second life or can be recycled or re-used.

Recycling process will record the recycled product's eco-credits into the consumer's eco-account (by registering in ONA online store). The recycling centre will sort out end of life products and will send the components with working condition to the manufacturer to be incorporated in the production of new lights.

The actors of our demonstrator in the supply chain are:

- The suppliers of the materials that have been chosen in the design of the product.
- The online store where the products will be sold.
- The logistics that will distribute the products.
- ONA as a business were all of the employees have an assigned function to make everything possible in the supply chain.
- Then, the commercial work of the ONA department carried out by email or phone where users can contact us to learn about our products, to resolve questions or incidents.

The relationship that exists among consumers is through the online store and as we have indicated previously this relation is also through email or telephone.

The consumer can also be informed through internet about certain technical aspects of the materials, technical specifications of the light bulbs that the lamps carry or about ONA as a brand and a company. Another source used by the users these days is social media (e.g. Instagram, Twitter) where the consumer can interface with the brand/company or check comments and opinions from the products from other users.

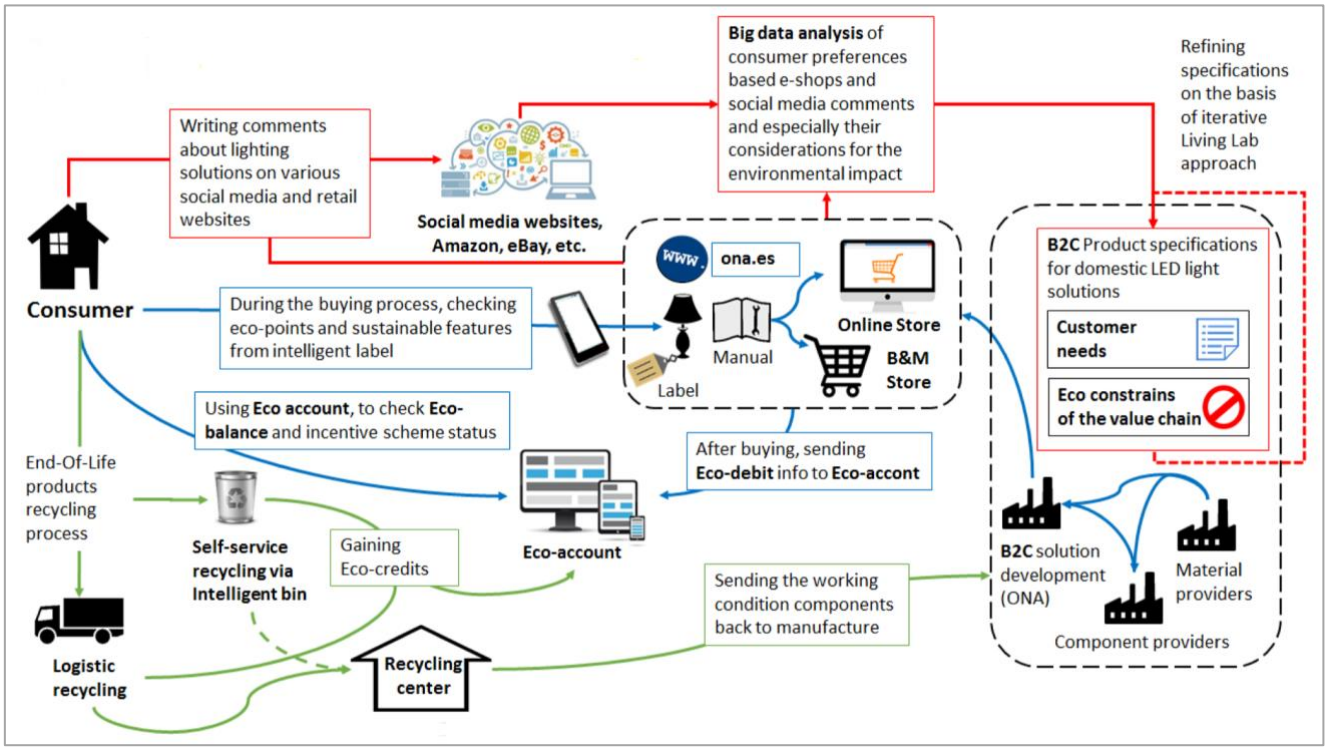


Figure 3.4 Schematic illustration of ONA supply chain

3.4 Recycled Tablets

IND is a specialised industry in the integral handling of WEEE (Waste Electrical and Electronic Equipment) and complex scrap, including logistic services, onsite dismantling of industrial facilities and decontamination and recycling. IND has different consumer groups that are able to apply the three circular business models developed in CIRC4Life project (see Figure 3.5):

- Co-creation: tablet users, academia, producers, designers, retailers, repairers, eBay, Financial Sector, Influencers, Media, EU researchers.
- Collaborative recycling and reuse: eBay, Schools, Second-hand Stores, Stores, Recycling Centres, Repair Shops, Logistic Service Providers, Logistics Hubs, Public Sector, EU regulators, Local Authorities, NGOs, Social Companies, Media, Influencers, Bloggers, Collective Schemes, Public places (libraries…), Tablet Users.
- Sustainable Consumption: Local Authorities, tablet users, second-hand markets, schools, Stores, Influencers, designers, Media, EU Regulators, Logistics companies.

A survey approach collecting consumer's needs, particularly the needs from the environmental perspective will be applied. The developed survey also has been implemented by the favour of integrating into the survey conducted in Task 3.6 (Consumer satisfaction survey, M13-M18). Approx. 400 responses have been received as reported in the Deliverable 3.4 submitted M18 (October 2019). The survey results will be further analysed in Task 6.3 (M19 – M33) to investigate the consumer needs for supporting co-creation process for OEM, which will be reported in the linked Deliverable 6.2 (M33).

The project includes a heavy workload in educational institutions, as a source of information for stakeholders (due to the increasing use of electronic tablets in schools), and as potential mass end users of reused tablets. The information of users of interest will be transferred to the co-creation process as well.

It has to noted that IND and REC are re not producers neither manufacturers, and because of this there is no LCA implementation and no manufacturing of new tablet products as in the other Demos. So, OEMs were not expected to be involved in the co-creation process, but they are expected to receive useful information from the survey analysis results.

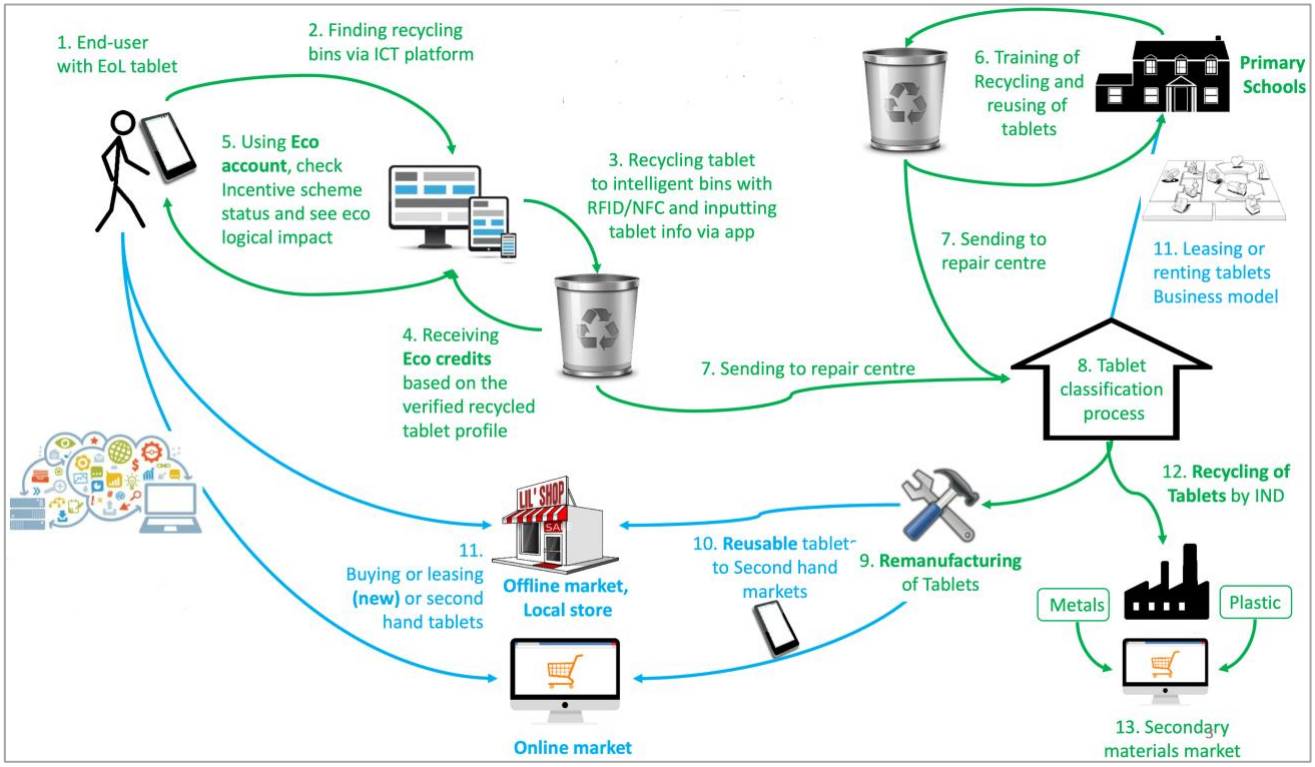


Figure 3.5 Schematic illustration of IND supply chain

3.5 Organic Vegetables

Supply chains of the vegetable sector vary based on the product type, market size and processing level. according to the product, market and level of processing, but the vegetable product supply chain can be generally classified into the following stages:

- **Production**: includes the growth of vegetables, involving all stages of production up to harvest of vegetable crops.
- **Processing**: On a simple level this could include trimming, packaging and refrigeration of vegetables to make them a marketable product. This is often carried out 'in house' by the growers on their farm. A secondary level of processing can take place which turns the basic product from the field into a different product. Examples include potato chips, carrot sticks, diced cabbage, coleslaw, prepared salads, etc. This processing could be carried out at dedicated sites on larger farms, or at separate regional or national processing businesses.
- **Distribution**: The distribution stage consists of road transport by van or lorry (either of which could be refrigerated) from farm to point of sale, perhaps via various processing centres. Supermarket distribution is usually via regional hubs of the supermarket in question, and then perhaps to a further distribution centre, before delivery to the supermarket. When talking about long distance distribution, ships and trains are involved in this stage as well.
- **Retail**: The final link in the chain is the point of sale before the consumer buys the product. Supermarkets can control the process right from leaving the farm through to point of sale, so definition of specific scoping boundaries need clarifying when assessing such systems.

- **Waste management**: At all stages through the supply chain, waste management is an important element. Waste products fall in to organic and inorganic categories. Inorganic wastes such as plastics, paper and metals are handled by waste management and recycling companies; Organic wastes produced at farm level would usually be composted on the farm. The waste from processing could either be taken back to farms for composting or sent to green waste management companies. Organic wastes from distribution and retail (by which time products can be processed and have packaging), are more difficult to deal with. These products could be sent to green waste composting, anaerobic digestion, energy from waste, or landfill.

In the example of vegetable products from Scilly Organics, the supply chains are very short, which is a good example of a local farm model (see Figure 3.6). In this model, there is no processing stage, because vegetables are prepared and packed on farm. Most vegetables are sold in their natural state, whereas some products, like mixed salad leaves, are cut, mixed and bagged before being sold. This involves minimal processing.

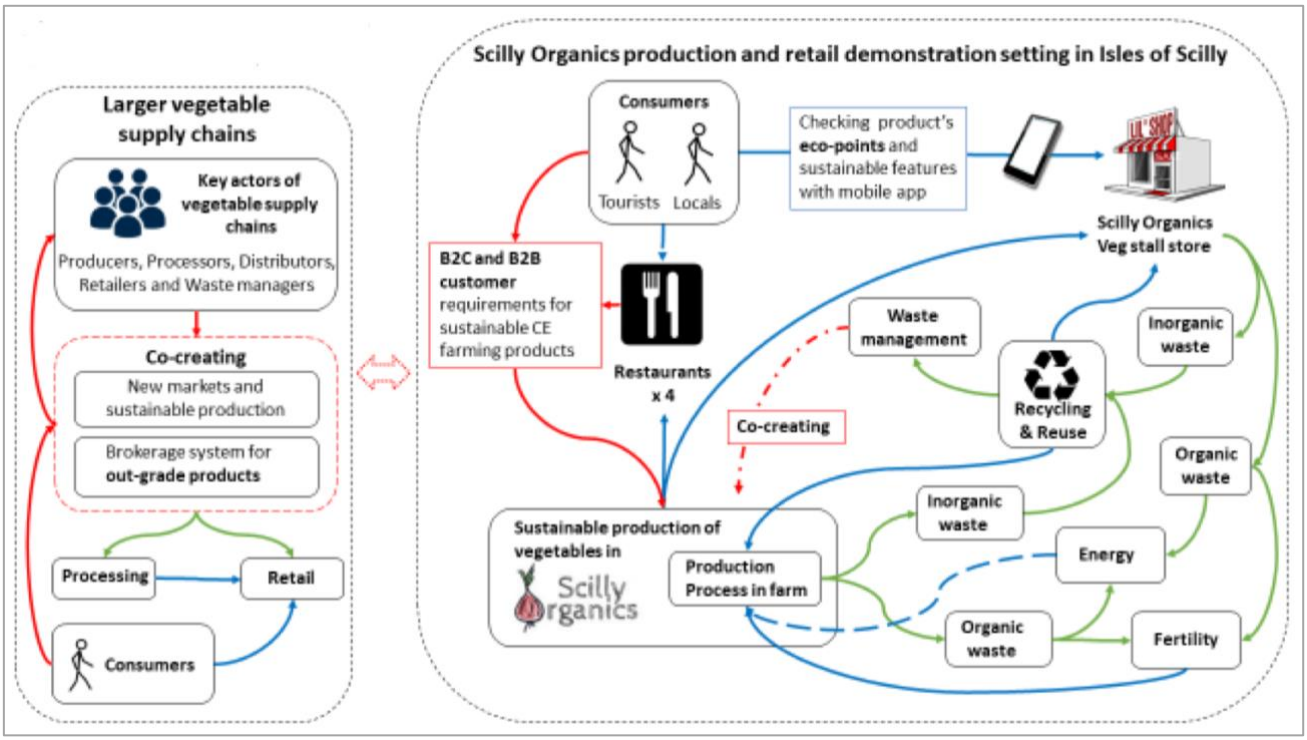


Figure 3.6 Schematic illustration of vegetable supply chain

Then, the distribution is carried out by the farm business to individuals. Vans or any other means of transport may be used in order to distribute the products. Furthermore, sometimes the end-consumer is the one who directly buys the products at this farm.

The customers for this business are all based on the group of islands where the farm is situated, the Isles of Scilly. There are five inhabited islands, comprised of St Mary's (the largest), Tresco, St Martin's, Bryher and St Agnes.

Waste management is applicable at all stages. Organic wastes may be directly used for compost for the farm itself together with compostable packaging. Products outbounds may be used with the same purpose or for the development of new food products such as juices or jam, whether in the farm or in other company. Other wastes are usually managed in the waste management system of the municipality. Bio-waste can be used in innovative development as the production of organic fertilizers or as food for insects, which are used as a source of proteins in the animal feeding stage.

During the CIRC4Life Demonstration, the actors in the supply chain for organic vegetables fall in to three CEBM models:

1) **Direct sales to consumers:**
    - Scilly Organics (producer).
    - Consumer supplied direct.
    - Relationship is either informal or unknown. Contact details of the business are on Scilly Organics website. Meetings with customers do happen on a regular basis.
    - Any residents of St Martin's buying products will be personally known by the farmer, Jonathan Smith as the island only has around 150 permanent residents.
    - Tourist customers will be less known; however direct interaction with them is often made on an informal basis.
    - No regular or formalised feedback mechanism currently exists between consumers and the farm business.
2) **Sales to St Martin's based pub and hotel:**
    - Scilly Organics (producer).
    - Seven Stones Inn (pub).
    - Karma St Martin's (hotel).
    - Consumer.

The relationship between Scilly Organics and pub/hotel is a direct link to the chef(s) and/or owner of the catering outlet. Regular feedback is established, and good communication exists.

No direct contact is made with the customers of the pub or hotel and no feedback mechanisms exist. However, the CIRC4Life consumer surveys will help to capture some of their views to recycling, reuse and food purchasing decisions.

3) **Sales to St Mary's and St Agnes cafes**
    - Scilly Organics (producer)
    - Isles of Scilly Steamship Co (freight boat company)
    - Courier (for St Mary's customers)
    - Cafe
    - Consumer

As above, direct contact is made regularly between Scilly Organics and each cafe. Some direct contact is made with the freight boat and/or courier but is not considered particularly important unless problems with deliveries occur. No direct contact is made with customers of the cafes.

Methods of interaction consist of:

- Consumers – face to face interaction, phone calls, emails, Instagram.
- Business customers – phone calls, emails.

Furthermore, the CIRC4Life surveys with business customers will establish more formal communication and feedback mechanism between Scilly Organics and the business customers.

3.6 Meat Product Supply Chain

The meat sector involves six main stages to be considered along the whole supply chain (see Figure 3.7). ALIA is one of examples of a big group. ALIA owns the livestock feed production plant, the livestock farm and the meat elaborate plant, and also participates in the slaughterhouse together with other companies.

- Primary production.
- Livestock feed manufacturer.
- Livestock farm.
- Slaughterhouse.
- Meat elaborates.
- Distribution and selling point.

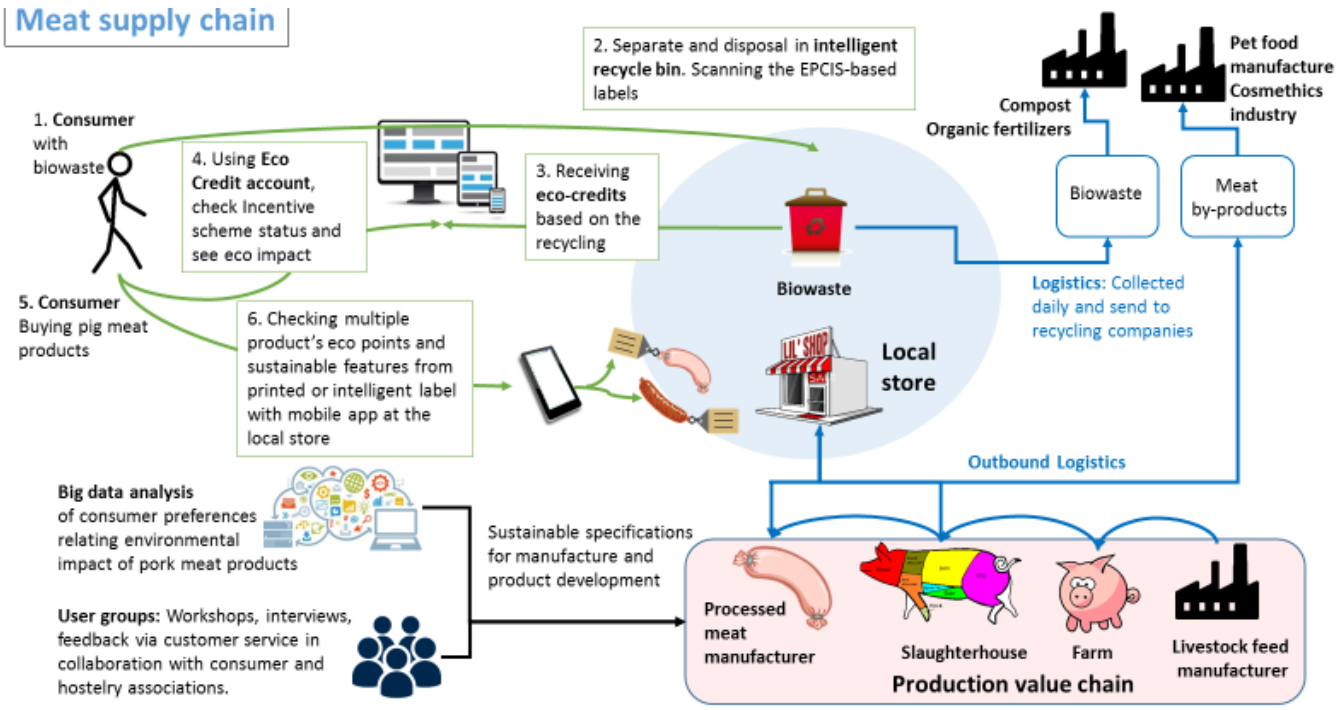


Figure 3.7 Schematic illustration of meat product supply chain

The meat sector involves all the stages mentioned above stages along the supply chain, and, although they are all connected and each one is needed for the next process, there are some substantial differences on how companies are organised and how the stages along the supply chain are covered.

There are two main different types of production system:

- Big groups which integrate more than one stage of the supply chain. Usually these groups integrate the livestock feed production, farms and meat elaborates plant. Furthermore, they may own the slaughterhouse stage or take part on it.
- Small companies which just integrate one stage of the supply chain.

During the last years, there is a clear tendency in which the evolution of the meat sector is integrating the whole process in big groups, especially in pork and poultry sector (Ministry of Agriculture, Fishing and Food, 2003). The small companies are being integrated in bigger groups or they are joining to others in a cooperative structure.

This new situation also offers new trade relationships between these big groups and the retailers or suppliers. In this direction, they have contractual agreements with suppliers, not for short periods of times and for the development of specific products in a concrete situation, but for a large variety of processes, products and also for long periods of time. Furthermore, these big companies have contractual agreements with big retailers' groups in order to offer their products which may include exclusivity clauses so the retailer point can just offer certain products of certain companies.

Considering all these aspects it is stated that big groups have main competitive advantages on the sector and this tendency will continue in the next years.

Along the different stages of the meat supply chain there is no direct interaction with the consumer groups. The end consumer just interacts directly in the last stage, the selling point, and occasionally in the meat elaborates stage through different activities, as participating in gastronomic fairs or tastings, in which the end-user can have big influence in the way the final appearance, flavour or any other aspect of the products will be developed. Another way of participating directly in this process is through comments in online shops, although for food products this is not so widespread as in others kind of products as electronic devices.

However, there is something that must be considered when analysing the interaction of consumers within the whole process. As we have mention in section 2.2.2, society has changed its behaviour in the past few decades. We are currently living in a moment in which sustainable aspects are considered as more important than ever in different activity sectors. One of these aspects is, without a doubt, the food sector and, particularly, the meat supply chain.

Some of the main aspects why people are changing their attitudes towards the meat sector are described as follows:

- Health issues: the European diet includes high intake of meat products and the decrease of it is sometimes associated with health issues.

The International Agency for Research on Cancer (IARC), published a study which related high levels of consumption of red and processed meat are associated with an increased risk of colorectal cancer (IARC, 2018). In addition, significant health benefits are expected to result from a lower intake of saturated fats and red meat, as diets rich in saturated fats are associated with an increased risk of cardiovascular diseases (CVD) and stroke. According to the World Health Organization, in the European region, currently, around 25% of total mortality can be attributed to CVD and 15% to stroke, in total about 3.8 million deaths, annually (Westhoek *et al.*, 2014). All this makes people think about the health consequences of eating meat regularly, especially red and processed meat.

In addition, nowadays there is a commonly held view between the European population that meat products contain too much artificial components such as hormones, artificial additives and antibiotics, which may make products less healthy than they used to be in the past.

- Environmental problems: the meat sector has a huge impact on the environment.

The change of dietary habits considering above all the reduction of meat waste may contribute to the reduction of the global greenhouse emissions (Westhoek *et al.*, 2014). This is why people concerned about environmental issues may decrease their meat consumption or may demand changes in the sector in order to make meat products eco-friendlier. In addition, livestock is the world's largest user of land resources, with grazing land and cropland dedicated to the production of feed representing almost 80 % of all agricultural land. Feed crops are grown in one-third of total cropland, while the total land area occupied by pasture is equivalent to 26 % of the ice-free terrestrial surface (FAO, 2019). Pig feed (e.g. wheat, feed, barley and soybean meal) contributes the most to the carbon footprint of pig farming. Protein sources can include soy – which has been linked to forest habitat destruction in the Cerrado and Amazon ecoregions in Brazil (Asher,

2019)(Fearnside, 2001). Other less significant but still important sources of GHGs on farm are those arising from manure management and the use of energy in livestock housing. The water consumption due to its use in cleaning & sterilisation in the meat production is higher than other types of food products as well. Big amounts of wastes and by-products are generated nevertheless they can be used to produce higher value products.

- Animal welfare: traditional farming used to be significantly different than the one we have become accustomed to in the last decades, which has changed the way animals are fed and how they live.

If some decades ago animals were free in the countryside, now, they live indoors, and they do not have plenty of free space to live. Equally, they are grown faster, and their period of life is shorter.

Intensive livestock farming is one of the key reasons why the society awareness about these aspects has increased. Although intensive practices have some clear advantages, livestock sector supports the livelihoods and food security of almost a 1.3 billion people (IARC, 2018) and for that intensive practices have played a major role, it has also important disadvantages in relation to health, environmental and animal welfare issues. This is supported by different research studies, in which is studied its disproportionate contribution to the environmental cost of agriculture (Leip *et al.*, 2010), through resource use including water, soil, air and biodiversity, the environmental impacts of its waste (Tilman *et al.*, 2002), or that the efficiency gains through intensification may result in animal rights and welfare concerns (Austin *et al.*, 2005).

These three main aspects summarise some topics on how people could influence the meat supply chain. In fact, all these aspects are being considered and have vital importance in order to plan the further development and evolution of the sector. From primary production, to the distribution and selling point, companies should adapt their habits and methods in order to satisfy consumer requirements. Society awareness about all of this has significantly grown during the last years and will continue as it in the future. This can be shown as a threat for the meat sector (actually it is for some kind of companies), but it can also be shown as an opportunity for the adaptation of processes in the different stages of the meat supply chain and for the development of a more sustainable activity.

In this adaptation, the different kind of consumers should be considered, as all of them may have an influence on the satisfactory evolution of the sector, but pressure groups related to ecological and healthiness groups or associations may have a particular importance on it, as they develop awareness actions for the society and they also translate the citizenship feelings and attitudes into concrete proposals and petitions.

Once some of the main aspects which may influence the meat sector because of the society pressure and awareness, it is important to remark that meat products will continue being and important part of the European diet, as it represents an important source of high-quality dietary protein and ensures the food supply to a large population around the world. To understand consumers preferences and behaviours and to include their demands in the whole process will be vital for the successful development of the sector.

In relation to all these issues, new policies and regulations (EC, 2011) forces companies for the food sector in general to show more detailed information to the end consumer. In the next years, this information may include more details on products and production processes regarding sustainability, such as soil management, water efficiency, impact of pig feed or carbon printing of meat products. Legislators and policy makers may also be influenced by the society awareness. This is also an aspect companies will have to face, as while showing this kind of information, they may need to improve aspects about their processes in order to have positive marketing and to continue to attract the consumer.

4 Develop Approaches for Co-Creation of Products by Collaboration Among Consumers, Producer and Stakeholders in the Supply Chains

4.1 Overview of the Co-Creation Approach by Using Data Mining Technologies

Consumers post their comment about their online shopping experiences so as to help other consumers with new purchases; these comments are online reviews. Online reviews can aid the process of mining information on customers' sentimental tendencies, demands and other preferences related to products. Online reviews contain a plethora of useful information that plays a vital role in consumer choices and provides a dominant reference for businesses to adopt strategies for product development and improvement. These reviews are useful resources for manufacturers to discover the needs of consumers.

The product design specification (PDS) is a series of statement that describes the details of requirements for a product to be designed. This can include physical details (e.g. size, weight, colour), but may also include functional details, such as the functions a product must be able to perform or the needs it must meet. The confirmation of specifications is a critical preliminary step in the product development process.

Product manufacturers usually use market researches, surveys, mechanical knowledge, manufacturing knowledge and man-machine engineering knowledge as well as their personal experiences to compose a PDS document. This process often requires vast time and human resources. The result also needs to be tested by the market and then be improved manually with customer feedback. However, with the help of online data mining technologies, the process to obtain a large amount of customer preferences can be greatly improved. This will save massive human resource and can often provide us with more reliable results. CIRC4Life project proposes an approach by using online reviews to improve PDS for the demonstrators, with the support of online review mining software developed in Task 3.5, which is reported in CIRC4Life Deliverable 3.3 - Development of the big-data system for online mining consumer views for eco-products (CIRC4Life, 2019).

The approach for using obtained online reviews to compose PDS is depicted in Figure 4.1.

Figure 4.1 Schematic approach for mining online reviews to improve product design specifications (PDS)

Select Target Product: A target product is needed to select; this can be an individual similar product or a general product category. The existing PDS of the selected product(s) must be investigated and analysed as the fundamental information, the elements of which will be evaluated in the further steps and used to compose a new PDS.

Establish Analysis Objectives: For the selected products, objectives must be established. The objectives can be the improvement of one feature, a new designed product, or a defect may not aware by designers themselves until later steps.

Mining Online Reviews: Internet-crawlers a program or automated scrip that can automatically search the worldwide web for specific information and save to a target database. Internet-crawlers can be used to obtain product online reviews.

Select Online Reviews: Identifying and analysing valuable reviews efficiently and accurately to satisfy customers' needs have become a critical challenge for market-driven product design. Existing evaluation methods use the review voting ratios given by customers to measure helpfulness.

Texture Processing: Texture processing extracts meaningful patterns or information from a large, unstructured document; it is used to summarize and classify text data generated in a variety of fields. The statistical model assumption of texture processing makes statistical estimates using the frequencies and ratios of the words that appear. Typical statistical model assumptions include word count analysis, concurrent frequency analysis, and probability model analysis.

Compose PDS: The extracted online reviews are processed as key words extraction, words classification, words clustering, sentimental analysis in order to identify the useful customer requirements for product designer. After acquired the necessary information, we can start to find out about the engineering details. After this step, we have acquired the necessary information to compose a new PDS which can improve the product from different perspectives.

This approach is demonstrated by two demonstrators in CIRC4Life, i.e. domestic lighting product (ONA) and meat product (ALIA). The processes and results are introduced in the following sections.

4.1.1 Apply the Approach for the Domestic Lighting Products

In this case study, the domestic lighting products shown on ONA online shop (onaemotion.com) are used to illustrate the approach. The Website currently consists over 500 consumer views, and it is anticipated that the consumer views will increase to reach a large number when we conduct the demonstration.

First of all, a list of key elements of product design specification was built, which is presented in Table 4.1.

Table 4.1 Product design specification list

Key elements of ONA domestic lighting product design specification		
Colour/texture	Aesthetic	Assembly
Quality	Price	Performance
Packing	Size	Environment impact
Maintenance	Shipping	Customer service

The 'keyword' is either a word or a phrase referring to product design specification. Sometimes, only one word is utilized to refer to a product design specification, while, in some cases, a phrase is employed. If a sentence contains these keywords, they connected the keywords with the product design specification. Then, we need label the reviews with the product design specifications, we start to read all reviews and distinguish the keywords in each sentence. Afterwards, all the keywords are sorted and classified with different product design specification groups. These classified keywords are presented in Table 4.2.

Table 4.2 Product design specification with relative keywords in reviews

Product design specification	Keywords in review sentence
Colour/texture	frosted, blue, red, yellow, black, dark, white, grey, teal, mauve, pink, softer, soft.
Quality	damaged, can't be used, nice quality, fix, reliable, cracked, rough, broke, defective, poor quality, crooked, can't be adjusted, in great condition.
Packing	well packed, well wrapped, well packaged, all round, over packaging.
Maintenance	keep clean, easy to use, easy to change.
Advertisement	as described, fiddler, misleading, better in reality, on picture, lack of information.
Aesthetic	delicate, fitted, do not fit, modern, good looking, good design, contemporary, edgy, looks cheap, suit, beautiful, luxurious looking, clinical, stylist, pretty, chic, solid, unique, clean, elegant, superb, attractive, gorgeous, unconventional, cool, looks brilliant.
Price	good price, great price, worth it, great value, cheap, expensive, not cheap.
Size	too big, huge, tiny, quite small, very small, medium size, large, medium, not fit, bigger than I thought.
Shipping	fast, delivery on time, delivery, arrived, first estimated delivery date, in transit, on time, promptly, 4 weeks, takes too long.
Assembly	not fit, fitted, easy to install, suit, straight forward, installation, easy, fatigued, bracket, shade, bulb, vertically challenged, cable, fittings, installed, plastic fixings, basic, screw.
Performance	did the job, brighter, collecting dust, useless, bright, adjustable, disappointed, electricity, modify, nicely ornamental, warm white, flickering, ample, efficient, cool white, dimmable, brilliant, daylight illumination, daylight, too bright, halo, evenly, dispersed, buzzing, fail to, rival to, colour temperature, flicker, flick, bright output, tripping, lumens, ambient.
Environment impact	energy-efficient, far too bright, consumption, low energy, watt, LED, recyclable.
Customer service	return, great service, resolved, supplier, replaced, immediately response, quickly, compliments.

By analysing the frequency that keywords are mentioned in online reviews, in other words, those product design specifications, which are frequently talked about by consumers, will show the results of what concerns customer most (Figure 4.2).

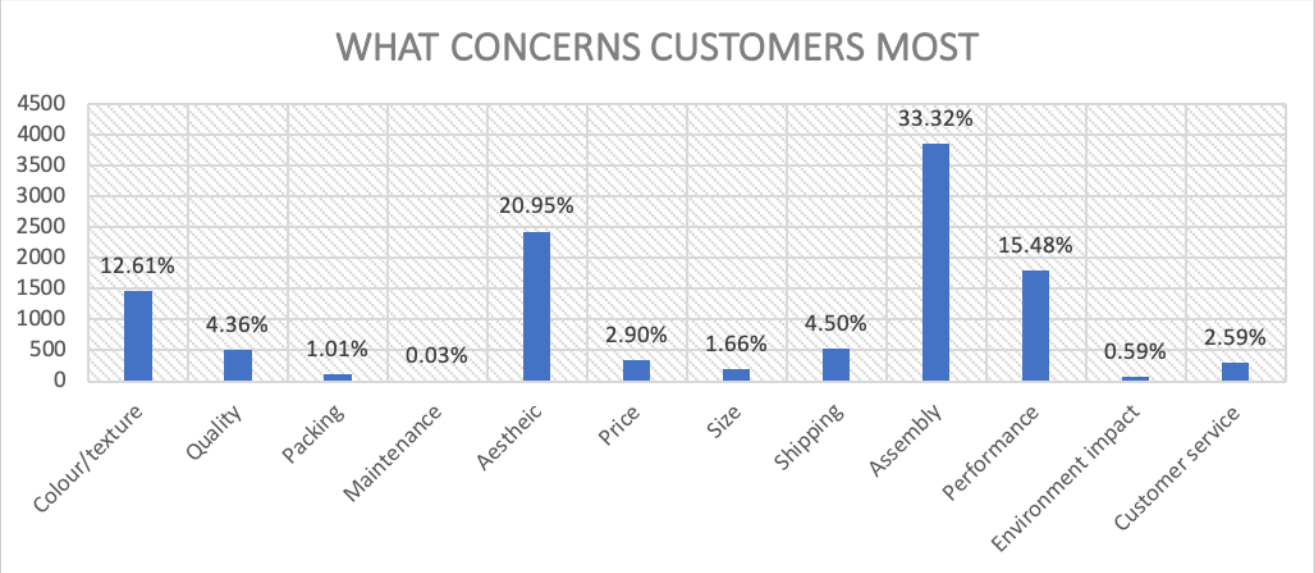


Figure 4.2 Key elements with consumers' concern for domestic lighting product

Figure 4.2 shows that the top three frequently-mentioned product design specification by consumers are 'Assembly', 'Aesthetic', 'Performance'. More than 33% consumers prefer talking about 'Assembly'. It is easy to understand. For a table lamp, the ease of use and assembly may always be the first concern for consumers.

All of the review sentence then processed by the sentiment analysis and been given the value of '1', '0', '-1' which means the positive, neutral and negative sentiment. An example is reported in Table 4.3.

Table 4.3 An example of sentiment analysis

sentence	keywords	product design specification												
		Colour/texture	Quality	Packing	Maintenance	Advertisement	Aesthetic	Price	Size	Shipping	Assembly	Performance	Environment impact	Customer service
The lamps aren't expensive and I think they are good value	good value							1						
A bit hesitant of this product because of the price	price							-1						
I'm very impressed, really easy to install	easy to install										1			
Fabulous product.	-													
The only slightly issues I've found is its website doesn't have enough information	information					-1								
Good item, does what it says on the box, but I think its package could be more environment friendly, like using some recyclable materials.	recyclable material												-1	
would be fine in a very small room or a cupboard.	small								0					
This is such a neat device. As a regular user, it's extremely simple to fit, and the function setup is really simple.	simple to fit										1			
Cool item but I don't think it's worth the price. Also is not as bright as I expected.	price							-1						
got it yesterday, very easy to put them together, did the job. Like it	easy										1			
easy to change the bulb, good one	change bulb				1									
Easy to fit and absolutely for kids. And I love the lamp shade, it looks so fresh and modern, and tones in perfectly with my kids room décor.	easy to fit,										1			
Easy to fit and absolutely for kids. And I love the lamp shade, it looks so fresh and modern, and tones in perfectly with my kids room décor.	fresh and modern						1							
I wanted an unbreakable and ecofriendly shade for my new dining room. this is just what was needed.	eco-friendly												1	

In Table 4.3, the first review sentence, 'The lamps aren't expensive and I think they are good value' contain the keyword of 'not expensive' and 'good value' matches the product design specification 'price' and with a positive sentiment, then under the price column gives a label of '+1'. But for the fourth sentence 'Fabulous product.', does not contain any keywords connected with product design specification, so the keyword in this line is labelled as '- '. If more than one product design specifications are mentioned in one sentence, this sentence will copy and pasted into next line again and labelled the second item in a new line. For example, in sentence number 12 'Easy to fit and absolutely for kids. And I love the lamp shade, it looks so fresh and modern, and tones in perfectly with my kids room '. It contained two product design specifications with the keywords 'easy to fit' related with 'Assembly' and keywords 'fresh and modern' related with 'Aesthetic'. This review sentence is repeated in the next line in order to unambiguously label the two keywords with two product design specifications.

With further analyse about each consumer concerned product design specification, the following list of consumers' requirements for ONA's products is summarised and shown as follows:

- The information provided on the website is not enough.
- Required for a video instruction for the lamp on the website.
- There is no colour selection for the lamp, would like more colour choice.
- Required for trade in old lamp for some discount for buying a new lamp.
- Delivery time is too long, takes more than one month.
- The lamp needs to be dimmable or provide different brightness levels for Eye protection.
- Wanted a smart bulb for the lamp, so it able to change colour temperature for different purpose of use.
- Need more function on the lamp, such as USB charging port.
- Wanted to buy spare part for the lamp f the shade has broken.
- Need a more detail specifications to show customer about the sustainable information.
- Materials used and the design of the lamp are not sustainable for recycling and reusing the components and materials of the product after its end of life
- Cannot find information how this product could be recycled after it reaches its and of service life and there is no information how it could save energy.
- No information how this product can be dismantled which could be helpful to recycle and reuse the component/materials of the product after the product reaches its end of life.
- The material of the cover seems not easy for recycling. Also, the coversheet is not easy to be separated from the metal frame which is not good for the user to recycle the product when it comes to its end of life.

According to consumers requirements above, a sample table lamp product design specification was generated, shown as follows:

1) Performance:
- The light must be able to light a small room (4 by 5 meters) perfectly if necessarily. The illuminance should be no less than 300 lumens.
- The light must be able to be dimmed, as some people want a less bright light than others.
- The light (LED) will not get too hot while using it.
- The light must be soft and evenly speared.
- The light mush be able to provide enough light for reading.
- There will be an energy indication depending of which type of bulb the lamp will have.
- The light must have adjustable (height or direction).
- The light should be able to provide warm light.

2) Environment:
- The lamp should be used in any household temperatures without losing the ability to perform properly.

- Use low environmental impact materials and manufacturing processes.
- The light will not make any noise while using.

3) Life in Service:

- The lamp should be able to be used for eight hours a day, seven days a week, without problems.
- The light should be stable and doesn't have flicker while using.
- The bulb must be changeable.

4) Maintenance:

- The lamp will need to change the bulb and clean it from dust.
- To apply eco-design methods, such as modular design, design for easy repair and upgrade, design for disassembly, design for reuse and reproduce.

5) Target Product Cost:

- The product price will oscillate between €300 and €450 per piece.

6) Shipping:

- The lamp will be able to be shipped every way (pallet, truck, bus).
- Delivery time must be within 14 days.

7) Packing:

- The lamp will be wrapped with plastic bubbles and put inside a cardboard box.
- There will be a short technical description to help the consumer recycle the different parts of the lamp.
- Two packing options will be provided, a sophisticated one (for those who buy as a gift) and a simple one (only serve as protection). 1% of the product price will be charged for the sophisticated packing.
- The material used for filler and boxes will be able to be reused or recycled.

8) Quantity:

- The first strip will be approximately 35 pieces.

9) Manufacturing Facility:

- The company has been making domestic lamps before and the machinery can be used again. Only the moulds will need to be made again for the new design of the product. All the other tools and machines will be re-used.

10) Size:

- There should be at least two size options. The larger one between 40-50 cm height and the smaller between 20-30 cm.

11) Weight:

- The product should use as few components as possible, whilst maintaining the required quality.

12) Aesthetics, Appearance and Finish:

- Design and implement schemes that facilitate components and luminaries' recovery for re-use, re-manufacture and recycle.
- Apply eco-design methods, such as modular design, design for easy repair and upgrade, design for disassembly, design for reuse.
- The edge and finish must be clean and well-manufactured.
- The lamp will use red or white or any dark colours or use any combination of these colours.

13) Materials:

- Use the minimum type of materials, which facilities the sorting of components for reuse and recycling when the product reaches its end of service life.
- Use low environmental impact materials and manufacturing processes.

14) Product life span:

- The product should be durable, and components should have easy access for repair or replacement.

15) Customer:

- The elaboration of the products will be based on the preferences of the end consumers.
- Design and implement systems (related with the product) that facilitate components and luminaires'
- recovery for re-use, re-manufacture and recycle.

- Avoid: The use of special tools for disassembly, non-detachable joints, labels attached the product, finishes in materials, and toxic materials.
- Provide paper or video guide for the assembly.

16) Timescales:

- The formulation time must be around 8 weeks.

17) Testing:

- The design of the lamp will be tested to ensure the type of certification and safety. This will align with relevant standards for electronic products.
- There will be testing during the design face with the LCA program.

18) Safety:

- Keep away from young children since there is use of electronics.
- The lamp will have the indication of which type of protection against electric shocks it has. This will align with relevant standards for electronic products.

19) Assembly:

- There will be as less components as possible.
- Every component must be able to be replaced or repaired.
- There will be detailed guidance (paper or video) for the assembly.
- There will be no special connector used. The lamp must be easily installed by simple and common tools.

The above is a full PDS list. It includes all the key elements from consumer requirements that are mined from online reviews, which were re-written in a technical PDS format. In addition, the following PDS items are included: 3) life in service, 8) quantity, 9) Manufacturing Facility, 13) Materials, 16) timescales, 17) testing, 18) safety, which are necessary to specify the product. Those additional PDS are determined by the product designers and manufacturers and cannot be derived from the consumers' views because they are too technical for the consumers to specify.

4.1.2 Apply the Approach for the Meat Products

In order to apply the data mining software tool into consumer feedback data regarding meat projects, ALIA contacted existing projects with developed surveys about similar topics, IRTA (Institute of Agrifood Research and Technology), a research institute owned by the Government of Catalonia, provided a survey developed from project 'Creativity aimed at innovation to develop new products for agricultural producer groups' (IRTA, 2017). There are total 100 survey results. Each survey consists of 37 questions and there are about 10 questions related to product design specification of meat products.

Part-of-Speech, a sentimental analysis method, was applied to identify the product attributes and all the attributes were ranked based on the frequency and the sentimental analysis. The terms of products attributes were classified into 7 categories regarding product design specification. The classified attributes and relative number of terms are described in Figure 4.3.

Figure 4.3 Key elements with consumers' concern for meat product

Figure 4.3 shows the majority of consumers concern about the performance of the meat product. For further sentimental analysis, Table 4.4 shows the classified sentiment and relative number of terms of performance about the ALIA meat product. The results show the customers were not satisfied with fatty and/or chewy product, shown as Figure 4.4.

Table 4.4 Performance sentiment and relative number of terms

Sentiment	Number of terms
Positive sentiment	18
Negative sentiment	298

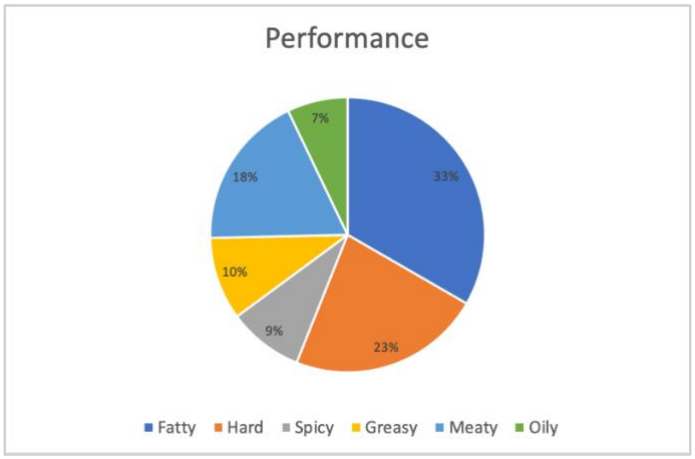


Figure 4.4 Results of sentimental analysis about performance and relative terms

The analysed results of the survey show that consumers more like meaty sausage products, required for a microwave safe packing, use natural ingredients, less chemical additives, and have more flavour choice with a good taste and texture.

316 reviews mentioned about the performance of the sausage, about 50% consumer mentioned the sausage was ‘fatty’, ‘greasy’ and ‘oily’ and with negative sentiment. That means most consumers dislike greasy sausage and the current product contains more fat and causes a greasy taste. Furthermore, 23% consumers thought the product was hard, and some consumer use the word of ‘chewy’ to describe the product, therefore, the product tastes hard and difficult to chew need to be improved in the further product development.

For the category of quality, most consumer talked about was 'good for kids', 'preservatives', 'chemical additives'. From the results, it clearly shows that proper meat product for children were a potential target market, and most consumers consider the safety of the meat as a concern for their kids' health. They would like the meat product with no preservatives or other chemical additives to reduce the health hazards.

For the category of packing, some consumers consider whether the packaging material could protect the freshness of the meat and the integrity of the product, therefore, consumers mentioned they prefer to use the bubble pad which could protect the product during delivery. Additionally, some consumers also mentioned about the vacuum packaging. Some of other consumer cares whether the packaging materials are health and safe, whether it is environmentally friendly and recyclable.

For the category of cost, most of consumers satisfy with the current price, they use 'cheap', 'worth the money', 'reasonable price' and 'price to quality' to describe the current pricing of the product.

For the category of flavour and taste, the words which consumer used were mostly adjectives, and the meanings are relatively general and lack of specific orientation. From the adjective itself and consumers' semantic and emotional tendencies, majority of consumers satisfy with the current product and expressed it is delicious and the meat is good. Some of reviews use 'flavourful', 'impressed' to state their satisfaction and recognition of the product. The overall product reputation is good, and majority of consumers satisfy with it.

The analysis of survey results show that the consumers satisfy with the current products, but they more like meaty sausage products, required for a microwave safe packing, use natural ingredients, less chemical additives, and have more flavour choice with a good taste and texture.

4.2 Overview of the Co-Creation Approach by Using Living Lab Framework

In this section, stakeholder engagement and different approaches and methods for supporting open interactions and co-creation in the CIRC4Life Living Labs' are presented.

Living Labs focus on involving and engaging users and other stakeholders and bringing their everyday lives and practices as part of the innovation and development processes from early on. In other words, Living Labs bring the development and experimentations out of companies' R&D departments into a real-world setting, with the **involvement and co-creation of users, partners and other stakeholders** (Leminen and Westerlund, 2012)**.** The description of CIRC4Life Living Lab concept and methodology for co-creation of products and services is defined and explained in **D7.1 Living Labs Concepts and Implementation Plan for CIRC4Life-project** as follows**:**

> **Co-creation of Products and Services with end-users:** Bringing end-users and other key stakeholders closer to the product and service development by identifying their preferences via various inclusive research and development methods and empowering them by utilizing the Living Lab approach in real-life settings. The key aim of the Living Lab activities is to specify and test how various co-creation methods and activities in different stages of innovation process from idea generation to concept development, mock-up testing, small scale piloting and finally to full scale go2market field testing can be adapted to CIRC4Life context. The key challenge to be solved during the Living Lab activities can be defined as follows:
>
> *What are the best ways to bring together end-users, key stakeholders and CIRC4Life demonstrators to co-create novel solutions for all the stages of circular economy?*

Co-creation approach

The current definition of collaboration is a transfer of knowledge from one party to another in an open and safe environment, where all actors are giving and receiving. This can also be referred **as co-creation**, which in the CIRC4Life context is defined as solving and defining shared problems with a systematic approach, in close cooperation with multiple actors with diverse backgrounds.

Co-creation can be defined as a cooperation between different actors who share the same overall objective or goal (Levén and Holmström, 2012). Co-creation has become a central framework used within many organizations to innovate novel products and services. It is based on planning, developing and innovating new solutions through a specific iterative development process while utilizing various methods, techniques and tools. The purpose of co-creation is to create a customer-centric solution that meets the needs and demands of the customers and fulfill the solution provider's business objectives. Through a co-creation approach, teams with diverse backgrounds can collaboratively identify needs, ideas, experiences and opportunities and generate fast.

The co-creation approach concentrates on the roles of different actors, as people participating the process have many different simultaneous roles, competences and life experiences, and should not be categorized into the narrow roles of an end-user, designer or a developer but given the opportunity to express themselves more freely. The co-creation process aims at pro-active stage of ideating where many different goals, solutions and possibilities are co-created, rather than merely investigating the participant's reactions and opinions towards the pre-determined solutions (Kunnari *et al.*, 2011). In the co-creation process, the user is seen as **an active and equal partner participating the development** alongside other actors, whereas more traditional and quantitative user-centric development methods see the user as an object of the design (Sanders and Stappers, 2008).

The co-creation process concentrates specifically on the adapted, and creative and participatory methods that are adjusted to fit their purpose within each Living Lab study (Almirall and Wareham, 2008). More traditional methods providing quantitative data, such as customer-surveys and market research are often conducted alongside to support the co-creation process (Hanington, 2003). In CIRC4Life Living Lab approach is supported with big data mining and consumer surveys.

Despite it has been recognized that co-creation, even when conducted as lightly as possible, demands fairly large amount of resources, the achieved results and outcomes can be significantly beneficial. For example, by involving users to the development process company is able to gain knowledge about certain thematic topics more efficiently than conducting research internally. A wide ranged and early involvement of users and other stakeholders fosters the suitability of the developed product or service in context of an everyday environments and actions.

However, managing a co-creation process can be quite challenging. Luotonen, A. et al. (2011) have identified some challenges and best practices of co-creation processes from which, a selection is presented below.

Best practices for co-creation**:**

- A wide ranged and early involvement of users and other stakeholders should be ensured.
- Co-creation activities should begin as early in the development process as possible.
- Involvement of users, who would not use services should be considered as they are able to provide valuable controversial viewpoints.
- Setting of clear and reachable goals that simultaneously enable unexpected ideas and results to emerge is important.

- During the co-creation activities, the participants should aim to achieve goals as a team instead of individuals.
- Co-creation process should be kept as open as possible; thus, participants should be informed about the closed development phases and their causes from early on.
- Participants should be encouraged to ideate freely outside the initial framework and set goals.

Challenges of co-creation:

- Co-creation methods are applied too late in the development process, the schedule of the product launch is not aligned with the results of co-creation.
- The customer target group selected for the co-creation activities is inconvenient.
- The viewpoints of different stakeholder groups taken into account is too narrow.
- Co-creation activities can be more time consuming than anticipated, too limited time is reserved. When scheduling co-creation process, time should be reserved for investigating new emerged knowledge and ideas.
- The results of co-creation process are conventionally unpredictable (as in innovation processes generally) thus, the results can be considered as success or a failure depending on the point of view and further actions.
- Exploitation of the results should be paid attention to.

4.2.1 Apply the Approach for LED Industrial Lighting Products

For the new modular design based industrial lighting LED luminaire, accordingly, KOS is proposing a leasing service in which a full maintenance cover is included. Due to the vast energy savings that LED lighting can offer (especially within the industrial sector), the estimated saving on a client's electricity bill should be able to cover the leasing service charge without extra financial burden. Flexible payment plans can be provided to suit the customer's individual financial situations. In summary, the leasing service we proposed provides following benefits:

- Small monthly payment to cover the cost of the products, installation and ongoing maintenance fee.
- The monthly fee will be covered by the electricity cost saved each month.
- Hustle free, the fitting will be regularly checked and fixed if necessary.
- The typical leasing duration is 3-5 years and the leasing contract can be as long as 10 years to minimise the monthly payment, although a long leasing contract (10 years or above) maybe a risk both for customers and leasing company.
- The leasing contract be flexible, and the contract can be transferred and updated if there is a better option available or terminated early as long as the remaining financial cost is covered.

Figure 4.5 shows two type of payment plans: stepped payment plan and flat payment plan, which we propose to offer to our leasing customers and use 10 years leasing contract as an example for illustration purpose.

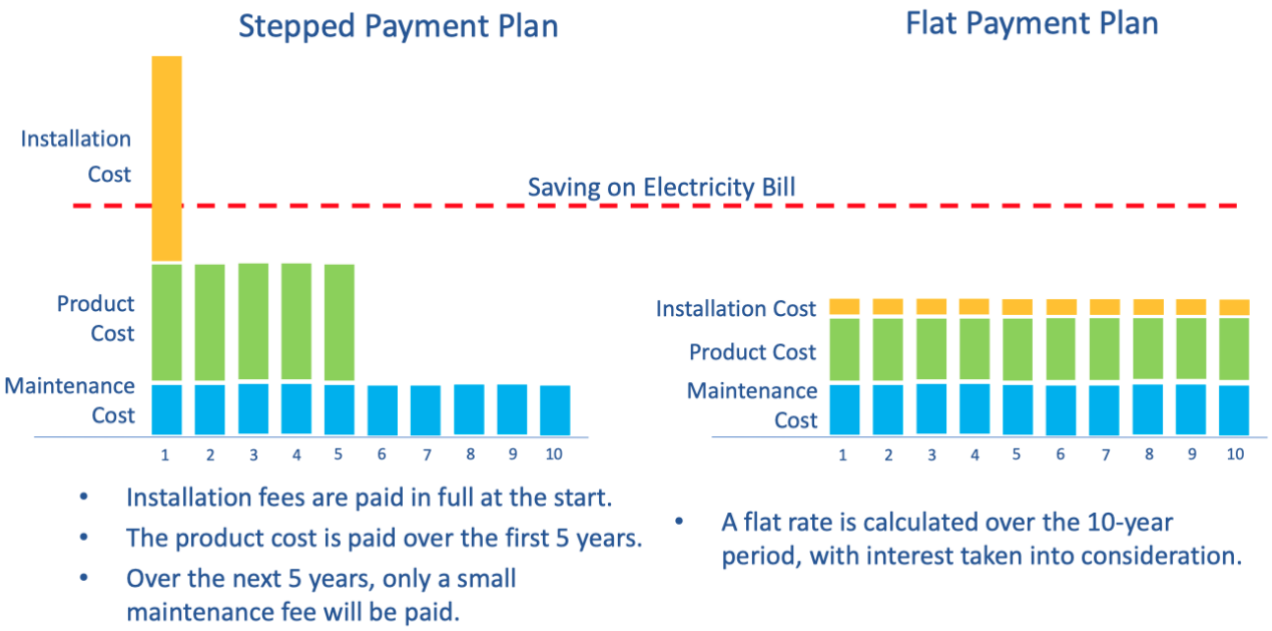


Figure 4.5 Type of proposed payment plans

The ultimate objective of this is to apply a circular economy approach instead of a linear one, to create a more sustainable model of consumption within industrial LED lighting by extending the product's life considerably through the encouragement of reusability and the minimisation of waste.

4.2.1.1 Survey Results Analysis for the Leasing Service

The following first concept Living Lab test during Innovation Camp at Krakow, KOS developed 30 questions on Kosnic Industrial Lighting modular design and leasing service with support of LAU team during January 2019 to March 2019, and the questionnaire (see Appendix 1) was circulated to KOS existing customers database plus selected Lighting Industry Association (LIA) members by email with the following key themes/questions:

- Perceived importance of the environmental sustainability and strategic readiness.
- Current status of lighting systems.
- Perceived importance of the different lighting leasing services and options.
- Willingness to become leasing service business partner for Kosnic.

Based on the responses from online survey on leasing service, the following results are abstracted:

- More than 57% responses think this service is important and align with company's business goals, mission and values, willing to build, maintain or improve brand reputation.
- 90% responses show that their own company is doing the replacement work when the lighting product goes faulty.
- More likely interested services: A) Intelligent usage and energy analytics via IoT solutions'; B) Transition of equipment at end of term; C) One service provider provides holistic solution together with its partners.
- A flat rate payment plan is preferred (71.43%).

4.2.1.2 Analysis for Results of the Leasing Service Workshop

The KOS leasing service concept has been tested following Living Lab methodology in first innovation camp, 12-15 November 2018, Krakow, Poland of CIRC4LIFE project, with the following result (Table 4.5):

Table 4.5 Leasing service test questions and results

WHAT = Leasing Service Business Model for industrial LED Lighting Systems
SOLUTION DESCRIPTION: • Offering leasing services instead of buying products. • This enables take back of the product at its end of life from customers. • Fixed leasing rate over a determined time for easy financial planning for customers. • Maintenance service contracts are included. • Reverse/takeback logistics and service to be included in the business model. • Selling 'light', not lamps. • Promote recycle and reuse, reduce environmental impact.
VALUE PROPOSITION/GOAL/OBJECTIVE: • High quality light systems. • Maintenance services are included. • Stable long-term financial planning. • Low environmental impact for the customer along the value chain.
CE-PHASE(S):
• All CE phases
WHO
• Wholesaler • User • Maintenance/installer service provider • Financial Service • Refurbish company
HOW
• By providing leasing service to customers.
WHY/IMPACT
• **ENVIRONMENT:** Longer product life time due to refurbishment or remanufacture. Using recycled materials from manufacturer's own products. • **BUSINESS:** offering leasing services Instead of buying products, B2B customer could buy leasing services for industrial lighting and getting cheap components from the recycle process. • **SOCIAL:** Instead of buying products, B2B customer could buy leasing services for industrial lighting
Additional insights
• Idea has linkage to co-creation phase (modular design)

A further one-day Co-Creation workshop for developing leasing service model was arranged at Lighting Industry Association (LIA), Telford, UK on 28 May 2019 using various service design canvases, brainstorming techniques and mock-ups. The workshop was targeted at: facility management company, wholesale company, Lighting Industry Association (LIA) experts, contractor, carbon trust etc. The key themes of this workshop were: testing and gathering new ideas , various thoughts and feedback on the KOS leasing service business model; identifying 1) key functionalities and sales arguments for leasing service; 2) roles for each business

partners; 3) revenue sharing model and 4) identification of the potential end-customer types. Some thoughts on how to implement leasing service model were presented as shown in Figure 4.6 with following points:

- CEL – ideally involve all key stakeholders such as manufacturer, wholesaler, contractor, installer, facility management company, finance institute, share profit, a win-win model for all.
- CEL – a group central office will comprise a set of directors or managers who are responsible for delivering manufacture, project, finance, maintenance & upgrade.
- CEL will involve multiple franchises; each local franchisee will look after the regional Maintenance, Warranty, Returns, Exchange and Performance Insurance.

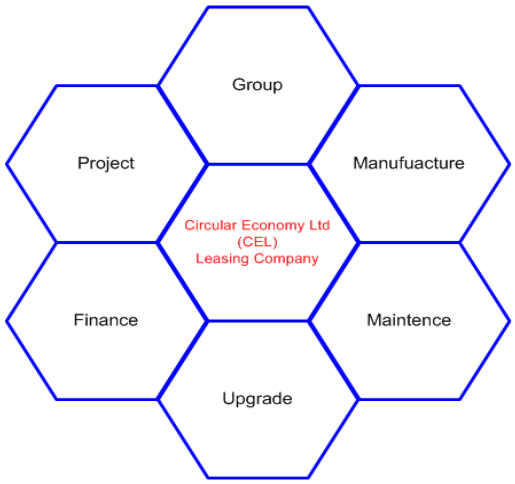


Figure 4.6 The proposed idea on how to implement leasing service

In the proposed solution for leasing service model, the following key partners are identified:

- Manufacturer (Supply of quality, affordable product)
- Contractors (Installation, initiate project leads)
- Wholesalers (Initiate project leads, customer relations, local knowledge)
- Bank (Due diligence, finance)
- Insurance Company (Due diligence, affordability of scheme)
- End-User (Initiation recommendation)
- Partners benefit due to regular financial income.
- Benefit via cost saving over existing models
- Social conscience
- The advantage to the customer is local contact but receives support from all stakeholders. One point of contact. Local connection – global outreach

With lots of challenges ahead as follows:

- Integrated Building Management System. How would this integrate?
- Building owned by third party.
- How to split payment?
- How do you split the franchises up?
- What happens at the end of the leasing term?
- Cost and/or due diligence of the insurance.
- How to monitor energy performance?
- How to manage upgradeability. Perhaps modular design could limit the impact of this?
- How to provide client with the confidence?
- How to provide potential members of the business plan to buy in to the idea and get involved?
- How to make the client aware of how the business model is set up?

4.2.2 Apply the Approach for Meat Product Supply Chain

4.2.2.1 Survey Results Analysis for Consumer Recycling Behaviours and Preferences for The Development of Sustainable Products

In order to engage consumers a, get their feedback and understand both, consumer recycling behaviours and preferences for the development of sustainable products, ALIA has conducted an online questionnaire (using Google Form), between February 22nd and April 10th, 2019. In total, 40 people were engaged by using ALIA's website and ALIA's mailing list. The survey conducted can be found Appendix 2.

The objective of the survey was to get insights from customers regarding, not only general attitudes and behaviours, but also to get them for specific objectives, challenges and open questions regarding the scope of the project demonstration in the meat supply chain. It has to be remarked that this survey should be considered as a pre-survey and not a high scientific quality standards survey. However, this questionnaire can give us a main idea about consumer behave toward these issues. Considering the target group ALIA can contact in their mailing list and the ones who visit its website, these results can be associated of people from the region where the demonstration of the meat supply chain will be developed. New surveys which will be conducted in Task 3.6, will show more extensive results about this topic.

In order to cover the different areas related to green purchase and recycling behaviour, this questionnaire has covered the following main topics along the different questions:

- Attitudes toward green purchase and recycling (AGP).
- Ecological knowledge (EK).
- (Actual) Green purchase behaviour (GPB).
- Scepticism.
- Environmental concerns (EC).
- (Local) Environmental awareness.
- Environmental attitude.
- Perceived behavioural control (PBC).
- Subjective norm.
- Environmental awareness.
- Confidence on green products, labels and products.
- Perceived Consumer Effectiveness (PCE).
- Green purchase intention (GPI).

The survey was divided into three main parts:

- General information of each consumer.
- General attitudes towards recycling and sustainable habits, in order to identify them as sustainable consumer, non-sustainable consumer or regular consumer.
- Specific attitudes towards aspects which may have an influence in the demonstration of the meat supply chain.

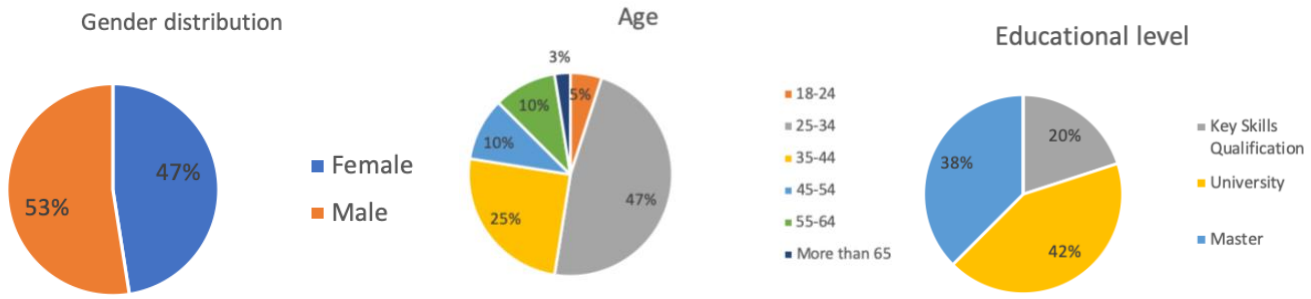
General information:
The first part of the society covered the socioeconomic and demographic characteristics of the participants.

Regarding the general information of the participants, we can assess there is an equitable gender balance, but most of the participants were between the ages of 25 and 44 years (72,5%) among them and most of them had university studies (80%), with similar distribution of having just a degree or also a master. The ones who did not have university studies had a Key Skills Qualification title, so all the participants had further studies after primary and secondary education.

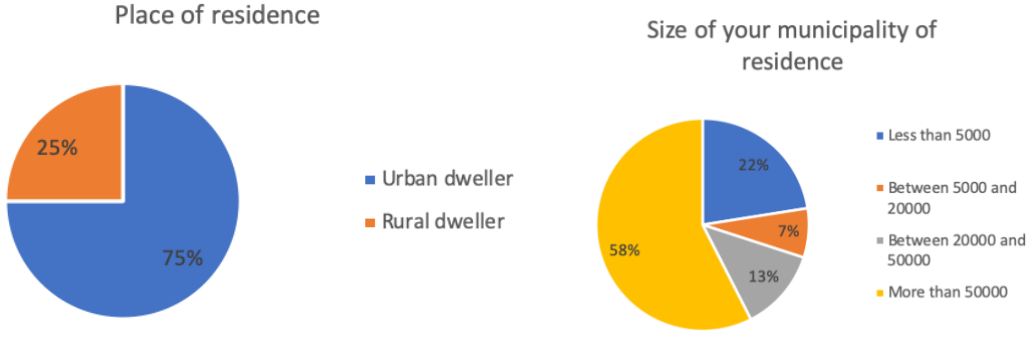
Furthermore, it can be noticed that most of the participants lived in an urban area and in a municipality of at least 50.000 inhabitants.

All this information indicates that we have a majority profile of young adults with university studies and who live in big cities.

	Gender	%		Age	%		Educational level	%
Female	19	47.5%	Younger than 17	0	0%	Primary education	0	0%
Male	21	52.5%	18-24	2	5%	Secondary education	0	0%
			25-34	19	47.5%	Key Skills Qualification	8	20%
			35-44	10	25%	University	17	42.5%
			45-54	4	10%	Master	15	37.5%
			55-64	4	10%	No education	0	0%
			More than 65	1	2.5%			

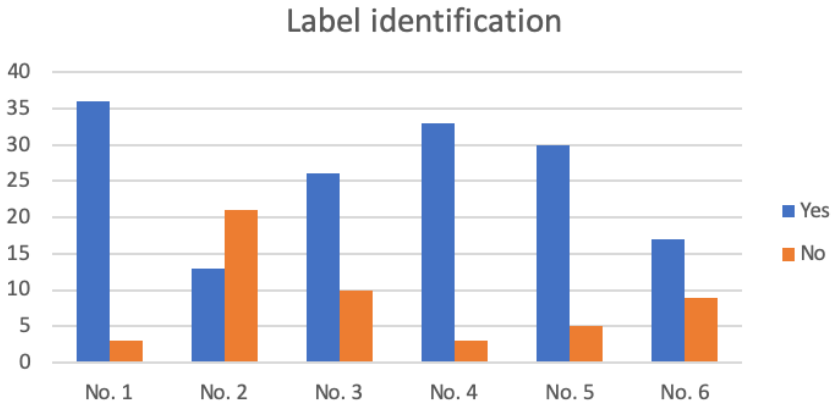


	Place of residence	%		Size of your municipality of residence	%
Urban dweller	30	75%	Less than 5000	9	22.5%
Rural dweller	10	25%	Between 5000 and 20000	3	7.5%
			Between 20000 and 50000	5	12.5%
			More than 50000	23	57.5%



General attitudes towards recycling and consumption habits:

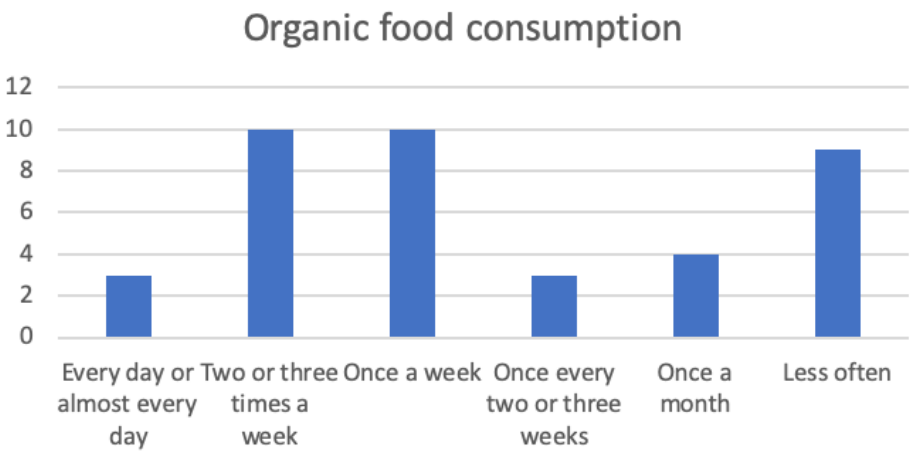
Label identification	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Yes	92.3%	38.2%	72.2%	91.7%	85.7%	65.4%
No	0.07%	61.8%	27.8%	0.8%	14.3%	34.6%



These questions are related to:

- Attitudes toward green purchase and recycling (AGP).
- Ecological knowledge (EK).

	Organic food definition	%		Organic food consumption	%
Yes	38	95%	Every day or almost every day	3	0.77%
No	2	5%	Two or three times a week	10	25.6%
			Once a week	10	25.6%
			Once every two or three weeks	3	0.77%
			Once a month	4	35.9%
			Less often	9	23.1%



These questions are related to:

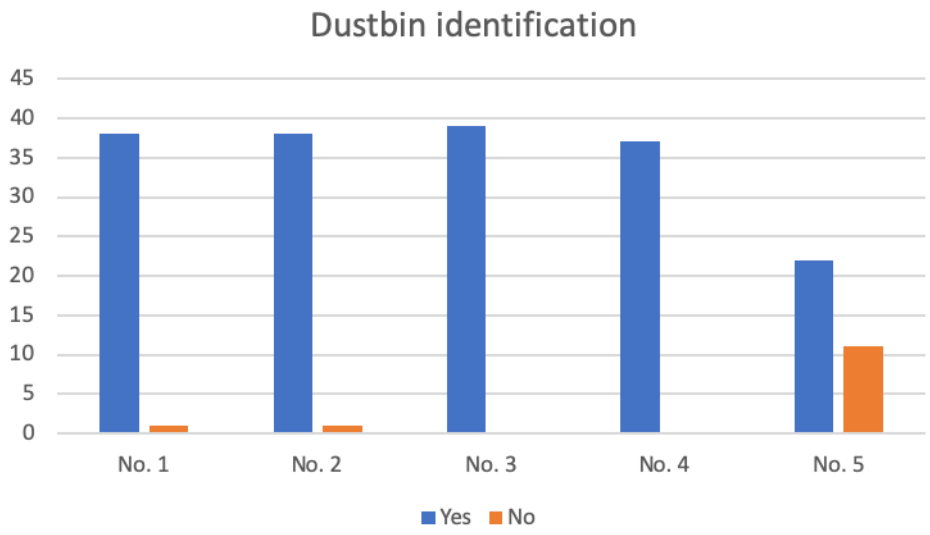
- Ecological knowledge (EK).
- (actual) Green purchase behaviour.

	Do you consider it useful to recycle?
Yes	100%
No	0

This question is related to:

- Scepticism.
- Environmental concerns.

Dustbin identification	No. 1	No. 2	No. 3	No. 4	No. 5
Yes	97.4%	97.4%	100%	100%	66.7%
No	0.26%	97.4%	0	0	33.3%



These questions are related to:

- Ecological knowledge (EK).

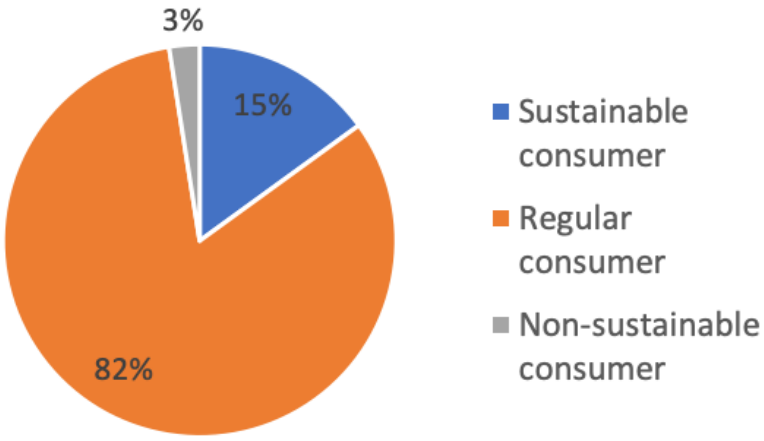
	Do you know the location of the Recycling Park of your municipality?	Do you usually separate waste for recycling at home?	Do you follow the information about environmental issues in the media?
Yes	60%	75%	82.5%
No	40%	25%	17.5%

These questions are related to:

- Local Environmental awareness.
- Attitudes toward purchase and recycling (AGP).

Regarding these general attitudes towards recycling and consumption habits, we can differentiate between three different types of consumers. It is possible to appreciate how most of participants have, in general, good knowledge of the different labels and dustbin and which also have a regular consumption of organic products as well as most of them show interest in environmental issues. However, just 15% of all of them satisfied all the different requirements needed to be consider as a sustainable consumer. Most of them were catalogued as regular consumer. This differentiation between different consumers according to their sustainability was done by using a similar approach of what was made in a study conducted by the Ministry of Agriculture, Food and Environment of Spain in collaboration with the company GFK in 2014. These parameters can be found Appendix 2.

	Kind of consumer according to our definition
Sustainable consumer	6
Regular consumer	33
Non-sustainable consumer	1



In order to consider opinions from the most stringent sustainable consumers, one parameter has been modified for the selection of the sustainable consumer, particularly the one associated with the frequency of organic food consumption. It has been changed from at least 'Once a month' to at least 'Once a week'. With this new parameter, half of the sustainable consumers were considered as strict sustainable consumers. However, no substantial differences can be observed in most of the questions as it is possible to appreciate in the results below.

Specific attitudes towards aspects that may affect the meat supply chain demonstration:

	Do you know if meat can be recycled and reused in other processes?	Sustainable consumer	Regular / Non-sustainable consumer	Strict sustainable consumer
Yes	34%	33.3%	44.1%	33.3%
No	66%	66.7%	55.9%	66.7%

This question is related to:

- Ecological knowledge (EK)

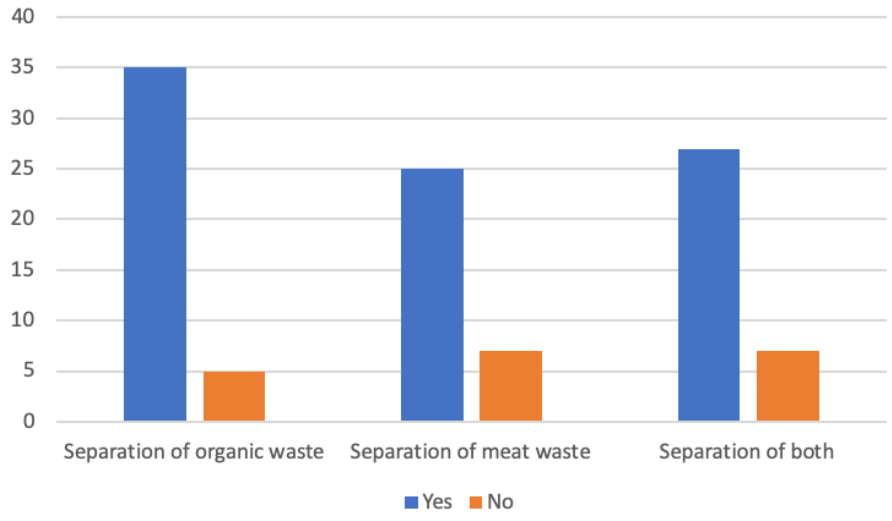
	How would you like to change meat production processes if you were able to do that?	%	Sustainable consumer	%	Regular / Non-sustainable consumer	%	Strict sustainable consumer	%
Improving animal	12	32%	1	16%	11	35%	0	0%
Using resources	4	11%	1	17%	3	10%	1	33%
Preserving nutritional	9	24%	1	17%	8	26%	1	33%
Promoting local business	10	27%	2	33%	8	26%	0	0%
Other	2	6%	1	17%	1	3%	1	34%

To preserve economic and environmental sustainability and to reduce the use of medicines and accelerated fattening products were also added in section 'Others'.

This question is related to:

- Environmental attitude.

	Would you bring your organic waste to a container so it can be recycled?	%	Would you bring your expired meat to a container so it can be recycled?	%	Would you consider to separate at home general waste and expired meat so it can be recycled?	%
Yes	35	88%	25	78%	27	79%
No	5	10%	7	22%	7	21%
Sustainable consumer						
Yes	6	100%	3	100%	3	100%
No	0	0%	0	0%	0	0%
Regular / non sustainable consumer						
Yes	29	85%	22	76%	24	77%
No	5	15%	7	24%	7	23%
Strict sustainable consumers						
Yes	3	100%	2	100%	2	100%
No	0	0%	0	0%	0	0%



These questions are related to:

- Attitudes toward purchase and recycling (AGP).
- Perceived behavioural control (PBC).

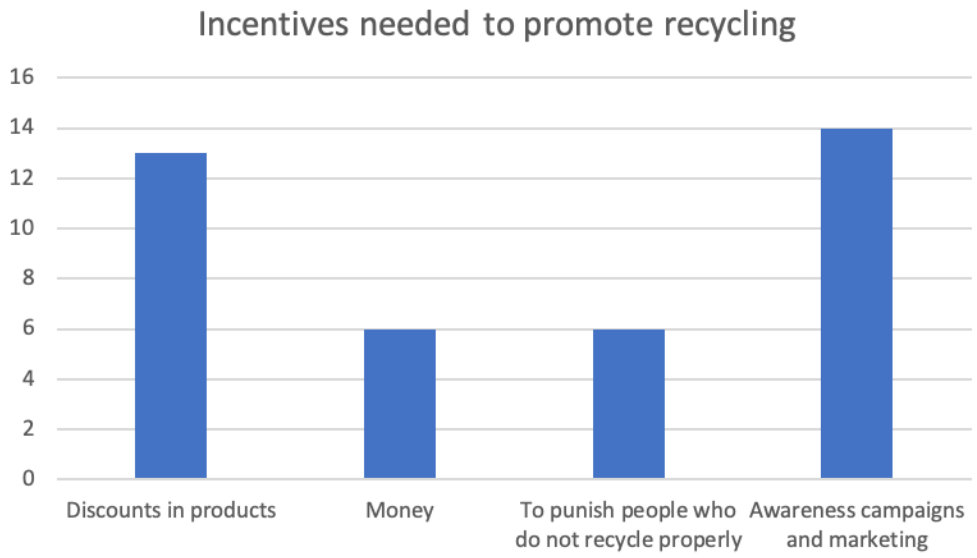
There are not substantial differences between different types of consumers, however, half of the sustainable consumer did not answer a yes or no, but they chose to add comments regarding question 2 and 3. These comments did not differ from the ones added by regular consumers.

Regarding the second questions, people suggested that they would bring the meat waste to a specific container depending in how easy was it was and if it was located near home. Some of them also pointed out that it would be complicated because if they are going to separate bio waste at home and bring it to a specific container, to include one more item at home in order to separate just meat was not feasible or that they just

did not know to what extent it can be recycled separately from the rest of organic. Additionally, one participant suggested that when people eat meat, if they are not going to eat all of it, they would just freeze it.
Regarding the third question, participants pointed out again that it would be difficult as they can't fit so many bins at home, that they would not store it for more than one or two days once expired and they would do it if they had a method that preserves the health conditions in my home.

Regarding the general results, it can be appreciated that people said they would recycle both, meat and organic waste. However, more people voted for just separate and bring to the recycling point the organic waste and most comments pointed out the difficulties of storing expired meat at home establishing a bin for just this kind of waste.

	Which are the incentives you consider needed to promote recycling?	%	Sustainable consumer	%	Regular / Non-sustainable consumer	%	Strict sustainable consumer	%
Discounts on products	13	34%	1	20%	12	35%	1	50%
Money	6	15%	1	20%	5	15%	0	0%
To punish people who do not recycle properly	6	15%	2	40%	4	12%	1	50%
Awareness campaigns and marketing	14	36%	1	20%	13	38%	0	0%
Other	0	0%	0	0%	0	0%	0	0%



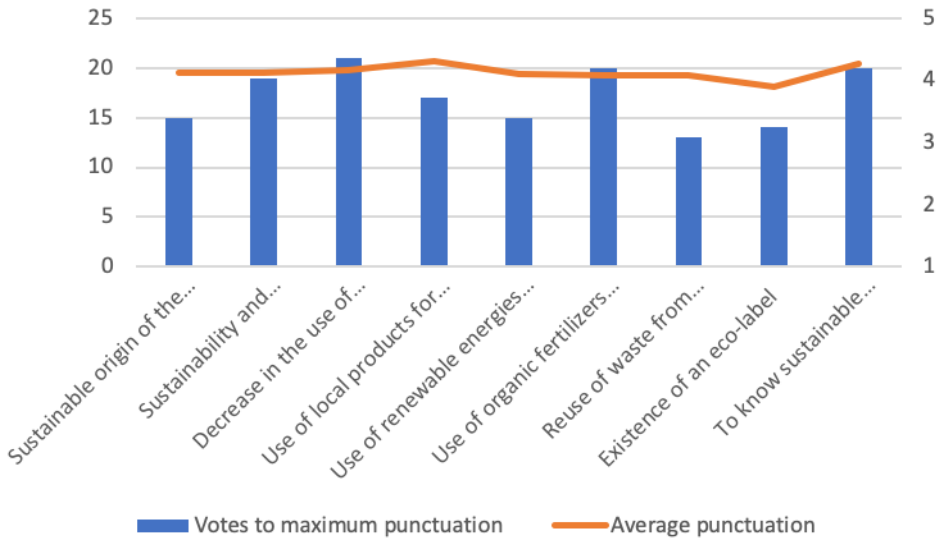
This question is related to:

- Perceived behavioural control (PBC).
- Subjective norm.
- Attitudes towards green purchases and recycling (APG).

Regarding the incentives, people agreed that the two main incentives to promote recycling were to offer discount on products and, especially, to develop marketing and awareness campaigns.

If we look at the results about the importance of different aspects of meat products, all of them were high rated, this is, people give value to different ways of developing more sustainable products along the whole supply chain of the meat sector.

value from 1 to 5 the importance that you consider of the following aspects about meat products	Average punctuation	Votes to maximum punctuation
Sustainable origin of the ingredients	4,128	15
Sustainability and recyclability of the package	4,125	19
Decrease in the use of antibiotics	4,175	21
Use of local products for production	4,300	17
Use of renewable energies for production processes	4,100	15
Use of organic fertilizers instead of chemical ones in agriculture for animal feeding	4,075	20
Reuse of waste from production in other processes	4,075	13
Existence of an eco-label	3,900	14
To know sustainable information of products	4,275	20

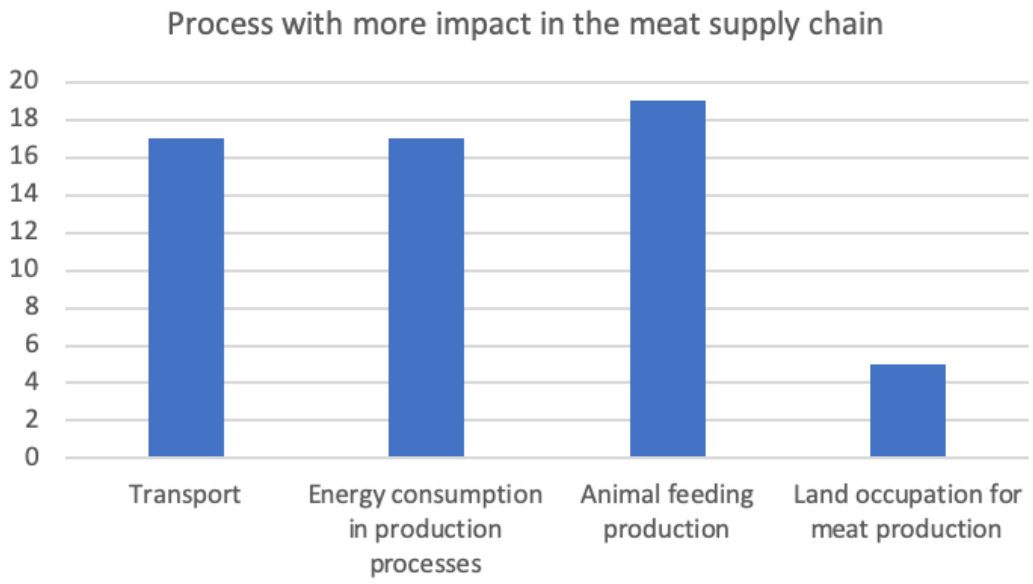


These questions are related to:

- Environmental awareness.
- Environmental concerns (EC).
- Confidence on green products, labels and products.
- Perceived Consumer Effectiveness (PCE).

	Which one do you think is the most important impact in the production of meat food from the environmental point of view?	%	Sustainable consumer	Regular / Non-sustainable consumer	Strict sustainable consumer
Transport	17	29%	3	14	2
Energy consumption in production processes	17	29%	2	15	0
Animal feeding production	19	33%	1	18	1
Land occupation for meat production	5	9%	0	5	0
Other	0	0%	0	0	0

Again, not remarkable differences were noticed between different types of consumers, and transport, energy consumption and animal feeding production were voted with a higher punctuation.



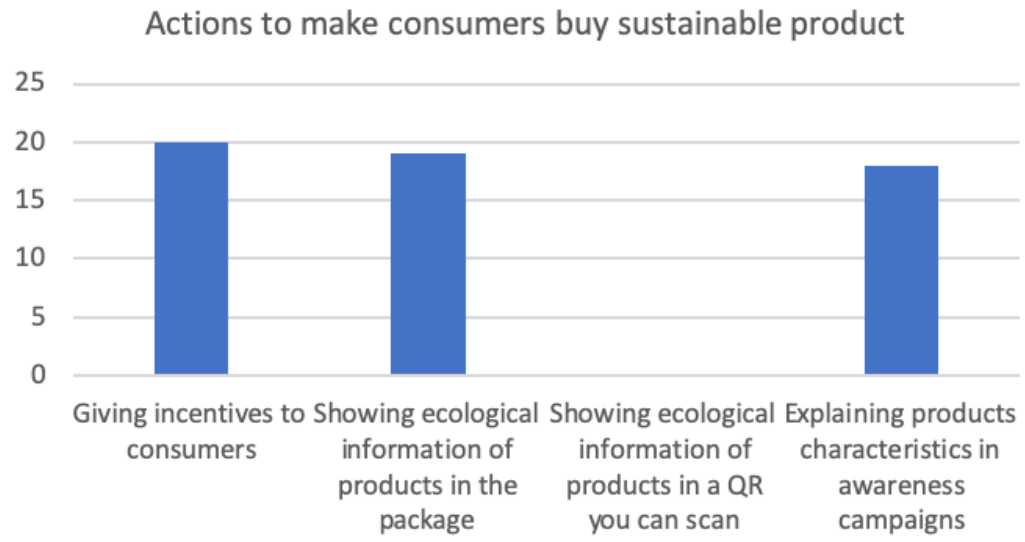
This question is related to:

- Environmental awareness.
- Environmental concerns (EC).
- Perceived Consumer Effectiveness (PCE).

	Which one do you think is the best way to make consumers buy sustainable products?	%	Sustainable consumer	Regular / Non-sustainable consumer	Strict sustainable consumer
Giving incentives to consumers	20	34%	3	17	2
Showing ecological information of products in the package	19	33%	2	17	0
Showing ecological information of products in a QR you can scan	0	0%	0	0	0
Explaining products characteristics in awareness campaigns	18	31%	1	17	1
Other	1	2%	0	1	0

It is remarkable how people did not choose as an efficient way of engaging people to show the ecological information in a QR code you can scan, and all the other options had similar and high punctuation. This may be due to the misunderstanding of people about it, as in some workshops developed in the frame of the projects in order to define the best solution to show the sustainable information, when explained how you could get more information of the products by using a QR code, people thought it was a good option.

In order to further explore the possibility of including a QR code in the products in order to facilitate an easy way to access to more detailed information regarding products sustainability, the approach was tested in different Living Lab activities (workshops and eco-label testing). During these activities it was highly valuated. Even people that do not usually use these kinds of tools suggested that it was a good idea. This is why, despite the result of this questionnaire, the QR code will be finally used.

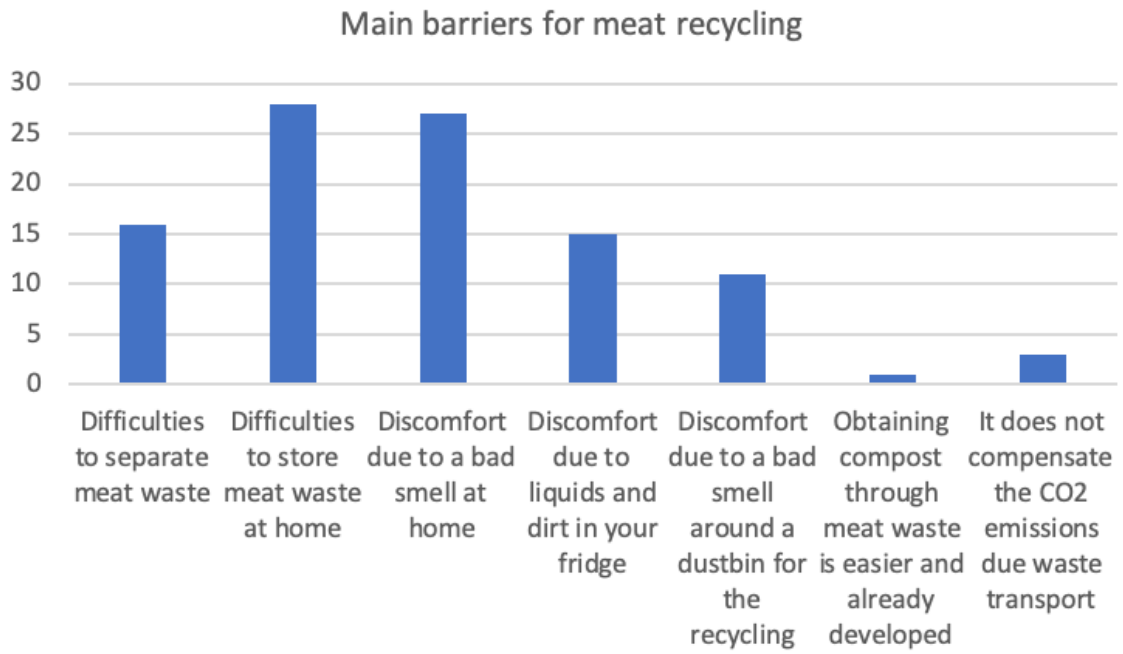


This question is related to:

- Perceived Consumer Effectiveness (PCE).
- Subject norm.

	Which one do you think is the best way to make consumers buy sustainable products?	%	Sustainable consumer	Regular / Non-sustainable consumer	Strict sustainable consumer
Difficulties to separate meat waste	16	16%	2	14	1
Difficulties to store meat waste at home	28	27%	4	24	2
Discomfort due to a bad smell at home	27	27%	0	27	0
Discomfort due to liquids and dirt in your fridge	15	15%	0	15	0
Discomfort due to a bad smell around a dustbin for the recycling	11	11%	0	11	0
Obtaining compost through meat waste is easier and already developed	1	1%	0	1	0
It does not compensate the CO2 emissions due waste transport	3	3%	0	3	0

When defining the main barriers for the possibility of meat recycling, participants pointed out the difficulties and discomfort situation these actions could lead to.



This question is related to:

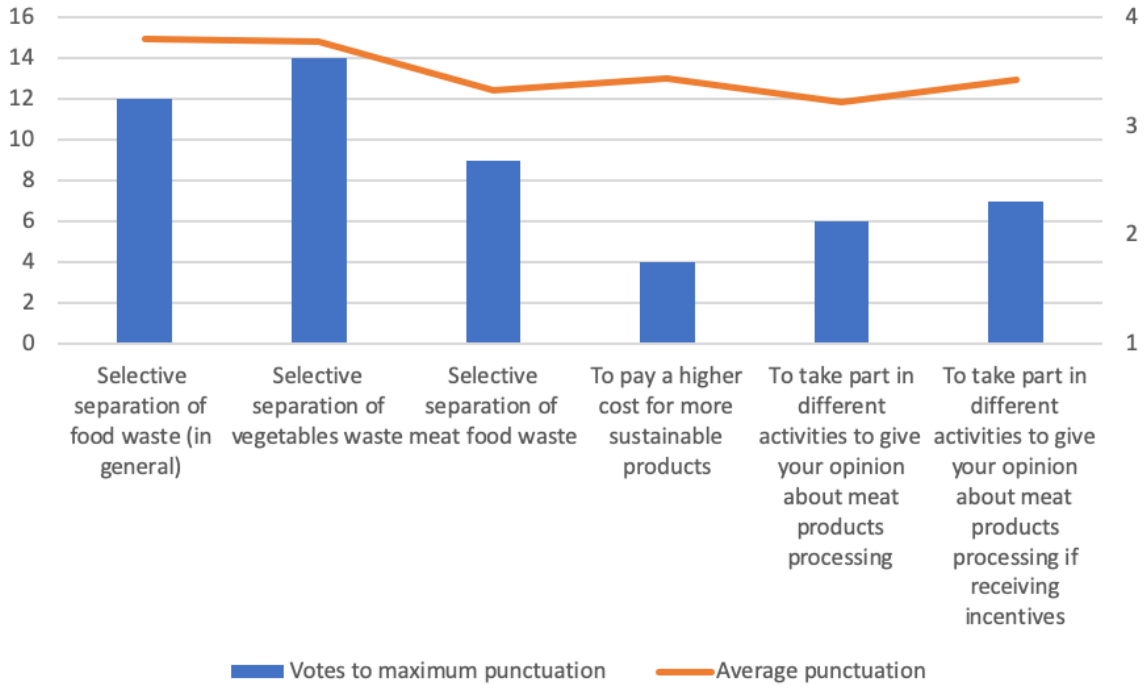
- Perceived Consumer Effectiveness (PCE).

value from 1 to 5 your personal disposition in the following cases	Average punctuation	Votes to maximum punctuation
Selective separation of food waste (in general)	3,79	12
Selective separation of vegetables waste	3,78	14
Selective separation of meat food waste	3,32	9
To pay a higher cost for more sustainable products	3,44	4
To take part in different activities to give your opinion about meat products processing	3,22	6
To take part in different activities to give your opinion about meat products processing if receiving incentives	3,43	7
Sustainable consumers		
Selective separation of food waste (in general)	4,75	3
Selective separation of vegetables waste	4,8	4
Selective separation of meat food waste	3,8	2
To pay a higher cost for more sustainable products	4,2	2
To take part in different activities to give your opinion about meat products processing	4,6	3
To take part in different activities to give your opinion about meat products processing if receiving incentives	3,8	2
Regular and non-sustainable consumers		
Selective separation of food waste (in general)	3,69	9
Selective separation of vegetables waste	3,63	10
Selective separation of meat food waste	3,26	7
To pay a higher cost for more sustainable products	3,32	2
To take part in different activities to give your opinion about meat products processing	3,03	3
To take part in different activities to give your opinion about meat products processing if receiving incentives	3,37	5
Strict sustainable consumer		
Selective separation of food waste (in general)	4,5	1
Selective separation of vegetables waste	5	2
Selective separation of meat food waste	4	1
To pay a higher cost for more sustainable products	4,5	1
To take part in different activities to give your opinion about meat products processing	4,5	1
To take part in different activities to give your opinion about meat products processing if receiving incentives	4,5	1

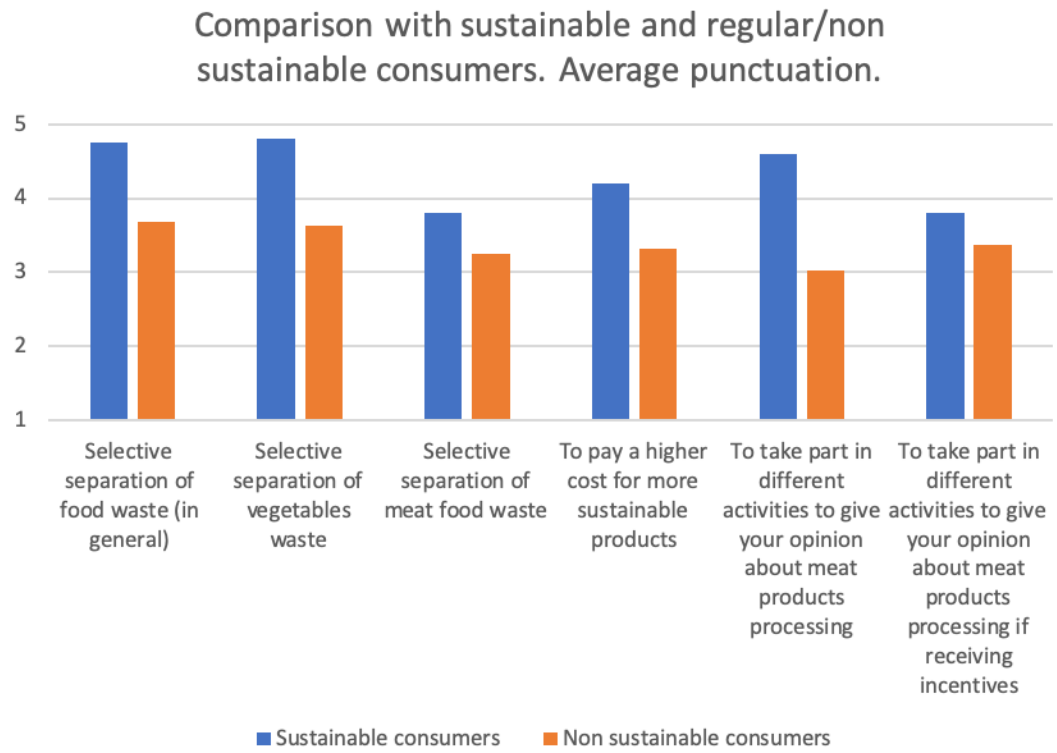
These questions are related to:

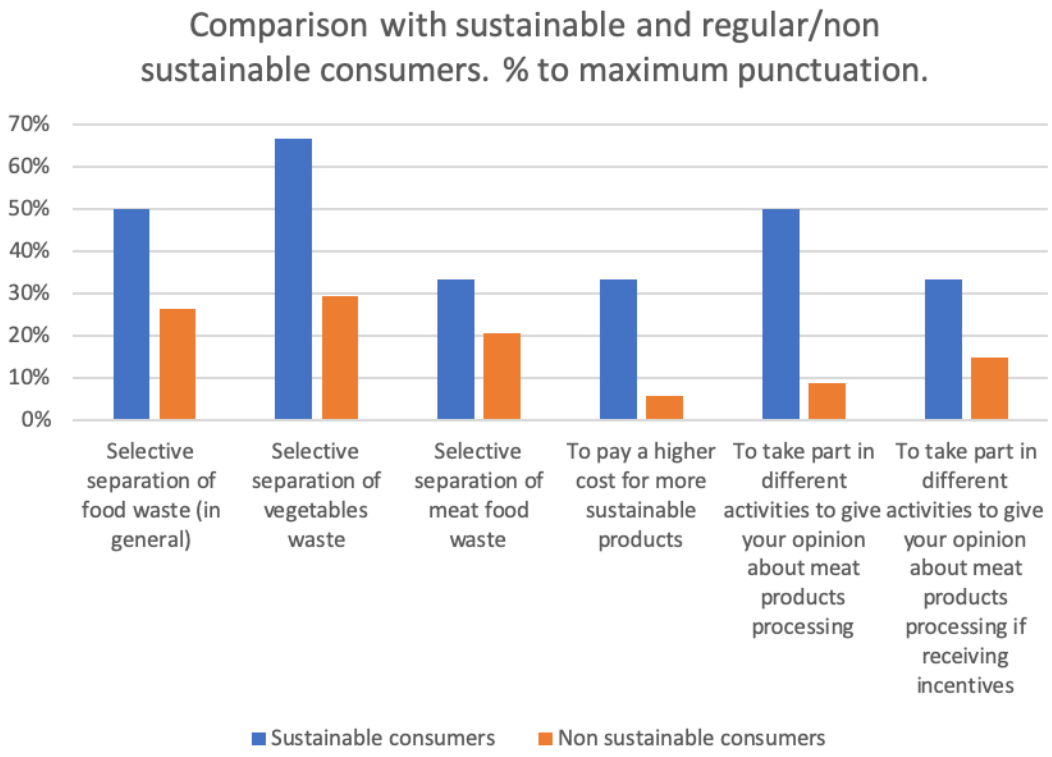
- Green purchase intention (GPI).
- Confidence on green products, labels and products.
- Attitudes towards green purchases and recycling (APG).

Finally, when analysing people personal disposition towards different sustainable behaviours, people were more willing to separate food waste in general and vegetable waste than meat waste. In addition, to pay a higher cost for more sustainable products was not well valued among participants, who were reluctant in general to that.



Regarding the differences between type of consumers, there are remarkable differences between sustainable and regular/non sustainable consumers in their personal disposition to carry on with sustainable daily actions.





This questionnaire has shown consumer attitudes about recycling and consumption habits. It has shown some differences between sustainable and non-regular consumers, especially in their willingness to carry out sustainable actions. The questionnaire should be considered as a first approach, which will be further studied and developed in the surveys which will be conducted in Task 3.6. of CIRC4Life.

The topics covered in the survey listed in the introduction will be the basis of the development of the new survey, so all the aspects to be considered about green purchase, sustainable consumption and recycling attitudes will be studied.

4.2.3 Apply the Approach for Organic Vegetable Products

Data mining technology usage in the vegetable sector is very difficult to obtain and somewhat irrelevant. Fresh food products are characterised by multiple, frequent sales that do not fit in to the pattern of online review by consumers for products such as electronic devices.

For this reason, the chosen methodology for co-creation in vegetable products will be:

- Consumer survey, using an online survey tool to ascertain:
  - Socio-economic background
  - Understanding of ethics of food production
  - Assessment of consumers' care about environmental and social issues of food
  - Whether consumers are prepared to pay more for food with lower impacts
  - Understanding of food waste issues in homes
  - Co-creation ideas with Scilly Organics and feedback of proposed new products

This survey will cover both residents of, and visitors to St Martin's and other islands on the Isles of Scilly. The results from each group however will be separated to obtain better quality information.

- Business surveys based on face to face interviews with business customers. This will aim to understand:

- Current understanding of environmental and social impacts of products they sell
- Current waste system and any moves towards waste reduction, reuse and recycling
- Co-creation of products with Scilly Organics and ideas for new products
- Methods to communicate better with their own customers – and how that can feed in to the process of co-creation

The survey will be conducted from M15 – M18 (July – October 2019), and the survey results and analysis will be reported in D3.4 that is due to submit on the project M18.

5 Conclusions

For the preparation of this report, the most important consumer groups, stakeholder groups, and their interactions in the five planned demonstration scenarios were examined with regard to the necessary information for the three CEBMs design and those processes were identified that could contribute sustainable demonstrators' development.

A preliminary questionnaire has been conducted to investigate consumer attitudes about recycling and consumption habits. It has shown some differences between sustainable and non-regular consumers, especially in their willingness to carry out sustainable actions. The findings reported in this deliverable will be the basis of the development of the new survey, so all the aspects to be considered about green purchase, sustainable consumption and recycling attitudes will be studied.

An innovative leasing service package was initiated that gives a broader picture and links to the four key elements: key functionalities and sales arguments for leasing service; roles for each business partners; revenue sharing model; identification of the potential end-customer types. The leasing service was validated in several internal and an open external workshop and in the demonstrator cases. Both of the LED lighting companies (KOS, ONA) will benefit from developing new sustainable LED lighting demonstrator products, which will be reported in Deliverable 1.5.

The involved companies went through an iterative learning process together with all other partners to build up their supply chains interactions by applying the Living Lab approach. Each demonstrator illustrates that this process leads to eco-innovation providing significant environmental impact reductions. This can be related to increased resource efficiency as well as to improved energy efficiency. It became evident that synergies can be found between product development and supply chain interactions in circular economy context. The demonstrators' showed that it is possible to generate sustainable revenue stream with circular economy business models. Solutions like design consumers preferred products by mining online reviews, encouraging and improving consumers' recycling and reusing practices, lighting as a leasing service, are some key strategies to do so.

To conclude, it is key to change the linear economy paradigm and embrace change towards circular economy business models. An attractive concept lies in the circular economy, but also other non-linear concepts might be valuable. This change provides also the insight that supply chain interactions require systemic approaches in which different stakeholders become key partners. To deal with this complexity an iterative Living Lab approach supports good practices to gradually reduce the uncertainties, make assumptions explicit and validate them. This iterative learning and validation make the companies agile and flexible to deal with the fast-changing conditions of technology, markets, capabilities, etc.

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7 Appendices

Appendix 1 - Questionnaire for KOS Leasing Service for LED Industrial Lighting product

Dear Kosnic customer/partner
Open call for participate in the co-creation workshop, DAY MONTH YEAR, London, UK
Kosnic is arranging a facilitated innovation workshop for our customers and partners. The workshop is a part of the CIRC4Life – project, which is supported by the European Commission H2020 circular economy programme.
The workshop brings together a diverse set of our customers and partners who have a passion for systemic change and who consider sustainability as an important driver for their business.
The aim of the workshop is to co-creating LED lighting products and services in order to

- develop a system in which various stakeholders can easily interact with each other to facilitate the use/reuse of end-of-life products and reduce waste and
- to support our customers and partners to actively implement the sustainable solutions and circular economy in their everyday business activities and
- to transfer Kosnic offerings from product-oriented approach towards use and results oriented services which are helping our customers and partners to do more successful and sustainable business.

In the workshop, participants will openly share their knowledge and experience to find solutions how to further develop the preliminary LED lighting product-service concepts which CIRC4Life – project has so far conceptualised.
If you are interested to 1) join the workshop OR 2) willing to respond to a few questions relating to the above development activities, complete the following online survey.
www
Among the respondents, we will provide a prize draw for all completed surveys that have been filled out to a satisfactory and useful manner. This will be drawn at random with various prizes offered including and iPad, an Amazon Alexa, and monetary gift vouchers.

Deadline for answering is DAY MONTH YEAR.
Look forward to meeting you at the workshop

Questions for online survey

1. Name

2. Company:

3. I am:

- A contractor
- A wholesaler
- A maintenance manager
- A lighting designer
- A business owner
- Work for an Facility management company
- An end user

The current state of your corporate environmental sustainability strategy

Environmental sustainability involves making decisions and taking action that are in the interests of protecting the natural world. Corporate strategy encompasses the way in which firm's various business operations work together to achieve particular goals and to achieve a competitive advantage over its competitors. Environmental sustainability strategy define all the goals and factors that contribute to the quality of environment within your company. This strategy helps to make long term decisions that will reduce your business' negative impact on the environment.

The following questions evaluate the current state of your firm's Environmental sustainability strategy.

1. Our firm has a written strategy (or plan) for environmental sustainability

(1) No (2) Yes (3) I don't know

2. How important is environmental sustainability to your company?

(1) Highest priority, (2) Top-three priority, (3) Top five priority, (4) Less than top five priority

3. Environmental sustainability is aligned with our firm's business goals, mission and values.

(1) Strongly disagree, (2) Disagree, (3) Somewhat disagree, (4) Neither agree or disagree, (5) Somewhat Agree, (6) Agree, (7) Strongly agree

4. Our firm is using environmental sustainability to build, maintain or improve our brand reputation

(1) Strongly disagree, (2) Disagree, (3) Somewhat disagree, (4) Neither agree or disagree, (5) Somewhat Agree, (6) Agree, (7) Strongly agree

5. We are improving operational efficiency and lowering cost by operating in an environmentally friendly way

(1) Strongly disagree, (2) Disagree, (3) Somewhat disagree, (4) Neither agree or disagree, (5) Somewhat Agree, (6) Agree, (7) Strongly agree

6. Would your firm potentially be interested in becoming a Kosnic partner of a circular business model? (for relevant FM company or contractors only)

(1) Definitely not
(2) Maybe later when Kosnic have validated that the suggested circular business model is genuinely working (and terms are reasonable for us)
(3) We are willing to try the ready-made business model among the first ones (if the terms are reasonable for us), but we do not want to participate on the business model development activities
(4) Definitely yes and we want to actively co-create the business model together with Kosnic

Your company lighting system

These questions are mainly for business owners/end-users. If you are from a different background (i.e. Contractor, Lighting Designer) please provide an overview of an average existing lighting system that you would see on most of your projects.

1. What type of lighting system do you currently have?

2. How often do you change/upgrade your lighting system?

- Once every couple of years
- Every 5 years
- Every 10 years
- When there are numerous faults / Ad hoc

3. When did your firm last change/upgrade your lighting system?

- We have never changed the lighting system
- Less than year ago
- 1-3 years ago
- 3-5 years ago
- 5-10 years ago
- 10-15 years ago
- more than 15 years ago

4. How often would you say that you suffer from faults to your current lighting system?

- Every month
- Every quarter
- Every 6 months
- Every year
- Very rarely

5. When an aspect of your lighting system goes faulty (i.e. lamp, driver/ballast, battery), do you spot replace it instantly? Or wait until multiple faults have occurred?

- Spot replace instantly
- Wait until multiple faults have occurred and replace in bulk

How would you (or your customers) like to buy lighting systems?
If there were multiple ways to buy the proposed lighting product and service, which of the following options would you find most desirable?
Rank the following options (A to D) by giving (1) the most describable option, (2) the second-best option, (3) the third-best option and (4) the least desirable option.
We (or our customers) would rather buy …

- **A) Products**: In this case, ownership of the product(s) is transferred to the end user and all related services are managed by them.

- **B) Product-oriented services**: Similar to selling products, but some extra services are added via service agreement. Typical services are 1) maintenance contract, 2) a financing scheme, 3) the supply of consumables, 4) a take-back agreement and 5) advice and consultancy.

- **C) Use-oriented services:** The ownership of the product(s) remains with the lighting system provider and a set of predefined services are included into a service agreement. Typical services are 1) product lease where lessee pays regular fee for the usage of the product or 2) renting or sharing.

- **D) Result -oriented services:** The customer and lighting system provider agree on results, and there is no pre-determined products or services involved. Lighting system provider will independently define a set products or services, which are required to meet the defined result criteria. Typical services are such as 1) activity management/outsourcing, 2) pay per service unit or 3) functional result (e.g. 'lighting environment according to regulation.
  A) Standard sale. Ownership of product transfers and becomes end user's responsibility
  B) Ownership of products transfer but a maintenance contract, finance scheme etc. is agreed upon.
  C) Ownership remains with supplier and a leasing service/maintenance contract is agreed upon.

Which of the following lighting system related services do you find the most interesting?
The interpretation of the numeric scale is as follows:

0 - Not interested at all, **1 -** Little interest, **3** - Interested, **9 -** Extremely interested

	Not at all	**Little**	**Medium**	**Very**
(1) A financing scheme to purchase lighting system	0	1	3	9
(2) Maintenance contract including the supply of consumables	0	1	3	9
(3) A take-back agreement including end-of-life recycling or re-use	0	1	3	9
(4) Advice and consultancy related to lighting	0	1	3	9
(5) Short term lighting system renting	0	1	3	9
(6) Medium to long term lighting system lease	0	1	3	9
(7) Option to upgrade lighting system under leasing system	0	1	3	9

The advantages of the leasing lighting systems services instead of buying products.
There are multiple advantages for renting/leasing services instead of buying products. In your opinion, which of the suggested rent/leasing advantages do you consider the most relevant for your business?

The interpretation of the numeric scale is following:

0 - Not interested at all, **1 -** Little interest, **3** - Interested, **9 -** Extremely interested

	Not at all	**Little**	**Medium**	**Very**
(1) Avoiding ownership / avoid risk of ownership	0	1	3	9
(2) Balanced cash outflows	0	1	3	9
(3) Quality assets	0	1	3	9
(4) Better usage of capital	0	1	3	9
(5) Tax benefits	0	1	3	9
(6) Off-balance sheet dept	0	1	3	9
(7) Better planning	0	1	3	9
(8) Low capital expenditure	0	1	3	9
(9) No risk of obsolescence	0	1	3	9
(10) Termination rights during the contract period	0	1	3	9
(11) Possibility to upgrade or downgrade the equipment if our needs change	0	1	3	9
(12) Hassle free for us so we can focus on our core business activities	0	1	3	9

The disadvantages of the leasing lighting systems services instead of buying products?

There are also multiple disadvantages for leasing services instead of buying products. In your opinion, which of the following leasing disadvantages you consider the most relevant for your business?

The interpretation of the numeric scale is following:

0 - Not interested at all, **1 -** Little interest, **3** - Interested, **9 -** Extremely interested

	Not at all	**Weak**	**Medium**	**Highly**
(1) Not able to claim capital allowances	0	1	3	9
(2) Putting down a deposit or having to make some payments in advance (e.g. due installation costs)	0	1	3	9
(3) Higher overall costs than buying the lighting system outright	0	1	3	9
(4) Inflexible medium or long-term agreement which is difficult to terminate	0	1	3	9
(5) Leasing agreements are more complex to manage than simply buying products	0	1	3	9
(6) Loss of ownership incentives	0	1	3	9
(7) No alteration or difficult to upgrade/downgrade if our needs are changing	0	1	3	9
(8) Penalties on termination of lease	0	1	3	9
(9) Loss of salvage value of the asset	0	1	3	9

Which of the following payment options do you find the most interesting for leasing lighting services?

1. Would your company (or customer) rather prefer stepped or flat lease/service payment for lighting system?

- **Stepped payment** (see illustration 1) where 1) installation fees are paid in full at the start, 2) the product cost is paid up-front over the first years of the lease contract
- **A flat rate** (see illustration 2) payment which is calculated over the whole leasing time period

2. Which of the following contract durations would your company prefer for their lighting system?

- Yearly
- 1 to 3 years
- 3 to 5 years
- 5 to 10 years
- 10 years plus

3. If the monthly leasing service cost could be covered by the electricity cost saved by upgrading to LED lighting, would you (or your company) be more willing to switch to a leasing system for your lighting …

- We are not interested on leasing services
- Only when there is a genuine need to change/upgrade our lighting system anyway
- Only when the switching cost from the current lighting system is low
- As soon as the switching cost from the current lighting system is moderate
- Even if the switching cost from the current lighting system is high

Your willingness to attend the co-creation workshop
Would you like the opportunity to explore more about this by attending our co-creation workshop in DAY MONTH YEAR, London, UK? During the workshop we will provide meal and refreshments.

- **No**, I am not interested at all
- **Maybe some other time** (I want to join the mailing list which informs the possibilities to join in further workshops)
- **Yes**, but only **if I receive a consulting fee** for my participation
- **Yes**, but only **if my travelling expenses are covered**
- **Yes**, I am willing to join **for free of charge**

Appendix 2 - Questionnaire for meat product

General information

1. Gender

Male: ☐ ; Female: ☐

2. Age
   - 18-24 years..... ☐
   - 25-29 years..... ☐
   - 30-34 years..... ☐
   - 35-39 years..... ☐
   - 40-44 years..... ☐
   - 45-54 years..... ☐
   - More than 54 years..... ☐

3. Please, indicate your educational level:
   - No education ..... ☐
   - Primary education..... ☐
   - Secondary education ..... ☐
   - Key Skills Qualification ..... ☐
   - University ..... ☐

4. Country of residence:……

5. Place of residence:

   Urban dweller ☐ ; Rural dweller ☐

6. Size of your municipality of residence:
   - <5.000 inhabitants ..... ☐
   - ≥ 5.000 ; <20.000 inhabitants ..... ☐
   - ≥ 20.000 ; <50.000 inhabitants ..... ☐
   - > 50.000 inhabitants ..... ☐

Questions to identify if the consumer has sustainable habits or not

1) Below, it will be shown different labels that identify certain types of products. Please, indicate if you have consumed products with this label and if you know which type of product correspond to each label:

a)

What type of product do you relate this label to?

- Organic food ..... ☐
- Dietary food ..... ☐
- Gluten-free food ..... ☐
- Food with European quality certificate ..... ☐
- Denomination of origin products ..... ☐
- Other (to specify) .....

b)

What type of product do you relate this label to?

- Organic food ..... ☐
- Dietary food ..... ☐
- Gluten-free food ..... ☐
- Food with European quality certificate ..... ☐
- Denomination of origin products ..... ☐
- Other (to specify) .....

c)

What type of product do you relate this label to?

- Organic food ..... ☐
- Dietary food ..... ☐
- Gluten-free food ..... ☐
- Food with European quality certificate ..... ☐
- Denomination of origin products ..... ☐
- Other (to specify) .....

d)

What type of product do you relate this label to?

- Organic food ☐
- Dietary food ☐
- Gluten-free food ☐
- Food with European quality certificate ☐
- Denomination of origin products ☐
- Other (to specify)……

e)

What type of product do you relate this label to?

- Organic food ☐
- Dietary food ☐
- Gluten-free food ☐
- Food with European quality certificate ☐
- Denomination of origin products ☐
- Other (to specify)……

f)

What type of product do you relate this label to?

- Organic food ☐
- Dietary food ☐
- Gluten-free food ☐
- Food with European quality certificate ☐
- Denomination of origin products ☐
- Other (to specify)……

2) Please, indicate which of the following definitions corresponds to an organic food:

- Organic food is this one that has been produced without using synthetic pesticides or fertilizers, but only natural, and avoids all types of transgenic alteration respecting the natural system or ecosystem where the product is developed ☐
- Organic food is this one that has been produced in a natural way and does not contain harmful products to health ☐

- Organic food is this one that has been cultivated in a traditional way with techniques of a lifetime and that is whole .....☐

3) Please, indicate how often do you consume organic food:

- Every day or almost every day .....☐
- Two or three times a week.....☐
- Once a week .....☐
- Once every two or three weeks .....☐
- Once a month .....☐
- Less often.....☐

4) Do you consider it useful to recycle? Yes: ☐ ; No: ☐

5) Please indicate what waste is deposited in each of the following dustbin:

a)

- Plastic, cans and bricks .....☐
- Paper and board .....☐
- Glass.....☐
- Organic waste .....☐
- Other.....

b)

- Plastic, cans and bricks .....☐
- Paper and board .....☐
- Glass.....☐
- Organic waste .....☐
- Other.....

c)

- Plastic, cans and bricks ..... ☐
- Paper and board ..... ☐
- Glass..... ☐
- Organic waste ..... ☐
- Other.....

d)

- Plastic, cans and bricks ..... ☐
- Paper and board ..... ☐
- Glass..... ☐
- Organic waste ..... ☐
- Other.....

e)

- Plastic, cans and bricks ..... ☐
- Paper and board ..... ☐
- Glass..... ☐
- Organic waste ..... ☐
- Other.....

6) Do you know the location of the Recycling Park of your municipality? Yes: ☐ ; No: ☐
7) Do you usually separate waste for recycling at home? Yes: ☐ ; No: ☐
8) Do you follow the information about environmental issues in the media? Yes: ☐ ; No: ☐

With these questions we want to classify consumers in three main groups: sustainable consumers, medium consumers and non-sustainable consumers.
Sustainable consumers will be considered those who answer the questions as follow:

1) They classify at least two a), b) and c) labels as organic food.
   They don't classify d), e), or f) labels as organic food.
2) Choose the first option.
3) They consume organic food at least once a month.
4) Select "Yes" as answer.
5) They answer correctly about the waste to be deposited in each dustbin
6) Select "Yes" as answer.
7) Select "Yes" as answer.
8) Select "Yes" as answer.

Non-sustainable consumers will be considered those who answer the questions as follow:

1) -
2) They don't choose the first option.
3) They don't consume organic food at least once a month.
4) -
5) They don't answer correctly about the waste to be deposited in each dustbin (one mistake).
6) Select "No" as answer.
7) Select "No" as answer.
8) Select "No" as answer.

The rest of the consumers will be considered as medium consumers.

Specific questions for our CEBM for both groups

- Do you know if meat can be recycled and reused in other processes? Yes: ☐ ; No: ☐
And how?.....
- How would you like to change meat production processes if you were able to do that?
  - Improving animal healthcare .....☐
  - Using resources from your area .....☐
  - Preserving nutritional value of products.....☐
  - Promoting local business.....☐
  - Other.....

- Would you bring your organic waste to a container so it can be recycled? Yes: ☐ ; No: ☐
- Would you bring your expired meat to a container so it can be recycled? Yes: ☐ ; No: ☐
- Would you consider to separate at home general waste and expired meat so it can be recycled? Yes: ☐ ; No: ☐
- Which are the incentives you consider needed to promote recycling?
  - Discounts in products.....☐
  - Money.....☐
  - To punish people who do not recycle properly .....☐
  - Awareness campaigns and marketing.....☐
  - Other.....

Next, value from 1 to 5 the importance that you consider of the following aspects about meat products, being 1 not important and 5 totally important.

Sustainable origin of the ingredients	1	2	3	4	5
Sustainability and recyclability of the package	1	2	3	4	5
Decrease in the use of antibiotics	1	2	3	4	5
Use of local products for production	1	2	3	4	5
Use of renewable energies for production processes	1	2	3	4	5
Use of organic fertilizers instead of chemical ones in agriculture for animal feeding	1	2	3	4	5
Reuse of waste from production in other processes	1	2	3	4	5
Existence of an eco-label	1	2	3	4	5
To know sustainable information of products	1	2	3	4	5

Specific questions for our CEBM for sustainable consumers

- Which one do you think is the most important impact in the production of meat food from the environmental point of view? You can select more than one option

- Transport ☐
- Energy consumption in production processes ☐
- Animal feeding production ☐
- Land occupation for meat production ☐
- Other.....

- Which one do you think is the best way to make consumers buy sustainable products? You can select more than one option

- Giving incentives to consumers ☐
- Showing ecological information of products in the package ☐
- Showing ecological information of products in a QR you can scan ☐
- Explaining products characteristics in awareness campaigns ☐
- Other.....

- Which are the main barriers you find for meat recycling?

- Difficulties to separate meat waste ☐
- Difficulties to store meat waste at home ☐
- Discomfort due to a bad smell at home ☐
- Discomfort due to liquids and dirt in your fridge ☐
- Discomfort due to a bad smell around a dustbin for the recycling ☐
- Obtaining compost through meat waste is easier and already developed ☐
- It does not compensate the CO_2 emissions due waste transport ☐
- Other (to specify).....

Then, value from 1 to 5 your personal disposition in the following cases:

Selective separation of food waste (in general)	1	2	3	4	5
Selective separation of vegetables waste	1	2	3	4	5
Selective separation of meat food waste	1	2	3	4	5
To pay a higher cost for more sustainable products	1	2	3	4	5
To take part in different activities to give your opinion about meat products processing	1	2	3	4	5

To take part in different activities to give your opinion about meat products processing if receiving incentives	1	2	3	4	5

- Other comments:

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