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A circular economy approach for lifecycles of products and services

Report on the stakeholder involvement along the supply chain

Deliverable 7.3

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Summary

Deliverable 7.3 'Report on the stakeholder involvement along the supply chain' is the result of Task 7.4 'Stakeholder interactions' of Work package 7 'Stakeholder Interaction and End-user Involvement'. The main objective of this document is to understand the interactions between stakeholders in the supply chain of different activity sectors in order to achieve co-creation of products.

For that purpose, a brokerage system has been developed so supply chain can be tracked down, it allows understanding which actors are collaborating among them, and innovative business opportunities can be created. This is, resources can be interchanged between industries from different or similar activity sectors. In the new circular economy frame, these tools have vital importance so resources are not wasted, but they are used in other processes.

Furthermore, an analysis of the supply chain mechanisms and waste patterns has been performed for industries from various activity sectors. After that, possibilities to develop circular economy approaches in each activity sector have been proposed. A description about the traceability technique using the EPCIS Standard (developed in Task 5.2) has been included and advices on how companies could benefit from its use have been proposed.

Finally, and considering all the study performed, an approach for business partner selection was developed. This approach will help industries to co-create products in a more sustainable way and will help them to identify which kind of stakeholders can be relevant for their purpose. Some indicators have been proposed in order to measure the most suitable interactions.

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Acronyms and abbreviations

Abbreviation	Description
MVP I	Minimum viable product. First version.
B2B	Business-to-business.
CE	Circular Economy
CEBM	Circular Economy Business Model
ICT	Information & Communication Technology
LCA	Life Cycle Assessment
E-LCA	Environmental Life Cycle Assessment
S-LCA	Social Life Cycle Assessment
EPCIS	Electronic Product Code Information Services
WEEE	Waste of Electric and Electronic Equipment
IPCC	Intergovernmental Panel on Climate Change
GHG	Greenhouse gas
R&D	Research and Development
CRMs	Critical Raw Materials

1. Introduction

In the last 25 years, the total amount of resources consumed in the planet has increased by 65%. In 2050 the global population is expected to grow until 9.7[1] billion of inhabitants, while the demand of resources is expected to be three times larger than today.

The Global Footprint Network[2] calculates every year the "Earth Overshoot Day", the date which marks when humanity's demand for resources and services in a given year exceeds what Earth can regenerate in that year. This date has moved from late September in 1997 to July 29th in 2019, the earliest date since the world first went into overshoot in the early 1970s.[3] This means that in 2019 the consumption of the 7.7 billion inhabitants was equivalent to the resources 1.75 planets could provide.

In that context, using resources more efficiently is key in order to reduce our footprint and move towards more sustainable behaviour. This is a vital aspect that society needs to consider.

The principles of circular economy will be one of the main aspects the society will have to integrate and develop in the next decades. To consider waste as a resource is vital for a more sustainable growth and development in the near future.

A better understanding of the mechanisms, waste patterns and material flows exchange in the value chains of different activity sectors can help companies collaborate to minimise waste and use resources more efficiently. That information, together with the study of the industries and companies established in the territory, can help in defining an approach on how companies and sectors can develop innovative business models and make their process more circular through interacting.

This report focuses on the interactions between different stakeholders/businesses in the supply chain, in order to achieve co-creation of products. This will enable new circular economy business models to be created, operating in an innovative way that ensures consumer preferences and drivers are integrated in to product design, development and production, resulting in products with lower impacts and reduced waste, whilst creating business opportunities.

[1] https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf
[2] http://www.footprintnetwork.org/
[3] https://www.overshootday.org/newsroom/past-earth-overshoot-days/

2. Stakeholder involvement through the brokerage system

In order to facilitate communication between companies, identify trade relationships and enable new business opportunities an online brokerage system has been developed. The brokerage system will allow companies from various and diverse activity sectors to offer or purchase different kind of resources (wastes, by-products, raw materials…) as well as to make new business relationships.

2.1. Brokerage system development

The brokerage system is a B2B solution that enables companies from different activity sectors bringing their resources into the cycle of Circular Economy regardless of whether it is waste, a by-product or overproduction and share them in a sustainable way.

Furthermore, this tool will allow companies to find synergies in order to develop circular economy innovative business models with other actors of their activity sector or others. These relationships will help companies not only to acquire resources from other companies or to offer them, but also to identify relevant business actors which may help them to achieve circular economy in their business.

A brokerage system could help to extend current trade networks, since the easy possibility of getting in contact with companies from other sectors and characteristics is given in this online web service.

It has to be remarked that the brokerage system was developed within the collaboration of two tasks of CIRC4Life project: Tasks 7.4 and Task 4.7. The use of a brokerage system to engage stakeholders was one of the main objectives of Task 7.4 and to develop the concept of the brokerage system was part of Task 4.7, so there was a clear possibility of collaboration between them. In addition, there was a lack of resources for the development of a tool in the framework of Task 7.4, so without this collaboration, an external tool (not managed by CIRC4Life partners) would have been needed. For that reason, Task 7.4 and Task 4.7 have agreed to make the developed concept (T4.7) available in a test version (MVP I), which is now used as the Brokerage System.

It should be mentioned that the test version has the necessary functionalities and robustness for inviting external stakeholders who can make real use of the system, interact between them and make trade relationships. However, the brokerage system is subject to future improvements.

The specifications of the brokerage system core functions based on a standardised n-step maturity level model will be shown in the Deliverable 4.5 “Report on the development of a standardised n-step maturity level model with necessary skills for CE collaboration”.

The provision of a test version was a big challenge for Task 7.4 and Task 4.7 as their different time schedules have affected the expected results of the available Brokerage System. Further actions based on that are proposed in section 2.3.

Figure 1. CIRC4Life Circular Economy Brokerage home page (https://circ4life-brokerage.iccs.gr/)

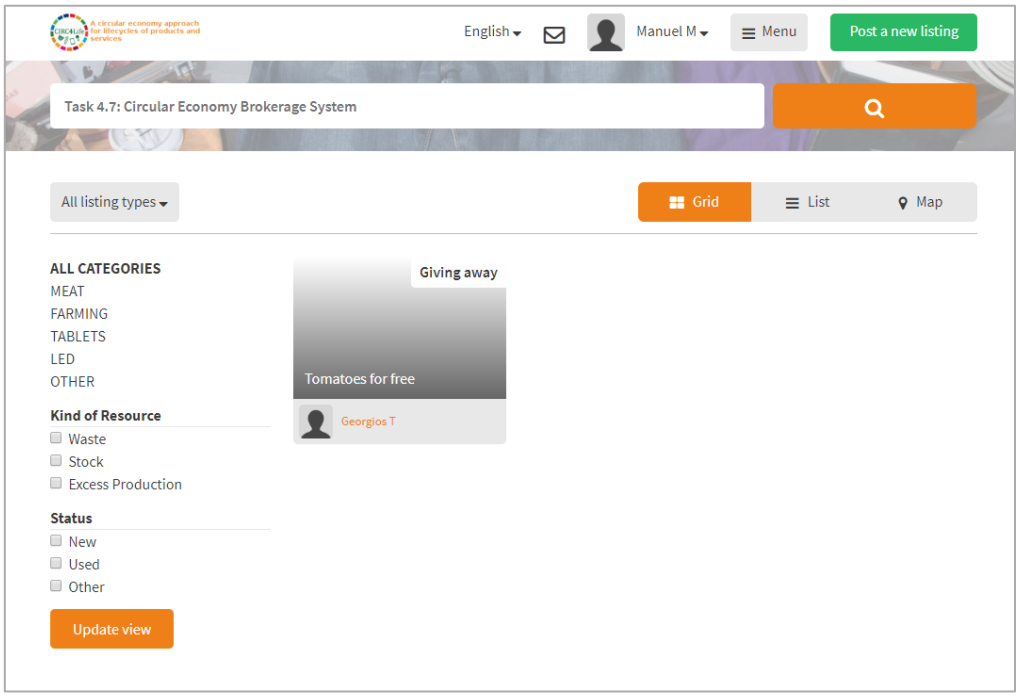

Figure 2. CIRC4Life Circular Economy Brokerage main menu

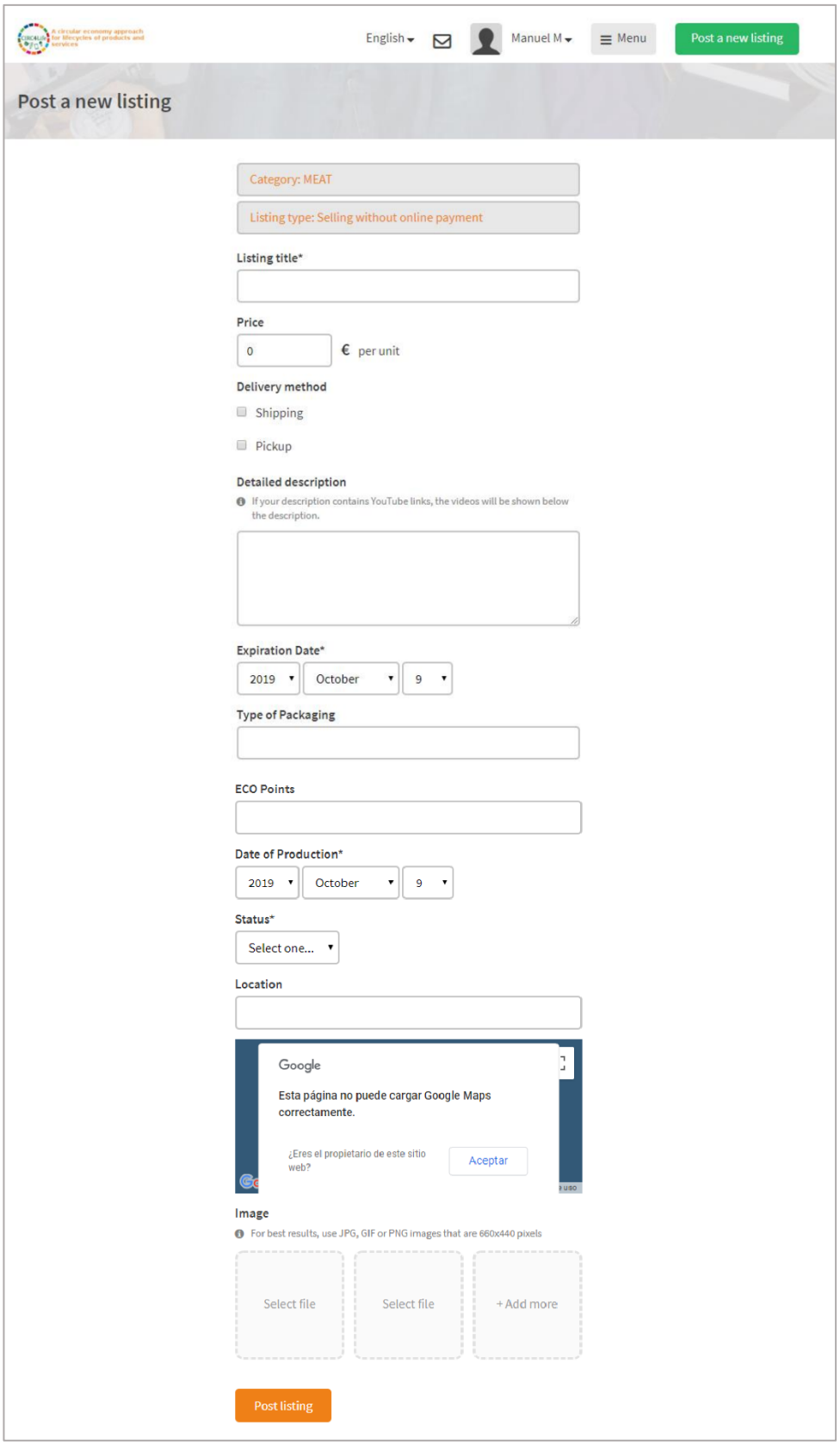

Figure 3. CIRC4Life Circular Economy Brokerage Post a new listing section

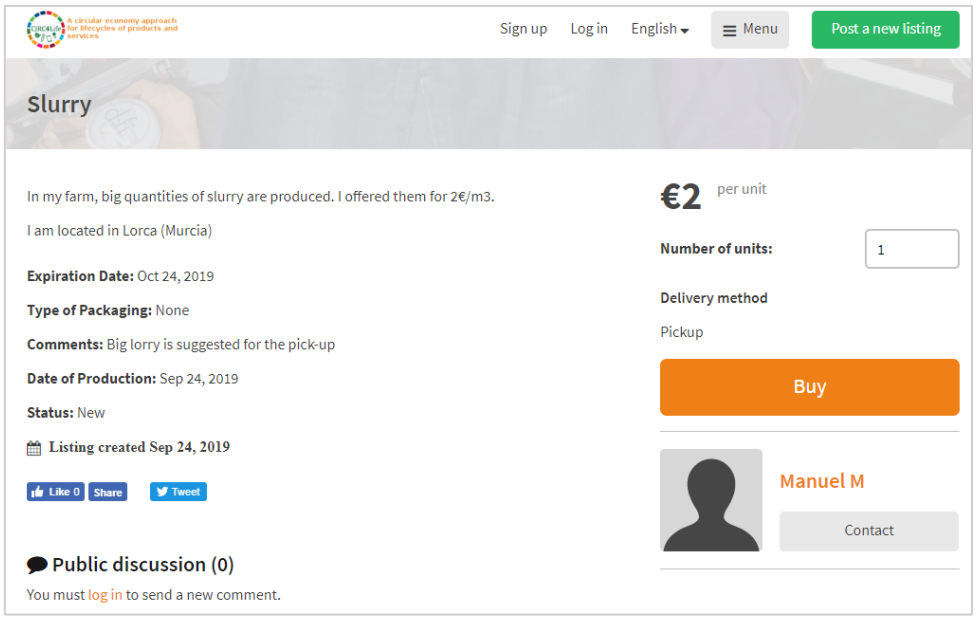

Figure 4. Example of resource offered in the system

2.2. Stakeholder engagement

The engagement of stakeholders is a crucial aspect for the success of the system and the achievement of relevant results. In its first stage, considering both, the inherent difficulties the satisfactory engagement of stakeholders and the lack of time due to the conflict of schedules with the two tasks involved, partners have focused in the four main sectors involved in the project: meat, vegetable, electric and electronic sectors. In addition, the UK, Spain and Belgium have been the three main target countries.

By focusing the target groups in this way, companies which use the brokerage system will be located in near areas and will offer/purchase more similar products, which will make the trade relationship among them easier. It should be noted, that the overall concept of the Brokerage System considers all companies regardless of their origin country and activity sector.

In this task, relevant stakeholders from the mentioned core activity sectors have been identified and engaged in order to participate in the system. They have been classified according to the level of relevance to our project as well. A list of the stakeholders to be engaged is shown in the Appendix I.

In the Appendix II it can be seen the template email developed to make the first contact with the stakeholders. Other channels as LinkedIn, Twitter or phone calls are suggested.

It has to be mentioned that for the identification of the stakeholders, the previous work done in Task 7.3 (CIRC4Life Innovation Camp) has been used as a starting point. However, in the framework of Task 7.4, we have focused in the selection of the most relevant ones for the use of the brokerage system.

In order to engage a sufficient number of users there are a few aspects that have been considered as crucial in the brokerage system:

- Firstly, it is vital that the IT part of the system, the matchmaking logic, is efficient in the way it relates each company which each other. Quality search criteria are essential for the success of the system.
- The data protection of companies registered in the platform has to be completely ensured as well. A not reliable system regarding this will be an obstacle for the engagement.
- The interface of the system needs to be clear and attractive for the users. The first few seconds while visiting a website can determine if someone will continue using it or not, no matter how good the system is.
- The use of the system needs to be easy, as companies will not spend time in using a tool with difficult or confusing use.

All these items have been considered during the development of the first version of the tool. In this direction, feedback from external users is of great importance. The feedback of external agents will be included in the final concept of the Brokerage System. In order to gather as much feedback as possible, partners will follow-up the stakeholders engaged so valuable information can be gather and a *Contact us* section has been included in the tool as well.

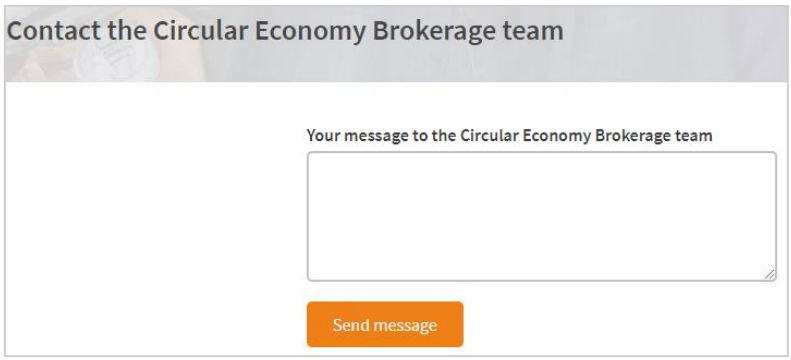

Figure 5. Contact us section of the brokerage system

The role of associations and other bodies are vital as well, as the reliability of the tool may be determined by the one who recommend it. To successfully engage an association may have enormous potential as it may have a multiplying effect and reach a big amount of its members. Lots of associations have been identified in the stakeholders list in Appendix I.

The inherent difficulties of the engagement of stakeholders in this kind of tool have been already mentioned in the beginning of this section. Along Europe, there has been several experiences during the last years, lots of them promoted by the public administration, and they have not achieved successful results. However, due to the emergence of the Circular Economy and considering the growth in the awareness, legislation and possibilities found from every actor of the supply chains, these platforms may gain importance in the next years.

2.3. Results obtained, further steps and limitations

Due to the conflict of schedules between Tasks 4.7 and 7.4 of the project, there are clear shortage of results obtained from provided brokerage system at this moment. The brokerage system first version was finally ready for its use in the middle of September, so not much time was left for the engagement of external actors. In addition, the version available in the framework of this task is the first one (MVP I). In the next steps of Task 4.7, the concept of the brokerage system will be updated based on the feedback coming from the external users as well as on the further development of the n-step maturity model. This concept can be used as the basis for further versions.

At this time the test version of the brokerage system focuses on the operational level, i.e. the standardized listing of offerings is matched with the search queries of potential buyers. Further functionalities at the strategic level, i.e. the long-term collaboration between actors based on the brokerage system, are only taken into account in the extended scope of the concept in Deliverable 4.5. Likewise, CE match making in the extended scope is to be automated and self-learning with the help of algorithms in comparison to the current MVP I.

Furthermore, the success of the system should be analysed considering the first results of the system (number of users, identified problems, transactions made, etc.), so the new versions of the brokerage system concept will include this input.

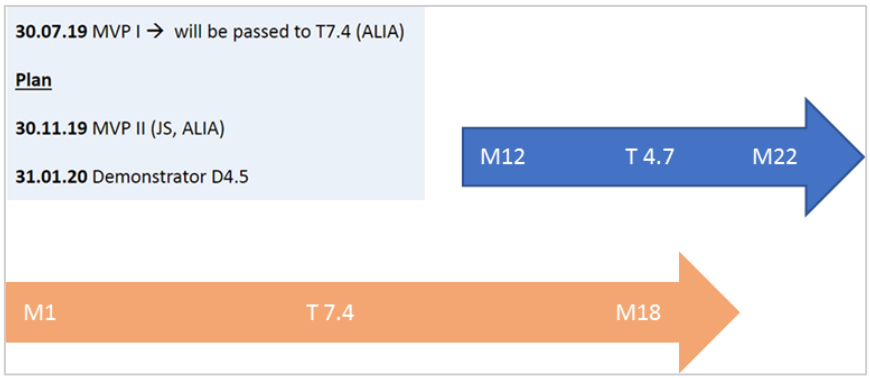

Figure 6. Conflict of schedules between tasks 4.7 and 7.4

Considering the problems and limitations mentioned above and the results obtained, it is noticeable that the final objective of the brokerage system has not been satisfied at this moment. Thus, it is important to define a plan for the next steps of the project.

In task 4.7 the development of the brokerage system concept will continue until M22 of the project. During this time, ALIA and JS, the responsible partners of the demonstrators in the meat supply chain and the vegetable sector respectively, will collaborate actively for an updated final version of the concept. Feedback from external companies who may use the system will be included in the next version.

Once the system and the concept are finally developed, the engagement will continue and the results will be shown in the correspondent deliverables of the demonstrations, Deliverable 6.3 “On site demonstration of CEBM for vegetable foods” and Deliverable 6.4 “On site demonstration of CEBM for meat supply chain”. ALIA, as responsible partner of this task will include in Deliverable 6.4 a summary of results of the brokerage system and the results obtained, not only those related to the meat sector but a general view of them.

The results obtained should serve as knowledge to understand how companies interact among them. In this direction, the brokerage system should not be just a tool to study their traditional trade relationships, but a tool which could give a new view on how they interact when they have new opportunities to make relationships with others.

In order to draw useful and relevant conclusions, a relevant number of companies should use the system and interact with it. Work is needed for that and will be done in the next stages of the project.

3. Waste patterns and business interactions along the supply chain

3.1. Waste patterns in value chains

To conduct the study of waste patterns in the supply chain of different activity sectors, two main groups and four main sub-groups were selected according to the different demonstrators of CIRC4Life project:

- Food sector.
  - Meat sector.
  - Vegetable sector.
- Electric and electronic sector.
  - Lighting sector.
  - Tablet sector.

3.1.1. Food sector

Nowadays, according to the Eurobarometer, EPRS and FAO, approximately 1/3 of the food produced in the world for human consumption (1.300 million tonnes) is wasted every year along the whole supply chain. Within the EU, 88 million tonnes of food, which means 173 kg per person, are wasted every year, from primary production to final consumption in homes. The production and management of the food waste generates 170 million tonnes of CO_2 in the EU. The EU has the objective to reduce the total amount of food waste by 30% in 2025 and 50% in 2030.[4]

Food waste is produced along the whole supply chain, from primary productions, to restaurants and households. It has to be mentioned that most of the food waste in the EU is produced by households (53%) and food processing (19%) as depicted in Figure 7.

Figure 7. Share of EU food waste. Source[4]

However, food waste is not only produced during the different stages of the supply chain of the food industry, but also in the different activities and processes carried out in the whole sector (e.g. when large volumes of waste, both solids and liquids are generated).

Reducing this waste and using it as a resource in other processes will enormously help not only to reduce the environmental impact of the food industry, but also to bring down production costs. On the one hand, this is a source of incomes for companies which produce them, as these resources have economic value and otherwise the waste would not offer any benefit; on the other, resources coming from other industries waste are usually cheaper than raw materials.

[4] http://www.europarl.europa.eu/news/en/headlines/society/20170505STO73528/food-waste-the-problem-in-the-eu-in-numbers-infographic

There are lots of by-products related to different food sectors than can be valuable resources for others, not only in the food industry but also in other activity sectors. Extraction of pectin, essential oils from the citrus peels, and whey protein concentrate from whey are some of the examples of by-product utilisation from the food-processing industry. The by-products from processing fruits and vegetables are also found to be good sources of antioxidants and antimicrobial compounds. Microbial synthesis of single cell protein, amino acids, and vitamins is also possible by the use of whey or molasses.[5] Almond shells or olive stones can also be used as a source of energy in a biomass boiler. Though there are many more examples, these illustrate some of the ways in which wastes produced in the food industry can be used successfully as valuable resources in other processes.

To identify key stakeholders who play a role in the supply chain is vital for the development of a circular approach. These key stakeholders, even though are sometimes common for the whole food sector, have significant differences for each specific case.

3.1.1.1. Meat sector

The meat sector involves six main stages to be considered during the whole supply chain:

- Primary production.
- Animal feeding.
- Livestock farm.
- Slaughterhouse.
- Meat elaborates.
- Distribution and selling point.

The primary production makes reference to the stage involving the agriculture and production of crops to be used in the animal feeding. In this stage, agricultures, fertilizer providers and the public administration (because of directives and regulations) are key stakeholders.

The main wastes produced in this stage are packaging items and crops surpluses. The crops differ from each other, but can be used as compost or as a resource with nutritional value to be added in other processes. Some of them can also be used as a source of energy, as biomass or be incorporated in a biogas reactor. This will be further developed in the study of the vegetable sector (section 3.1.1.2).

The animal feeding stage refers to the production of livestock feeding from raw materials. In this stage, by-products with adequate nutritional or organoleptic properties are incorporated from other industries in order to make the process more efficient. As such, circular approaches already feature in this stage of the value chain. The by-products come mainly from other food industries, such as juice manufacturers or the biscuit industry.

Therefore, food industries and R&D are the most important actors to be considered in this stage in order to achieve a more circular process. The main waste produced in this stage is the rejected final product, which is not a concern as it is reusable and is incorporated again into the process most of the times (unless it contains some specific antibiotics). Minor waste as packaging materials or bio-waste are not a major problem in this stage either, since the waste produced is minimal and they are treated in the regular waste management.

The livestock farm stage uses as main resource food produced in the previous stage and other complements as veterinary consumables or medicines. The main wastes produced are manure/slurry and corpses. In Europe, more than 1.35 million tons of slurry are produced every year[6]. This waste is usually applied directly to the soil in crop fields as organic fertilizer. However, according to the Directive 91/676/EEC, only 170 Kg N/Ha in vulnerable areas can be applied. In high-density livestock areas, the amount of slurry produced is much higher

[5] Food Industry Waste: A Panacea or Pollution Hazard? Renu Khedkar, Karuna Singh. 2017.
[6] LIFE METABIORESOR (LIFE08 ENV/ES/0113)

and not all of it can be applied directly to the soil. Other alternatives for using the waste includes development of organic fertilizers and energy production in cogeneration and biodigestion plants.

The main agents involved in this stage are the suppliers of livestock feeding and other necessary products and the ones which can use the slurry or manure as a resource. This is, there are different actors which can be interested in obtaining value from this waste produced at large scale. Public administration is a relevant actor because of the introduction of regulations as well.

In the slaughterhouse stage, the animals are sacrificed and prepared for the meat elaborates process. The main waste produced is meat waste, which is managed according to the EU Directive 200/98/CE and its transposition in each European country. Companies from the cosmetic sector, pet food sector and livestock feeding producers uses the meat waste in their production, and thus, they are interested in purchasing this kind of resources from other companies in order to make their process more efficient, cost effective and environmentally friendly. Furthermore, there are other wastes which correspond directly to the animals, such as blood, hair or hooves, which are also directly used by other industries such as the cosmetic sector, food sector or pharmaceutical industry.

Regarding the meat elaborates stage, the main waste produced is the same as in the previous stage, meat waste. Different additives produced by specific manufacturers are added to the final product besides the fresh meat obtained from the slaughterhouse. It is unlikely that they come as by-products from other processes, they are usually products elaborated with raw materials.

At the selling point, the same process as in the meat elaborates plants and the slaughterhouse is performed with the meat waste. Its main role is to offer the final product to the client.

Distribution has to be considered not only in the last stage but also between all of them, as transportation is required from one stage to another. However, no major wastes are produced in here. The vehicles used are mainly ships and lorries which are expected to increase their efficiency and to reduce their environmental impact.

It is important to remark that some raw materials used in the meat supply chain, especially in the animal feeding stage, come from remote areas. A clear example is soybean, which is grown mainly in Brazil and North America and used in Europe for the animal feeding manufacture. Soybean is one of the elements of the whole process with the highest environmental impact. One of the factors that are related to this high impact is the transportation stage.

Regarding the consumption of meat product, the waste will likely be separated together with the rest of bio-waste in the future. Farmers, organic fertilizers producers, composting companies or new business models as insects' breeders which will offer insects as a source of protein for livestock feeding could be interested in using this resource. To properly collect the bio-waste is a crucial aspect in order to obtain high value products from it and to avoid its landfilling.

In Europe, according to the DIRECTIVE (EU) 2018/851 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 the collection of bio-waste must be implemented before the 31st of December of 2023.

When talking about the different stages in the meat supply chain and relevant actors in each one, some aspects such as energy, water or packaging suppliers have not been mentioned, as they are not specific inputs of the meat sector. However, all of them are important agents along the whole supply chain to achieve a circular economy model.

Table 1 shows the main wastes produced in the meat sector, their associated future use as well as the user group which may use it.

Table 1. Meat sector wastes' next use

WASTE	NEXT USE	USER GROUP
Slurry	Fertilizer	Farmers

	Development of organic fertilizers	Organic fertilizers producers
	Energy production	Industry sector
Fresh meat	Animal feed	Livestock feed manufacturers
		Pet food manufacturers
	Personal care products	Cosmetics industry
Hair	Brushes	Cleaning sector
Blood	Development of food products	Food industry
	Protein recovery	Pharmaceutical industry
Hooves	Wines	Food industry
	Collagen	Food industry
		Pharmaceutical industry
		Cosmetics industry
Biowaste	Compost	Farmers
	Organic fertilizers	Organic fertilizers producers
	Insects' breeding	Animal feed manufacturers
Plastic	New sustainable packaging	Recyclers companies
	Energy production	Industry sector

3.1.1.2. Vegetable sector

Supply chains in the vegetable sector vary according to the product, market and level of processing. However, in the case of supply to supermarkets – which makes up the majority of vegetable sales in Europe– the supply chain would include the following stages:

- Production.
- Processing.
- Distribution.
- Sales.
- Waste management.

The production stage includes the growth of vegetables, involving all stages of production up to harvest of vegetable crops.

Regarding the processing stage, this can fall in two categories:

- 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.

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.

Distribution can be carried out by different companies, including vehicles owned and run by growers, processors, supermarkets or third parties.

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.

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 as follow:

- Paper and cardboard – these may either be composted or recycled.
- Plastics – these may be either recycled or sent to and 'energy from waste' plant, according to the type of plastic.
- Metals – these may be recycled dependant on the existing facilities.
- Other farm wastes – e.g. rubber tyres, batteries, etc. are recycled if facilities exist.

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.

There is one further consideration, which is excess retail products - for example vegetables that are unsold or out of date. These could be offered to food banks, charities, or similar outlets for the reuse of vegetables that would otherwise become waste products. There are some initiatives that aim to drastically reduce the waste impact in this stage. In France, since 2016, supermarkets are forced to donate unsold food in supermarkets to charities and food banks[7]. These initiatives may continue in other EU countries.

Furthermore, waste management as the final stage of the process related to household waste has as well a major importance due to the big amounts of food waste produced at this level. Regular waste management is the usual destiny of this waste, however there are other possibilities as composting it at home or to use it for animal feeding when possible. As it has been mentioned in the previous section, 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. Then, there are some places in where the selective separation of the bio-waste is widespread and others in where it is not.

Other supply chains, not just focused in the supply to supermarkets, would include:

- Food service - supply to catering businesses, such as restaurants and cafes.
- Independent shops and wholesalers.
- Direct sales from farms – for example vegetable box schemes, Community Supported Agriculture, farm shops, etc.

In these cases, the wastes produced are similar in the common stages, so no further analysis is necessary.

[7] https://www.theguardian.com/world/2016/feb/04/french-law-forbids-food-waste-by-supermarkets

The main stakeholders related to the supply chain are the public administration, which may include regulations; R&D, which may develop new possibilities of getting value from the wastes; waste managers, retailers and other farmers which may use the wastes or by-products generated in farms for obtaining value products from waste.

Table 2 shows the main wastes produced in the vegetable sector, their associated future use as well as the user group which may use it.

Table 2. Vegetable sector wastes' next use

WASTE	NEXT USE	USER GROUP
Biowaste	Compost	Farmers
	Organic fertilizers	Organic fertilizers producers
	Insects' breeding	Animal feed manufacturers
Paper and cardboard	Composted	Farmers
	Recycled	Paper industry
Plastic	New sustainable packaging	Recyclers companies
	Energy production	Industry sector

3.1.2. Electric and electronic sector

Raw materials are crucial to Europe's economic development. They form a strong industrial base and are needed for the production of a broad range of goods and applications used in everyday life and modern technologies. Reliable and unhindered access to certain raw materials is a growing concern within the EU and across the globe. To address this challenge, the European Commission has created a list of critical raw materials (CRMs) for the EU, which is subject to a regular review and update. CRMs combine raw materials of high importance to the EU economy and of high risk associated with their supply.[8]

Raw materials have a vital role in the actual economic system. They are crucial for a strong European industrial base, an essential building block of the EU's growth and competitiveness, as stated by the European Commission[9]. They are present in almost all industries. In addition, they are particularly present in new technologies as tablets, computers or smartphones, which might contain about 50 different kind of metals; and in the development of new clean technologies as solar panels, wind turbines, energy efficient lighting technology or in electric vehicles batteries.

The growth of these new technologies will increase the demand of the CRMs. An example of this is the demand of cobalt, which has been increasing at a rate of 3%-4% annually since 2010 because of the increase of the production of electric vehicles and is expected to continue increasing.[10]

In January 2018, the European Commission published the report "Report on Critical Raw Materials and the Circular Economy"[11] in which the enormous potential for a more circular usage of CRMs in our economy was highlighted. Furthermore, due to the technological innovation and the new emerging economies, the demand of critical raw materials could double between 2010 and 2030[12].

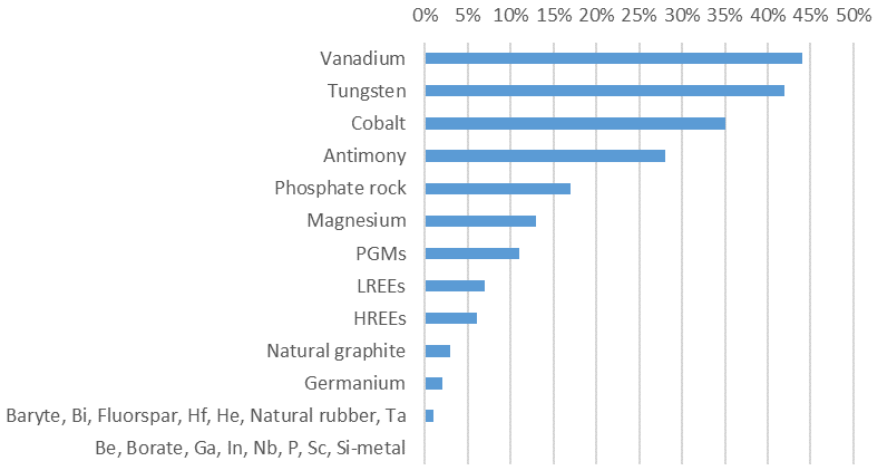

Figure 8. Contribution of recycling to meet EU demand of CRMs (Own elaboration based on the 2017 CRM study and on the MSA study 2015)

[8] http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en
[9] https://publications.europa.eu/en/publication-detail/-/publication/d1be1b43-e18f-11e8-b690-01aa75ed71a1/language-en/format-PDF/source-80004733
[10] Prospects for electric vehicle batteries in a circular economy Eleanor Drabik and Vasileios Rizos. CEPS Research Report No. 2018/05, July 2018
[11] https://ec.europa.eu/commission/publications/report-critical-raw-materials-and-circular-economy_en
[12] Decoupling natural resource use and environmental impacts from economic growth. A Report of the Working Group on Decoupling to the International Resource Panel. UNEP.

Regarding the low recycling potential of many CRMs nowadays (Figure 8), given that the majority of these resources are supplied from countries outside the EU[13] (Figure 9) and they are of vital importance for the development of the EU economy, it is clear that one of the biggest challenges of the electric and electronic industry sectors is to study their waste patterns in order to recover and reuse the raw materials used in the whole supply chain.

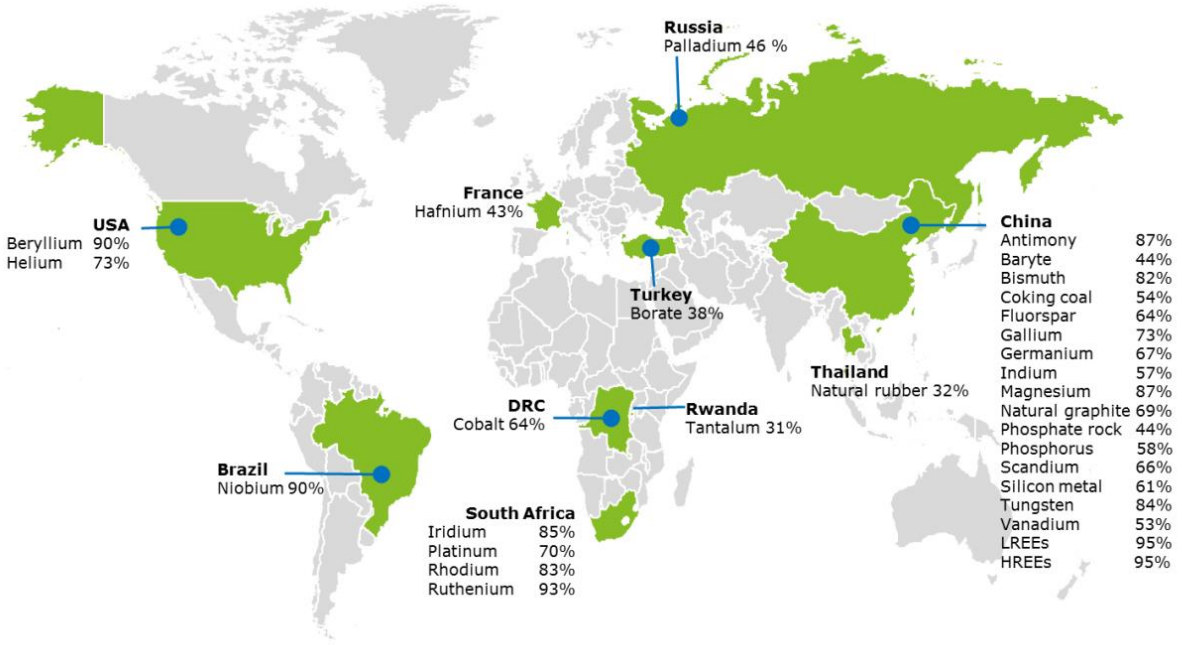

Figure 9. Contribution of primary global suppliers of critical raw materials, average from 2010-2014[13]

The aforementioned CRMs issue is one of the crucial aspects of the electronic and electric sectors, but it is not the only one. In addition, there is a need of using the resources more efficiently. To design products so their materials can be reused and to develop efficient mechanisms in order to collect and to give these resources a second life, is a crucial aspect the electronic sector has to face for its successful and sustainable development.

3.1.2.1. Tablets

The tablet sector includes five main stages in the production supply chain of the product:

- Extraction of raw materials.
- Processing of raw materials.
- Component production.
- Assembly.
- Distribution and selling point.

However, it is also important to mention the stage after distribution and consumption, which is significantly different from the food sector. While in the food sector the main wastes are produced not only after the consumption stage but along the whole supply chain, in the tablet sector it is important to focus on the final product itself, as it contains a lot of high value raw materials and recovering as much of them as possible is a

[13] https://ec.europa.eu/transparency/regdoc/rep/10102/2018/EN/SWD-2018-36-F1-EN-MAIN-PART-1.PDF

key challenge. Furthermore, its inadequate treatment may lead to health and environmental risks. The stages mentioned below have a major importance in this sector:

- Collection.
- Refurbishment.
- Recycling.

The production process starts with the extraction of raw materials (metals and minerals) in mines, as well as with the oil drilling plant. It continues with the processing of these raw materials in the oil refinery and plastic pellet production, the metalworking industry and the mineral processing industry and then it goes to the plastic, metal and mineral factory in order to produce the different components necessary for the development of the final product.

The main stakeholders related to these stages are companies from the mining sector and from the plastic or steel industry. It has to be mentioned that these stakeholders are usually located outside the EU, though a few are located in the EU[14].

Once the components have been developed, the next stage is the assembly of the different Tablets parts, namely, screen, PCB, case, etc., and the final product assembly. These two stages are conducted both outside and inside the EU.

During these stages the main wastes produced are outbounds of these raw materials, which may be directly reused when possible in the process. For example, during the processing of raw materials stage some of the raw materials are not used, but when possible, they will serve as raw materials for the production of new components in further steps.

Transport is not only included in the distribution stage, but it is also associated with every stage of the process. Whereas in other sectors some of the relevant stakeholders may be located close to each other, in the tablet sector, some of the stages take place in remote areas, far from the final product point of sale.

The distribution involves various transport, from little vans to big ships. Tablets, as an expensive product which is not bought with regularity is sometimes bought by consumers from remote areas. In this way, distribution has a considerable impact in terms of CO_2 due to de long distances covered. However, in this point no major wastes are produced, apart from packaging, which for sure has a big importance nowadays, and is general for every sector and a common problem to be solved.

Regarding the selling point, it is not a stage in which the tablet sector produces lots of wastes apart from the regular issues every product does (e.g. packaging). The unsold products are offered with less prices or are used for developing new products.

As it has been mentioned, after the consumption stage, there are further stages which must be considered. Electrical and electronic equipment at the end-of-life are currently one of the fastest growing waste streams in the EU, growing at 3-5 % per year[15]. The Directive 2012/19/EU on WEEE promotes the collection and recycling of such equipment and provides for the creation of collection schemes where consumers return their used waste equipment free of charge[15].

Regarding the collection logistics aspects, it is important to differentiate between the various ways of collecting the product. In Spain, the end-user is the one who is responsible for disposing of it in different possible locations according to the current legislation:

[14] https://www.xataka.com/empresas-y-economia/primera-unica-mina-coltan-europa-esta-pueblo-ourense
[15] https://ec.europa.eu/eurostat/web/waste/key-waste-streams/weee

- "Recycling collection points", which have been previously established by the public administration (which is also in charge of its management) and which can be fixed in one point or can have different locations depending on the day of the week, the season or the week of each month. This point is not just dedicated to tablet products, but also to others such as washing machines, mobile phones, printers and others.
- Electronic products retailers, which are required to collect the product by law. These shops are required to take the old devices back when a customer wants to buy a new product. Additionally, those shops with more than 400 m^2 (dedicated to the sale of electric and electronic equipment) are required to collect small electronic products without any additional cost to the customer and with no need of buying a new one. To accomplish this goal, sometimes they establish "multi-containers" which are managed by an external agent.
- In addition, and in order to make benefit from the old products, there are second hand stores which collect them.
- There are also some bins which are property of a specific company, which collect these old products and then may remanufacture them and put on sale again, or may sell it to remanufacturing companies so they can get value of the raw materials of the tablets.

After the collection stage, there are different possibilities regarding the next steps to follow:

- If the tablet is suitable for being directly reused or it has minor problems, a little check-up and reparation will be done and then it will be put into the market (second hand market) again. If the product needs to be refurbished, a deeper repair will be necessary before being put on the market again.
- If there is no possibility to be used again, the general destiny of the product is a recycling plant. There, different process and necessary in order to obtain recycled raw materials which could be sometimes reuse in previous stages of the supply chain or in other sectors. Due to expensive costs and no existing demand in the market or because of the difficulties of obtaining some of them, there are lots of raw materials which are not recovered and end up in the landfill.

From the recycling plants, metals (especially Aluminium), plastics (PC, PMMA, PET, ABS) and different products as PCBs or precious metals are obtained. However, hardly any of these obtained resources can be reused by industries focused on the tablet production – these resources are more likely to be reused in other sectors. There are some constraints which explain this particular issue. In the case of plastics, there are even legal aspects that interdict the use of plastics with brominated flame retardants in the production of new products. In other occasions, these plastic materials cannot be recycled so it is not possible to use them again. This is a common problem in different sectors, as this plastic ends up in landfills or being used in plants for energy recovery, which should not be the priority as it is not efficient.

Table 3 shows the different materials and their associated recovered final fraction after the recycling process, as well as the user group which may use it. This information was included in the development of Task 1.4.

Table 3. Tablet sector wastes' next use

COMPONENT	MATERIAL	RECOVERED FINAL FRACTION AFTER RECYCLING PROCESS	USER GROUP
PCB	Mixed of materials	PCB fraction	Copper and precious metal refineries
Housings	Metallic (Al)	Non-ferrous fraction	Aluminium foundry
	Plastic, back side	Mixed plastics	Energy recovery processes
	Plastic, frontal side	Mixed plastics	Energy recovery processes

Battery	LiIo	Extracted manually. Battery fraction for external management	Pyro/Hydrometallurgical recycling processes
Screen	Sandwich LED	Extracted manually. Screens fraction for external management	Currently there is no specific recycling process
Lighting	LED	Mixed plastics	Energy recovery processes
Wire	PVC+Metal	Copper concentrated fraction	Copper and precious metal refineries
Frames	Plastic	Mixed plastics	Energy recovery processes
Diffusers	PMMA	PMMA fraction	Plastic recyclers
	Films PET	Mixed plastics	Energy recovery processes
Small parts	Plastic	Mixed plastics	Energy recovery processes
	Stickers	Waste	Landfill
	Screws	Ferrous fraction	Iron foundry

The main stakeholders to be considered in these three stages are, primarily, the waste management companies dedicated to electronic equipment, which are focused in the different logistics issues; the mineral, metal and plastic industry, which may use the recovery materials in their own processes; the collection scheme organisations, which may influence and incentivise the collection of tablets directly from consumers; and the recyclers and manufacturers of tablets. Furthermore, the R&D is a key stakeholder as well, as the use of new materials (more sustainable or efficient ones) and recycling technologies is directly related to it.

The public administration, at regional, national and European level may also have an important role, not only in ensuring the possibilities of collecting the electronic wastes and using the recovered materials (public administration has the key role of establishing policies and laws to address the challenge of the waste management), but also in the trade relationships between countries, which may have enormous influence in the development of the sector considering the amount of countries involved in the process.

3.1.2.2. Lighting sector

The lighting sector has big similarities with that of the tablets. It includes five main stages in the production supply chain of the product:

- Extraction of raw materials.
- Processing of raw materials.
- Component production.
- Assembly.
- Distribution and sale point.

As in the tablet sector, after the consumption stage, there are crucial stages which cannot be ignored because of the amount of valuable raw materials the final products contain, such as Gallium, Indium, Gold, Silver and some rare earth elements. These stages follow as next:

- Collection.
- Recycling.

Regarding the first stages of the supply chain, the ones which take place before the consumption stage, it has to be mentioned that until the assembly stage, they rarely take place in the EU. Even more, most of the time they take place in Asia and particularly China. In this sense, the LED lighting sector is remarkably dependant on the Asian market.

Some of the materials which LEDs contain are CRMs (Gallium, Indium), whose extraction has a significant environmental and social impact in the given country. This is the reason why improving the efficiency of mines is a crucial aspect in order to waste the minimum materials possible and recover as much quantities of them as possible. It is important to mention that this an difficult aspect to achieve, as most of mines are located in Asia.

Once the materials have been extracted, they are separated and prepared in order to be used in the next stage, the component production. In these two steps, a large amount of physical and chemical processes is necessary. The main wastes produced in these stages are non-used raw materials which, as in the Tablet sector, may be directly used in the process again.

In the assembly stage of the lighting, the design aspects are such an important aspect. This is the reason why, apart from the necessary materials and components in order to develop the basis of LEDs products, there are products made from a wide range of materials, such as glass, wood, metal or plastics. New materials as recycled thermoplastics are gaining importance and they may be included in the future, especially because of sustainability reasons. In this stage, there are relevant stakeholders (lighting manufacturers) which are located in the EU. These companies assemble the components provided according to the different designs that may be developed and, afterwards, they conduct the distribution.

There are various target groups which may act as the receiver of the final product: commerce, residences, health centres, public institutions, hotels, restaurants, offices. Therefore, the final product will be particularly designed from more functional units, for example, if the destiny is a regular office, to more sophisticated and complex designs, as it is the case of some hotels or restaurants. Were the LED product to be located outdoors, its design would significantly change as well.

Furthermore, there are two distribution channels depending on the target group: direct distribution, which will be the case of hotels or hospitals, in which the manufacturer will provide directly the final product and may install it as well; or indirect, in which the destination of the product will be a store, as in the case of particular houses.

Regarding the logistic aspects, they are present along the whole supply chain. As most of the materials necessary for the development of the final product are located outside the EU, it is a key aspect, as the only way to reduce its impact, aside from the improvement of the efficiency of the transport (route management systems, electric vehicles…) is to improve the recycling and collection rates of this final products as well as to propose innovative business models.

Although the lifespan of LEDs[16] is much longer than that of the tablets, the disposal of LEDs products has increased significantly, since new and more energy efficient models keep being put on the market. This drives customers, especially companies, to change the older ones for the newer models before its lifespan has ended, as the payback period is substantially short.

The waste management of the LEDs products is based on the Directive 2012/19/EU on WEEE. The light bulbs are collected in shops, collection bins or “recycling collection points”. There are some ways of collecting the whole pieces directly as they were sold, in this case, it is the manufacturer who will be in charge of it. The waste management stage in the lighting sector has big similarities with the tablet’s one.

For the sustainable evolution of the LED lighting sector, to improve the collection rates as well as the recovery of raw materials contained in LEDs is a key challenge which must be considered.

[16] https://www.electronicsweekly.com/blogs/led-luminaries/led-life-expectancy-2009-02/

Furthermore, to extend the responsibility of the producers of the final product and retailers is essential so that social and environmental impacts are minimized. Consumers may play an important role as well – provided that by buying Fairtrade products or similar, companies may act in a more responsible way.

Table 2 shows some of the main wastes produced in the vegetable sector, their associated future use as well as the user group which may use it.

Table 4. Lighting sector wastes' next use

MATERIAL	NEXT USE	USER GROUP
Metal	To be used for the development of new products	Metal foundry
Wood	To be used for the development of new products	Wood industry
Aluminium	To be used for the development of new products	Aluminium foundry
Glass	To be used for the development of new products	Glass foundry
REE (Lutetium (Lu), Cerium (Ce) or Europium (Eu))	To be used for the development of new products	Electronic sector
Technology metals (Gallium (Ga) and Indium (In))	To be used for the development of new products	Electronic sector
Precious metals (Gold (Au) and Silver (Ag))	To be used for the development of new products	Precious metal refineries
Plastic	New sustainable packaging	Recyclers companies
	Energy production	Industry sector

3.2. Business interactions in the supply chain

3.2.1. Meat sector

As it has been explained before, the meat sector involves various stages in the whole supply chain, and, even though they are usually all connected and different actors are related to each other, they may also be independent. Thus, each actor can develop their innovative business models considering different stakeholders and ways to implement it.

Regarding the meat sector, there are two main different types of production systems:

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

During the last few years, there is a clear tendency in which the evolution of the meat sector is integrating the whole process, especially in pork and poultry sector. [17] Small companies are being integrated in bigger groups or they are joining others in a cooperative structure.

[17]Diagnóstico y Análisis Estratégico del Sector Agroalimentario Español. Análisis de la cadena de producción y distribución del sector de carnes. Ministerio de Agricultura, Pesca y Alimentación.

This new situation also offers new trade relationships between these big groups and the retailers or suppliers. This is, they have contractual agreements with suppliers, not for short periods of time and for the development of specific products in a concrete situation, but for a large variety of processes, products and also for longs 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.

JBS (Brazil), Tyson Foods (US), Cargill (US) and WH group (China) are the world's largest meat-producing corporations. JBS alone accounted for over ten million tons (carcass weight equivalent) of meat processing in 2009-2010, surpassing the combined total of the world's top 11 to 20 companies. The strategies followed by these companies have big similarities: mergers and acquisitions of other companies, vertical integration of their supply chains (including product diversification and/or wholesale retail), and successful lobbying of governments which means easier access to foreign markets. [18]

It is expected that big groups companies continue rising during the next years. This concentration of power is also applicable to national level. Traditional farms are disappearing and they are being incorporated in big groups all along the globe.

ALIA, the demonstrator in the meat supply chain is an example of a big group company. It manages the animal feeding stage, the farm and the meat elaborates plant. In addition, it participates in the slaughterhouse stage. This offers a wide range of opportunities for the demonstration stage of the project in the meat supply chain, a global vision and new practices along the whole supply chain will be put in place.

3.2.2. Vegetable sector

As it has been explained before, there are different kinds of supply chain in the vegetable sectors, which may vary from large distribution companies to local farms which sell their product directly to clients. Thus, in this sector there is a radical difference among them, because of various features such as legislation, environmental impact and social impact or their influence the market.

The complexity and length of these other supply chains would vary. The shortest supply chain would be direct sales from farms, whereby a single farm business might cover the producer, processor, distribution and retail elements all themselves. Local supply chains tend to be short and simple, whereas those serving national and international markets tend to be much more complex.

A good example of a local farm model is Scilly Organics, the vegetable sector demonstrator in this project. In this kind of supply chain 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.

Then, the distribution is carried out by the farm business to shops, restaurants or directly 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.

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.

[18] https://www.iatp.org/blog/leaders-global-meat-complex

These kinds of supply chains are usually focused on seasonal products and are usually more environmentally sustainable, as they do not tend to use intensive practices such us monoculture, the use of a large number of chemical products or the consumption of vast amounts of energy or water.

These intensives practices are associated with big companies which are dedicated to the distribution of a small range of products internationally. Although intensive practices are usually more harmful for the environment, they increase the efficiency of the agriculture system and sometimes may have less impact because of the smaller amount of land occupied. To consider aspects from both kinds of supply chains and to share these two models is a key aspect for the success of a sustainable growth of the agriculture.

Cargill (US), Archer Daniels Midland Company (US), DowDuPont (US) or Bayer (Germany) are agriculture sector companies' world leader. They are clear examples of companies which are innovating in improving the efficiency of crops and studying new agricultures possibilities as well as for the use of intensive practices which lead to a high environmental impact.

3.2.3. Tablet sector

Regarding the trade relationships in the tablet sector, there are large companies (Samsung, Apple, Lenovo, Huawei…) involved in the sector which can directly execute, or at least control or participate, several stages along the whole supply chain.

These companies may have direct production of some key components with a high level of technology. This, in general, happens outside the EU. Regarding the assembly of the final product and the final development of the tablets, there are some companies which do it by using their own means. They acquire the components which have been produced outside the EU (but which have also been produced in the framework of the company), and then they assemble them in their own area of work. Other companies may also do it outside the EU. In Spain, only BQ assemble directly the components. The tendency is that big companies own this stage of the supply chain, whether they do it outside the EU or not.

When talking about the distribution and the sale point, there are different approaches:

- There are some big groups which have been part of other stages and have their own facilities and distribution channels. Two examples of this are Apple or Samsung, which are companies involved almost in the whole process and which distribute directly as well as have different retailers around the EU and other countries.
- There are some distributors which are not involved in other stages of the supply chain.
- There are retailer points where you can find a lot of different products from a wide range of companies. They may acquire the products directly from the producer or the distributor.
- Online distribution must be considered as well. In the tablet sector in general, the online consumption has a major importance. Some companies, such as Amazon or Alibaba, have a really big market share in the tablet sector, which, in addition, is expected to grow in the next few years. They offer the product and they are in charge of the distribution. Sometimes, they even produce their own products[19].

The first stages of the supply chain are not covered by these big groups. Tablet producers may have trade relationships with some companies from the mining sector, but there is not direct collaboration between them. At this point there is an issue regarding the origin of the raw materials used for the development of the electronics product. Some of the locations where these raw materials are available are developing countries, and companies from the electronic sector are accused to have agreements with mining companies which may

[19] https://es.wikipedia.org/wiki/Amazon_Kindle_Fire

use child labour force for obtaining the raw materials[20]. Therefore, in this way social pressure is a factor to be considered for big companies, although they do not participate directly in the minerals or metals extraction. Regulations and legislation may have an influence on these topics.

After the consumption stage, it has already been mentioned that the final product may follow different paths.

Regarding the responsible actor of each stage, in logistics, legal or administrative issues, there are specific companies, named "Collective Schemes", which use the allocated budget producers are forced by law to provide in order to ensure the satisfactory waste management of the electronic products.

Hence, at this point, the producers are related to the waste management, but they use some companies as subcontractors in order to guarantee everything is done properly. It is also important to remark that the budget that producers have to allocate will be assumed by the end consumer in the final prize of the electronic products in most cases, however, there are sometimes in which the producer is the one assuming it.

In this stage, there are also other possibilities with lower market presence, as the professional use of tablets. In this case, it is the company the one who distributes the tablets to a specific company, who is in charge of collecting them, both by using its own means or buy using the system to which they are joined.

3.2.4. Lighting sector

Regarding the trade relationships in the LED lighting sector, there is a similar approach as the tablets one. Before the assembly stage, it is difficult to find EU companies which are involved on them and, in addition, they are usually independent and specialized companies which are involved in just one stage of the whole supply chain. After this stage, there are large companies which develop the final product and which may participate in the next stages of the supply chain, directly or not. Furthermore, these companies are more likely to have contractual agreements with suppliers and providers in a stable and close relationship.

In Europe, the main two LED manufacturers are Philips and OSRAM. They are involved in the assembly stage as well as the distribution and the selling stage, as even though they do not have a physical retailer point, they sell directly to clients (both individual and companies) in their online shops. These companies may use their own distribution system or may subcontract independent distribution companies. The retailers which offer these products vary from small local shops to large multinational chains. This is the case of most of the LEDs lighting sector big companies.

Regarding the implication of these actors in the previous stages, it is only limited to contractual agreements. This, added to the remote location of the raw material extraction, create a difficulty in tracing the whole process. This may create problems with the lack of transparency regarding some issues as child labour, pollution of preserved areas or lack of environmental controls. To ensure compliance with these environmental and social responsibilities, not only would it be advisable that companies act individually buying ethically sourced raw materials, but also to define all together some minimum criteria for the procurement process. It is in here where the big companies may have a major role in all the other stages of the supply chain.

The municipalities definitely have a great importance in this area as well. Not only regarding the procurement process of LEDs products for their own facilities, which are actually just a small amount in comparison to the residential or tertiary sector, but for the recycling protocols they may include at a local level.

The systems are quite different from one model to another. Whereas some of them may include individual collection for business, others may install specific containers for this purpose. The collection and waste

[20] https://www.cnet.com/news/apple-samsung-and-sony-under-fire-over-child-miners-in-africa/

management are established in the WEEE directive. However, at the point of establishing priorities, relationships between agents and legislation aspects, the public administration is the one who can change the global process. In the procurement process, just one municipality has not the strength to do any substantial change, but the public administration as a whole could make a great impact.

4. Innovative business opportunities

The innovative business opportunities section makes reference to the different possibilities that companies from different sectors have along the supply chain. In section 3, an identification of waste patterns and trade mechanisms has been performed. In this section, business opportunities and new forms of collaboration are highlighted. Again, it is important to mention the role that new platforms as the brokerage system may have in the identification of new opportunities and in the possibilities to develop the companies' strategies in a more sustainable way.

4.1. Meat sector

In the previous section, it has been explained how the meat sector has already accomplished some of the principles of circular economy. By-products from other industries are included in the process and the by-products produced are used in other industries as well, mainly in the food sector. It can also be noticed that the circular economy approach is done with the help of other activity sectors such as the cosmetics and the pharmaceutical ones.

The innovative business models to be developed in each activity sector should not only consider potential interactions with external stakeholders so they can exchange raw materials, by-products or wastes and incorporate them to their own processes. Even if this is a crucial aspect, they should also focus on finding ways to modify the current process so they can develop their activity in a more circular way.

Nowadays, the meat sector is facing a major change regarding the environmental impact related to its activity. The last IPCC report based on Climate Change and Land pointed out the importance of diets in the mitigation and adaptation to climate change and described plant-based diets as a major opportunity to achieve our goals. In addition, it included a policy recommendation for the reduction of meat consumption.

This is a major challenge the meat sector will have to face in the next future. Traditionally, there have been sustainable practices in the meat sector, especially promoted by local farmers with environmental awareness. However, now this is changing, and the biggest companies in the meat sector are increasing their sustainability practices.

A clear example of this is the company Cargill, one of the biggest companies of the meat sector all over the world, which has made a commitment in the sustainability of its supply chain. It should be noted that the company has two specific lines on sustainable soybean and beef, two of the most problematic environmental issues of the meat sector. In July 2019, Cargill announced its commitment to reduce greenhouse gas emissions across its North American beef supply chain by a 30% in 2030[21].

Big companies which have an influence in various stages of the meat supply chain have the possibility of influencing directly the process. However, it is still important to expand the range of stakeholders to collaborate with in order to develop new practices as the mentioned above.

Different general views of the process can be seen in Figure 10 and Figure 11, corresponding, respectively, first to a linear process in which recycling habits are being considered, and secondly, a more circular one in which more aspects are being considered.

Figure 10 shows the main stages of the supply chain and the most important wastes in each one. The potential uses of the generated wastes are studied as well. Minor wastes have not been considered in the analysis.

This is an example of how industries in the meat supply chain work and interact. The main wastes are used by other activity sector industries. The agriculture sector, food industry and the veterinary sector are present in different stages in order to provide the necessary raw materials to produce animal feed or the final product or animal health controls.

[21] https://www.cargill.com/2019/cargill-announces-commitment-to-reduce-greenhouse-gas-emissions

Figure 11 shows a circular economy approach of the meat sector. The focus continues being on obtaining the raw materials they need as by-products from industries located as close as possible. However, this is not only about obtaining ingredients to develop food or animal feeding products, but also other transversal needs as energy, water, packaging or transport for distribution to the sale point.

To achieve a real circular economy model in an industry, all of these aspects should be considered: using renewable energy, reusing and recovering water, using new possibilities for packaging (in Deliverable 2.2. there are mentioned new possibilities for different stages of the supply chain) or making the logistics system more efficient. Furthermore, to develop new services such as increasing the sales in bulk or return to local production as a sustainable need is one of the aspects to be considered during the whole supply chain.

It has also been pointed out that the regular waste management is important as well, in order to achieve the circular economy model. Plastics, bio-waste, paper and cardboard and others should be appropriately collected and managed.

In Figure 12 crucial trade mechanisms that should be taken into account in each stage of the supply chain are shown.

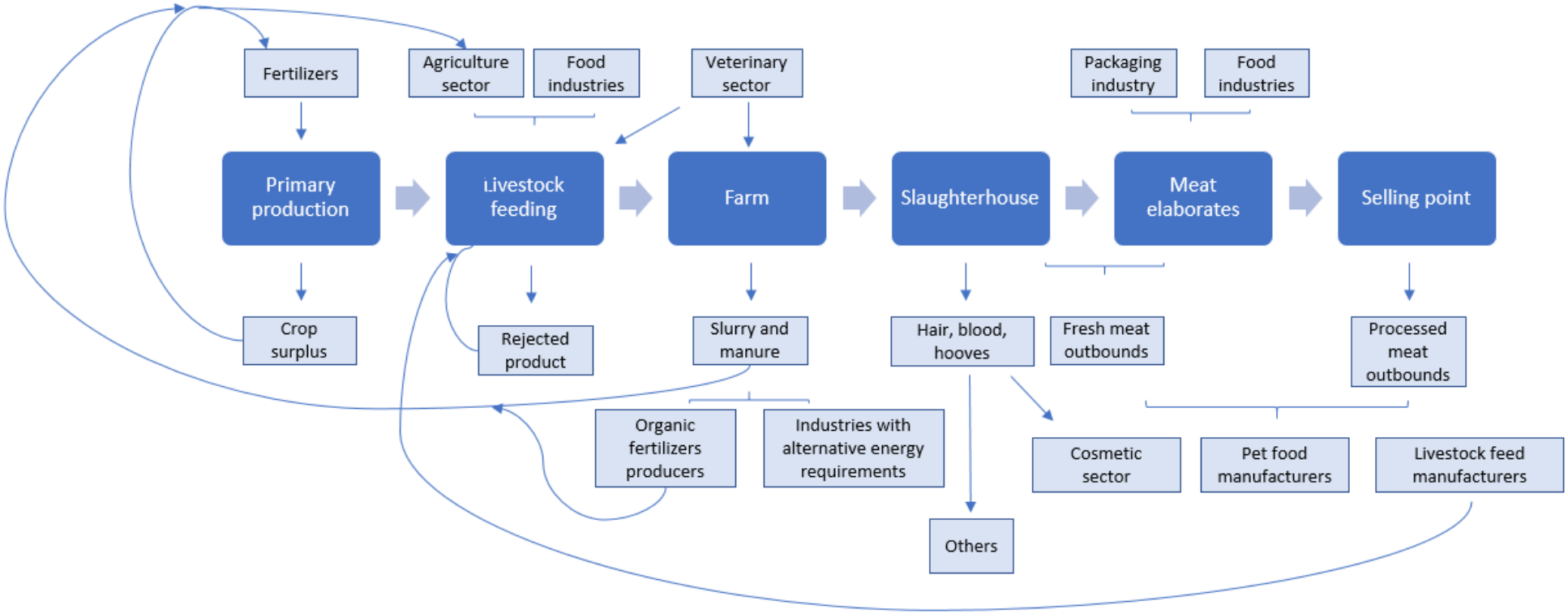

Figure 10. Recycle habits approach in the supply chain of the meat sector

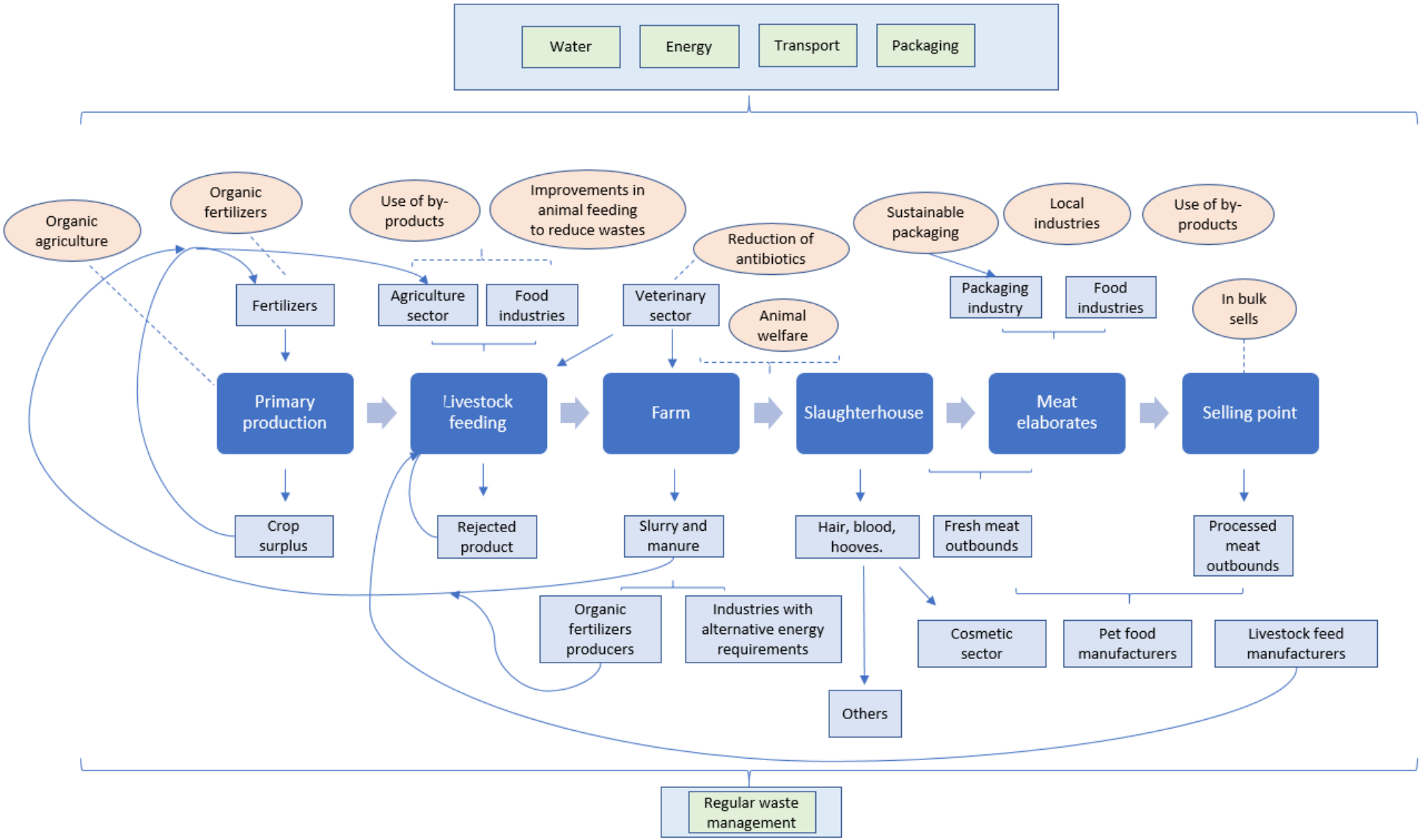

Figure 11. Circular economy approach the supply chain of the meat sector

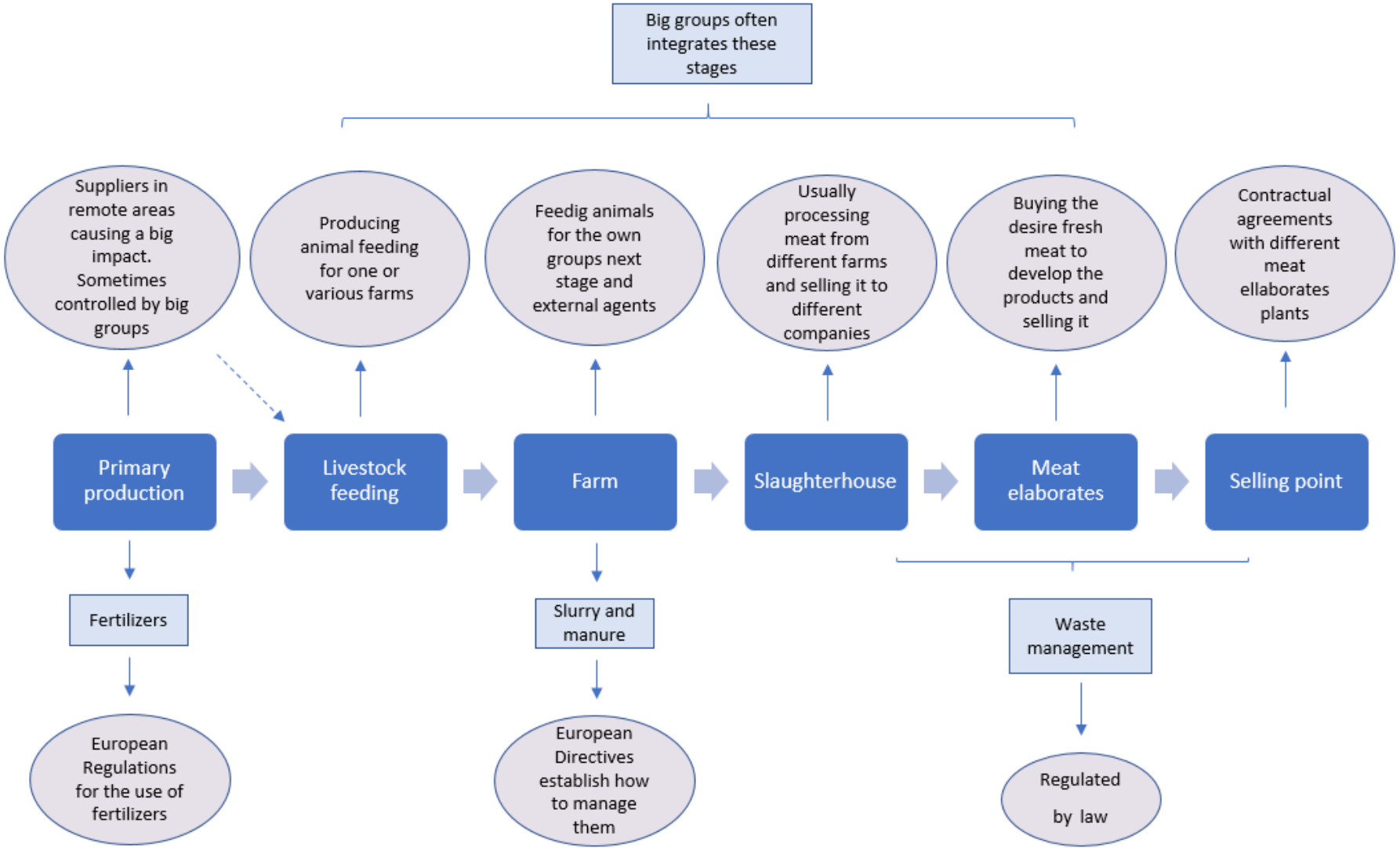

Figure 12. Stakeholders and trade mechanism in the supply chain of the meat sector

4.2. Vegetable sector

There are several opportunities for the vegetable supply chain to become more circular. The actions are split into the various parts of the supply chain.

1. On farm:

    - Enhance carbon sequestration, including more trees and hedges, and increase levels of soil organic matter.
    - Use and make more compost, especially utilising waste products.
    - Work closely with suppliers and customers to reduce waste, energy, and materials.

2. Waste:

    - Work with suppliers to reduce packaging on inputs.
    - Produce less packaging on products, and/or find alternatives that are compostable.
    - Increase levels of recycling of all farm wastes (establishing separate collection systems for all the wastes produced, purchasing durable, easy reusable, reparable and recycling products, etc.).
    - Reduce levels of waste produced (optimizing production, offering overproduction at lower prices, etc.).
    - To make contractual agreements with other companies so they can use the wastes as resources in their processes.

Furthermore, to work with other stakeholders is also necessary to reduce this food waste. In the area of consumer and catering sector there are some actions which could be performed to make the process more circular:

- Work with restaurants/cafés to increase the amount of food with lower ecological and social impact served.
- Reduce food waste.
- Reduce packaging waste.
- Recycle any food waste produced.
- Engage with customers to understand the importance of waste issues, and the impacts of the food they serve.

In addition, distribution is another aspect which should be considered. To decarbonise this part of the supply chain and to ensure the efficiency in the routes is crucial as well.

There are quite a few examples in the vegetable sector in line with sustainable practices, especially regarding farms at local level. The increase in organic agriculture area between 2012 and 2017 was 25%[22] Fertilizers directives, soil protection regulations and other environmental issues will continue promoting the organic practices in the agriculture sector.

Good Eggs[23] is a pioneering online grocery delivering to families throughout the Bay Area (US). Its main principle is to encourage local, ethical and sustainable farmers to continue growing sustainable products by expanding their market. It is a good example of how initiatives which englobe various local farmers can be successful and not be overcome by largest companies.

[22] https://ec.europa.eu/eurostat/statistics-explained/index.php/Organic_farming_statistics
[23] https://www.goodeggs.com/sfbay/welcome/step/zip

In Figure 13 it can be appreciated a circular economy approach in which additional aspects to the recycling techniques are considered.

Figure 14 shows a picture of crucial trade mechanisms that should be taken into account in each stage of the supply chain of the vegetable sector.

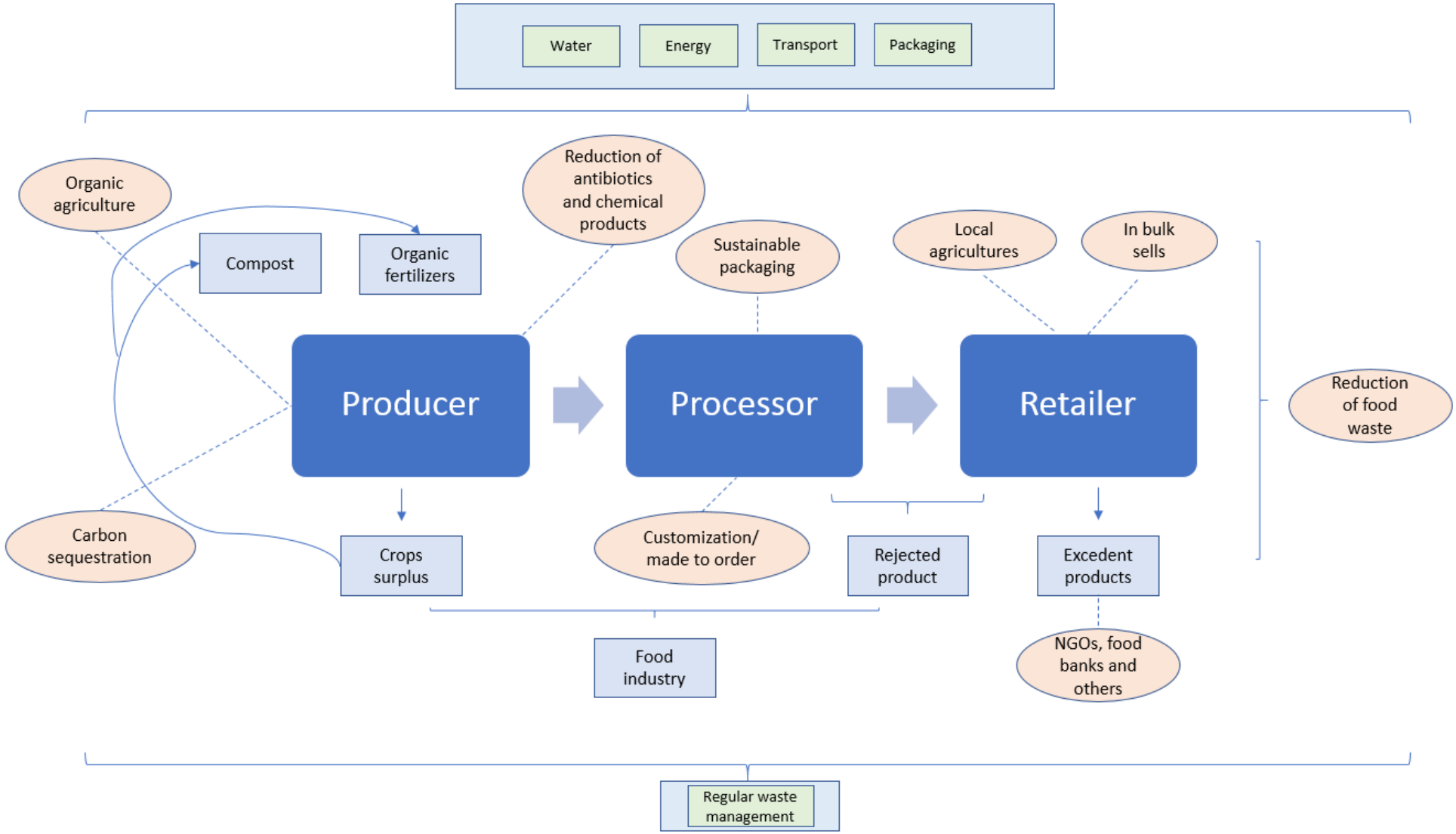

Figure 13. Circular economy approach in the supply chain of the vegetable sector

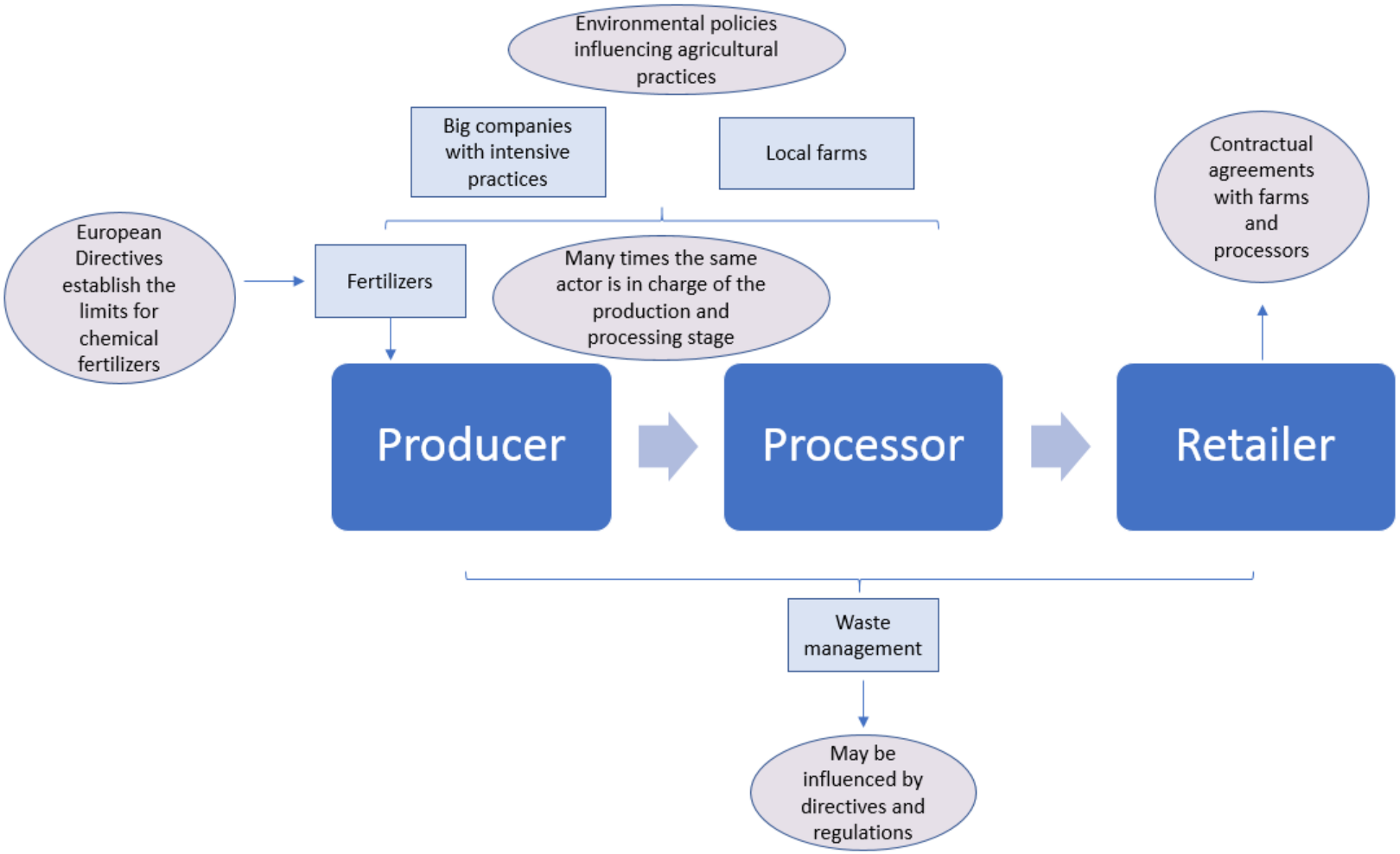

Figure 14. Stakeholders and trade mechanism in the supply chain of the vegetable sector

4.3. Tablet Sector

As stated in the previous section, there is a risk related to tablets (and other electronic products sector) regarding the availability of resources. Although this should not be a problem in the next few years, it may be in the future.

In addition, regarding sustainable and social aspects, the extraction of raw materials supposes a significant impact all over the world, but especially in vulnerable areas where there are metal and mineral ore mines as well as cheap labour forces.

This is why companies and public bodies should work for the improvement of: 1. collection rates and waste management efficiency of tablets products, 2. to promote a responsible consumption and 3. to avoid bad practices in the materials extraction stage (especially in this one, but also in other stages) related to high environmental and social impacts.

There are some successful examples which must be highlighted as approaches towards a circular economy related to electronic products.

The company Apple collects smartphones from their users in their physical shops and then they are sent to a disassembly and refurbishing centre, so they can be put on sale again. Big companies like Apple have the possibility of performing this approach as they manage most of the stages of the sector. Thus, for smaller companies an improvement in the relationship and collaboration between the different actors of the supply chain is necessary.

Fairphone[24] offers a mobile phone with modular design which allows the user to change the broken or damaged parts of the mobile phone so its lifespan is much longer than that of other regular products. In addition, Fairphone uses fairer, recycled, and responsibly mined materials, promotes social initiatives, raises awareness campaigns against e-waste or uses biodegradable packaging among other actions.

Fairphone is a clear example of how companies can contribute to the sustainability of the electronic sector developing a new and profitable business model. Although a conventional mobile phone with similar features may cost half of the Fairphone price, the company has already launched the third Fairphone generation after the success of the previous versions. This is the proof that a mobile phone with sustainable characteristics and with a longer lifespan, this is, with a circular economy approach, has big potential in the current market.

In addition, Fairphone clearly shows the different stakeholders that must be taken into account when planning a circular economy business model in the electronics sector: from the extraction of raw materials to the distribution and selling points and the recycling, all the stages have been considered in the model. Furthermore, it shows that close cooperation between public bodies and companies as well as establishing new regulations are both key for widespreading this kind of practices. Lots of efforts of non-profit organizations and volunteers has been needed for the success of the company.

Regarding tablets, some approaches have been conducted too in order to get value from old products and put them on sale again[25], but these activities are not so widespread in the sector.

In Figure 15, the approach of a circular economy model in the tablet sector is shown. The social aspects of the first stages of the supply chain have also been taken into account, as well as general aspects like water and energy supply, distribution (which should be as sustainable as possible), packaging and waste management.

[24] https://www.fairphone.com/es/
[25] https://www.apple.com/es/shop/refurbished/ipad

As a main conclusion, and regarding the particularities of the sector and the different locations around the world from where the materials for the production of tablets are obtained, one of the most important aspects in order to achieve a circular economy model is to collect and recycle as much materials as possible at the end of a product's life.

Figure 16 shows the main stakeholders to be considered and the crucial trade mechanisms that are conducted in the tablet sector.

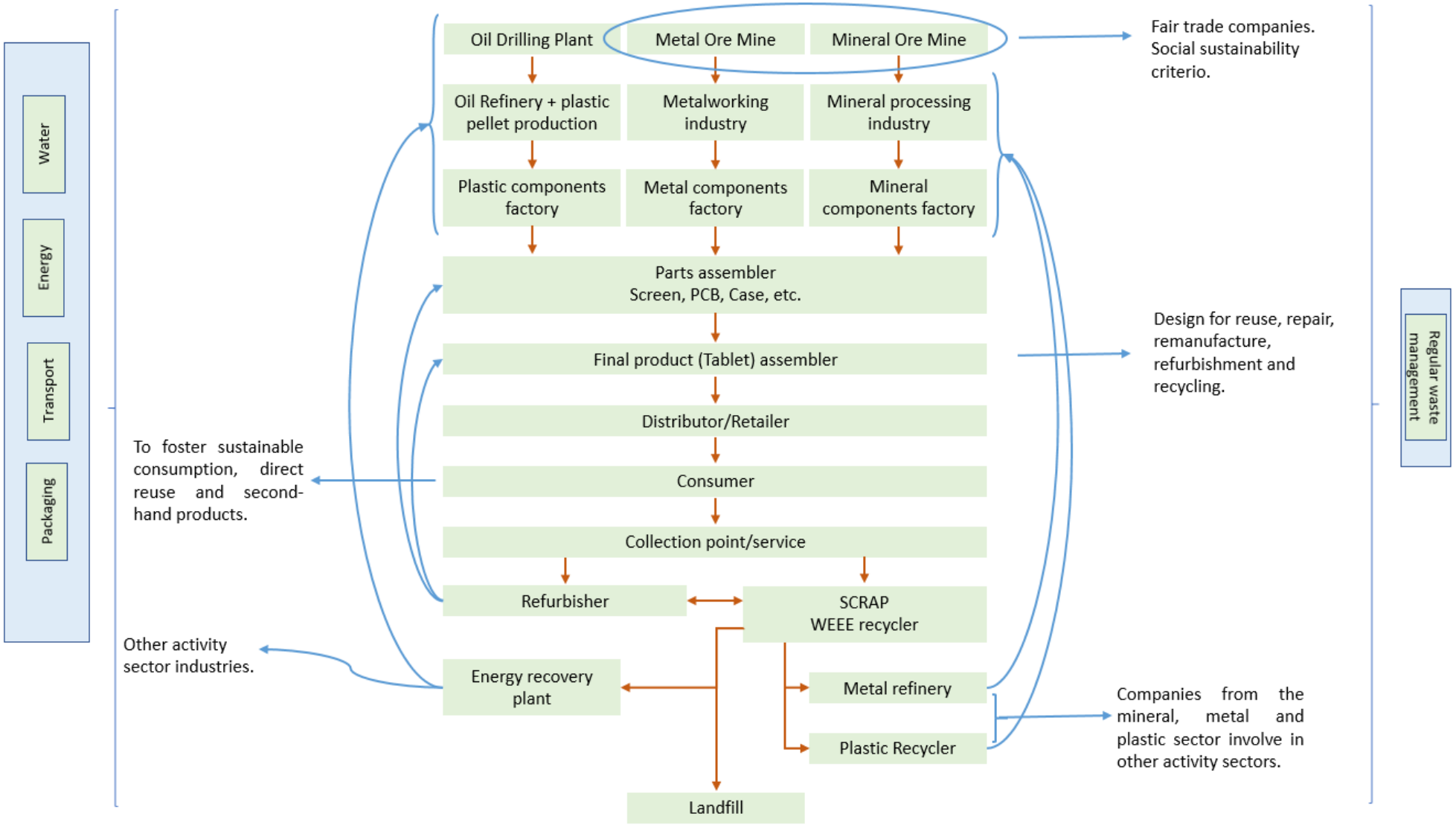

Figure 15. Circular economy approach in the supply chain of the tablet sector

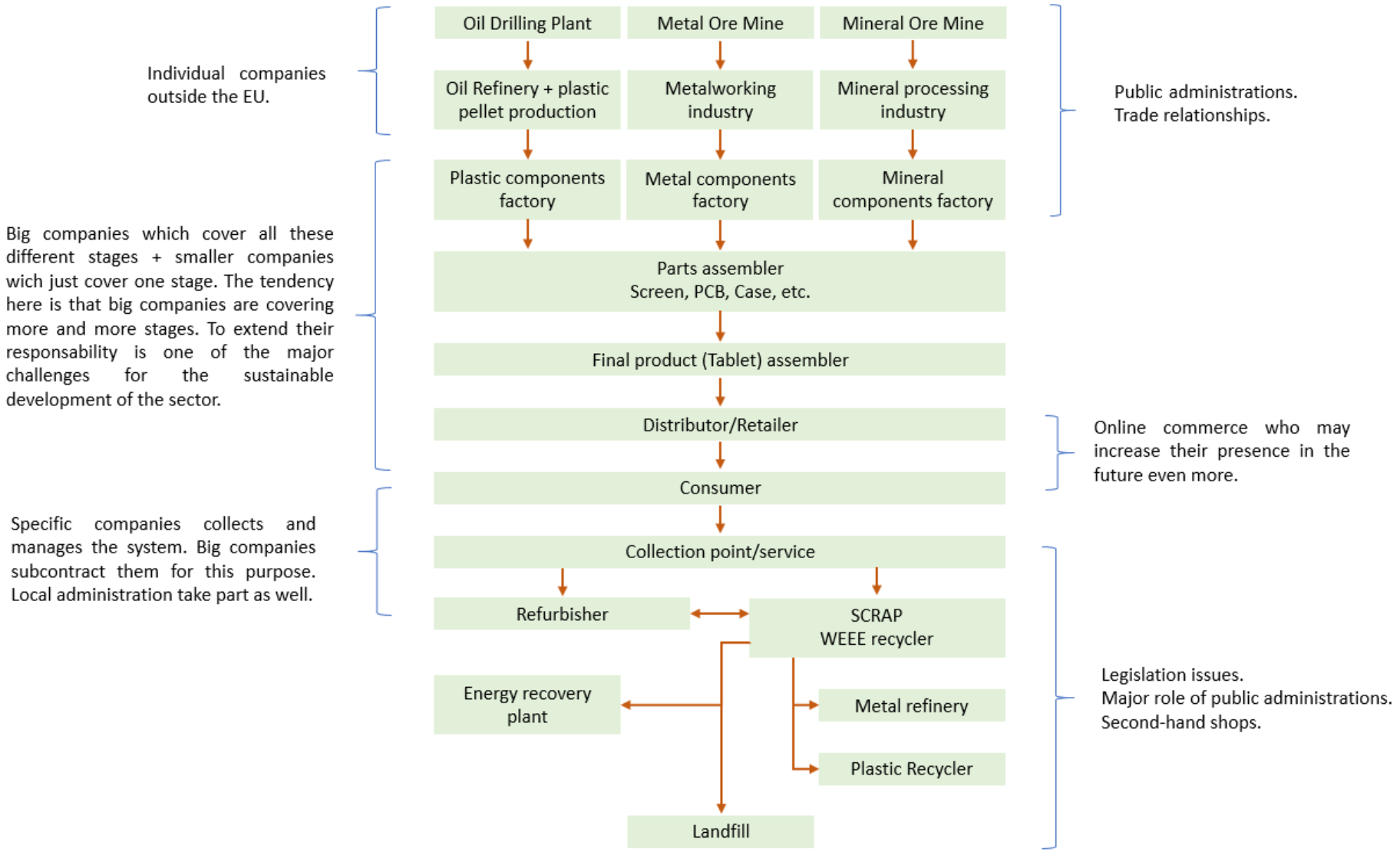

Figure 16. Stakeholders and trade mechanism in each stage of the supply chain

4.4. Lighting sector

Regarding the innovative business models of the lighting LED sector, there are some models which in the last few years have soared in popularity.

During the past decades and in the traditional linear economy, the lighting sector has been a clear example of the purchase, use and throw philosophy. Nowadays, it is a sector with high potential in order to implement a circular economy approach, especially because of the success of LED technology.

The economic savings related to the improvements of the energy efficiency in the lighting sector have supposed the emergence of new business opportunities which companies are developing nowadays. In addition, the use of new materials and the improvement of recycling technologies establish a scenario in which circular economy approaches are to be developed more easily than ever.

Leasing services are one of the main opportunities for the sustainable development of the sector. This business model consists on renting the products to the client instead of selling it. Then, the client pays a fix amount of money during the period of time that is agreed between both parties. After that, the provider recovers the infrastructure provided so it can be reused, remanufactured or recycled. In a leasing service system, the design of the product is key to recover high value products, and that is why criteria such as modularity, recyclability, quality and long-life are followed in this design stage.

Design for repair, remanufacture, refurbishment and recycling is vital for circular economy in every sector, however, it is especially important in sectors such as the lighting one, because depending on the materials and components used in the development of LED products, their lifespan could be enormously extended, reducing drastically the consequent environmental impact.

ESCO contracting is other interesting business model. In this case, both the client and the provider share the energy savings during a certain period of time, which is agreed between both parts. The investment is responsibility of ESCO, which during this period of time recovers the whole amount invested thanks to the energy savings related costs.

These business models are not just focused on the LED sector, but they are widespread among various activity sectors. However, they have a major importance in this one.

In Figure 17 is shown the approach of a circular economy model in the led lighting sector. The social aspects of the first stages of the supply chain have also been taken into account, as well as general aspects like water and energy supply, distribution (which should be as sustainable as possible), packaging and waste management.

As a main conclusion, and regarding the particularities of the sector and the different locations around the world from where the materials for the production of LED lighting are obtained, one of the most important aspects in order to achieve a circular economy model is to collect and recycle as much materials as possible at the end of the product's life and to design the products considering the possibilities of repair, reuse, remanufacture and recycle at the end of their life span.

Phillips, one of the main companies of the lighting sector, has developed a sustainability programme[26] in which circular economy plays important role. Performance- and access-based models, refurbishment and parts recovery, on-site or remote upgrades, promotion of recycled materials, eco-design and the use of renewable energy are key aspects.

Figure 18 shows the main stakeholders and trade relationships along the supply chain of the lighting sector.

[26] https://www.philips.com/a-w/about/sustainability.html

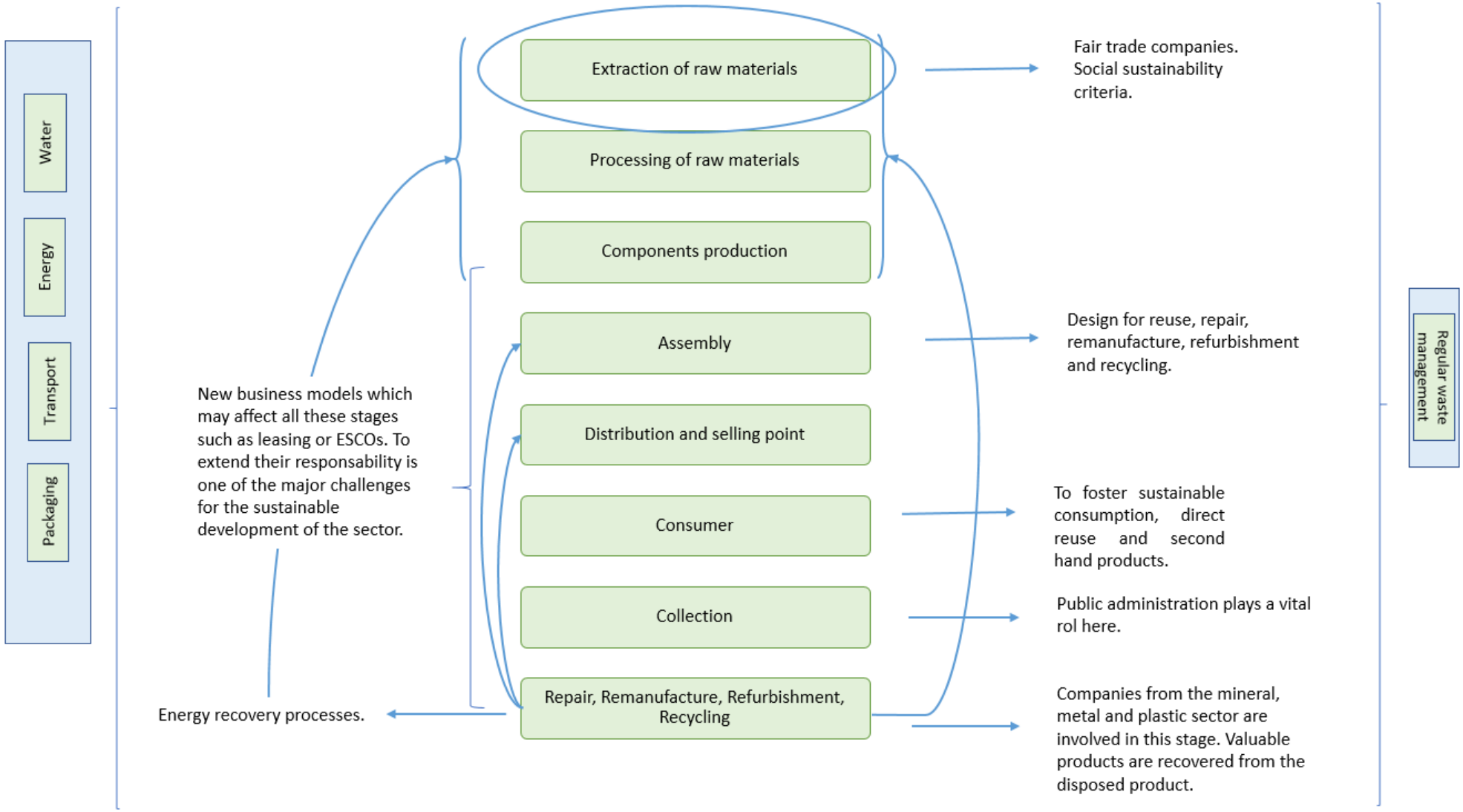

Figure 17. Circular economy approach in the supply chain of the led lighting sector

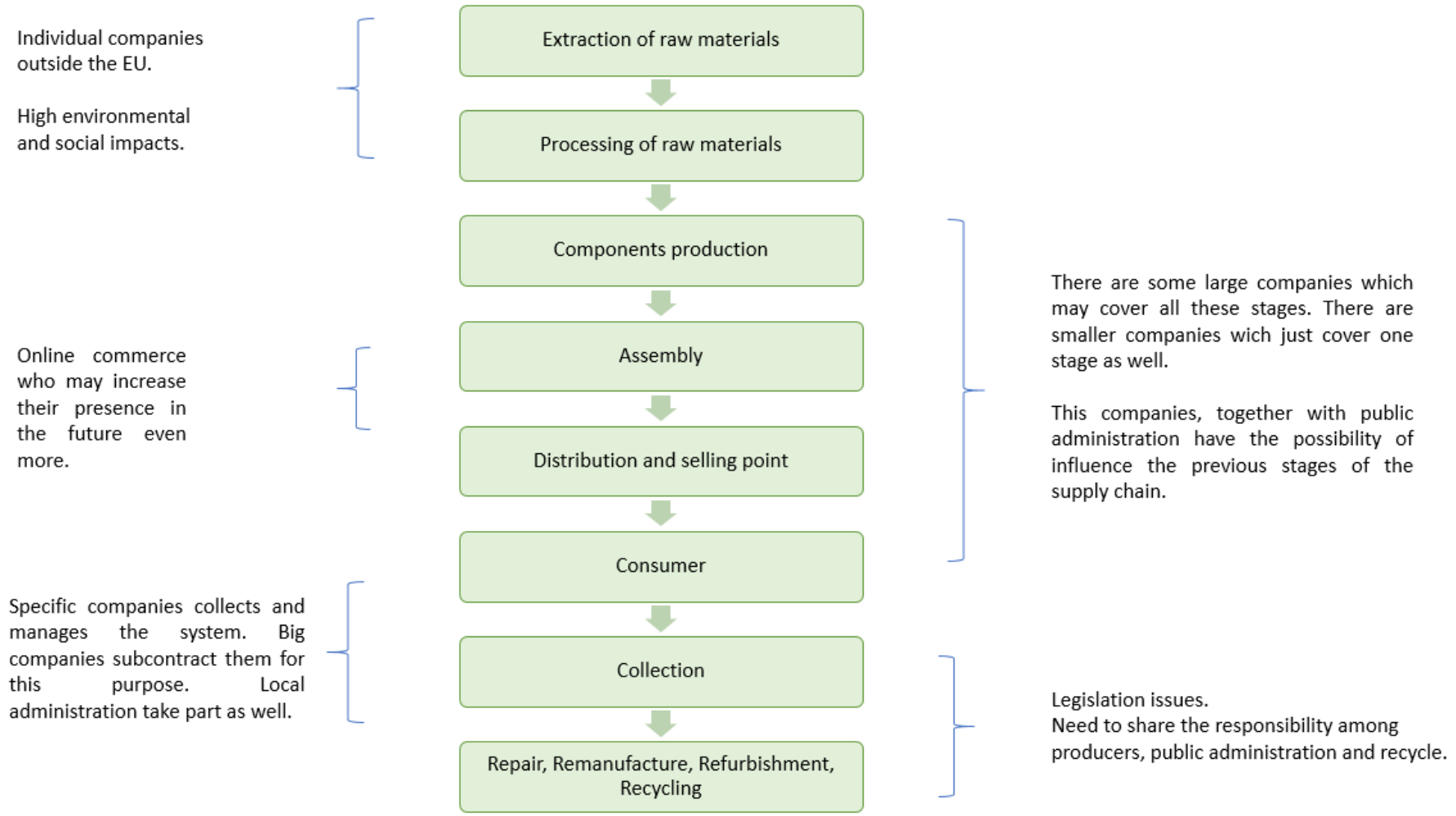

Figure 18. Stakeholders and trade mechanism in each stage of the supply chain

4.5. Lessons learned for demonstrators and future steps

The analysis conducted in the previous sections leads to the conclusion that, in order to develop a circular economy approach in every industry sector, the participation of a vast number of stakeholders and external agents is vital.

This underlines the question of how it is possible to improve the collaboration between companies and how to enable new possibilities for the communication of the relevant actors in the system.

For that purpose, a brokerage system has been developed in the framework of this task. Regular brokerage systems, which traditionally have not reached a real success in the engagement of external companies, are focused in the exchange of materials between actors with no further interactions between them. In this case, the Brokerage System wants to expand the ways and possibilities of collaboration, especially focused in Circular Economy based collaborations.

The holistic concept of the CE match making and the n-step maturity model will suppose not only the possibility of making exchange of resources with other companies, but to develop innovative possibilities of collaboration among companies. The concept will be co-created with the users, this is, their feedback and interactions made of the external users of the Brokerage system will be considered and part of its future development. This future development will be shown in Deliverable 4.5.

In addition, it is important to remark that a single Brokerage System can't make the difference just by its own. Hubs, clusters, brokerage events and other platforms are also necessary channels companies should consider when planning how to improve their strategy in terms of sustainability and find new partners and opportunities that may help them in the process.

Furthermore, it has been studied how different approaches big companies which controls most of the stages of the supply chain and companies just focused on a single stage are. Especially for those who are not related with other agents and do not have a big network of companies who collaborate with, the collaboration is vital.

In the framework of this project, the technical part of the system (the online platform) will be further developed. However, the focus will be not in the technical part of the system but in the concept, which will suppose a breakthrough for establishing circular economy relationships.

In the present document, some successful circular economy approaches have been highlighted. In this direction, and taking into account new relationships opportunities, companies have the possibility to expand their range of action and change from a fixed and traditional group of stakeholders with whom to collaborate, to a flexible group of stakeholders which may be selected according to circular economy criteria along the whole supply chain.

5. Traceability approach for the supply chain

Work Package 5 of the CIRC4Life Project, "Traceability Solutions for Implementing the CEBMs", aims to develop traceability tools which help companies to make their supply chains more traceable and transparent. The traceability module of the CIRC4Life project has the main objective of capturing dynamic data from partners along the value chain. This module is connected to the ICT platform, which will use the captured data in on order to perform the calculation of ecological scorings, developed within the project. The module allows the ICT platform to use all the data collected by it.

As the CIRC4Life project's main objective is to develop a circular economy approach for lifecycles of products and services, the aim of the traceability module is not to track regular characteristics of the products such as colour or weight, but to capture the relevant data which will influence in the sustainability of the individual product or service developed.

The traceability module provides the dynamic data that allows companies to calculate the value of their products' eco-points and eco-credits for individual products. Using this data, the ICT platform will perform the calculation according to the methods developed in the project.

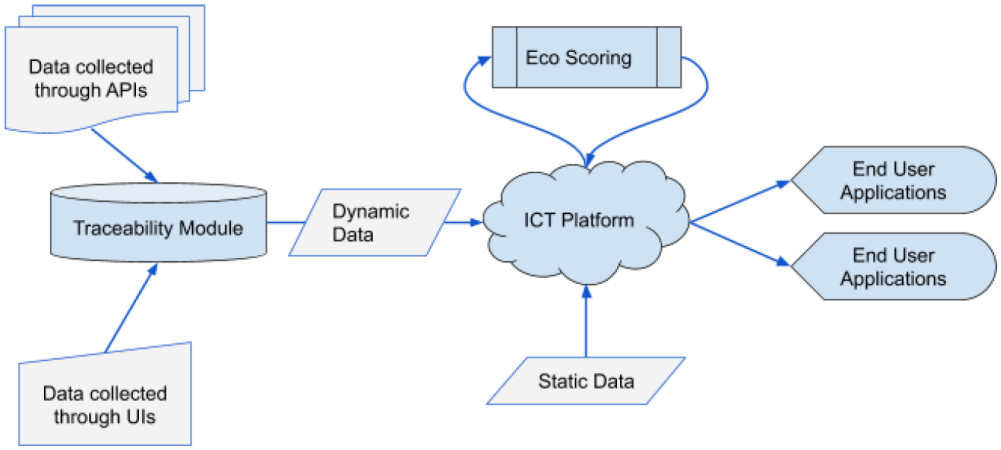

Figure 19. High level data flow diagram of the Traceability Module [Source: CIRC4Life Deliverable 5.2]

It is important to remark that not all companies have the sensors or tools needed to track their products in real time. If so, data gaps still need to be filled with average data, which, obviously, make the ecological scores less accurate and reliable.

In this document, the relationships between different actors along the supply chain have been studied. As it has been shown, there are many different actors involved. This significantly increases the difficulty of tracking all the relevant events in order to provide the accurate ecological scores of the individual products. To establish relationships with companies and facilitate the share of information is key for that purpose.

The following is a good example of how difficult to calculate the ecological information of products can be without controlling all the stages of a supply chain: in the LCA of meat products conducted in Task 1.2, it has been shown that soybean is one of the elements which has the biggest ecological impact throughout the whole supply chain. Thus, if we think of a meat elaborates plant, there are some relevant events which are out of their hands and which should be analysed if relevant ecological information is desired. It would be difficult to have the information of how and when the soybean was produced and about the related ecological impacts, since the responsible actor of this stage is few stages up the supply chain.

This is why it would enormously help to establish a common methodology for all partners involved in order to obtain all the relevant information.

EECC has modelled all processes along these value cycles as traceability events using the EPCIS (Electronic Product Code Information Services) standard. Using this standardised description of processes, all partners can act as traceability data sources.

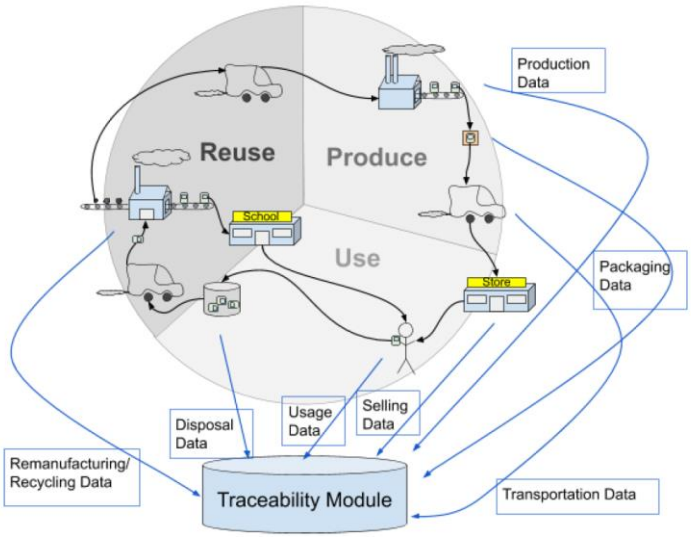

Figure 20. Simplified data flow for the electronics recycling and reuse demonstration to the Traceability Module

After this brief description of the Traceability Module (a detailed description is given in Deliverable 5.2) it is important to define how companies can use it in reality.

Firstly, it has to be mentioned that the implementation of the Traceability Module has not been completely performed yet in CIRC4Life project. The main EPCIS Repository is already developed, but there is a lack of specific connectors for the partners in order to deliver the data to the Traceability Module, so there is no possibility of using the final approach and think about how it could be widespread among other external actors of the supply chain. However, from the previous description of the module and WP5 work, it is possible to understand that this is an easy access system which can be adjusted to the needs of every different actor.

In this direction, the traceability can be done in various way: from a module in which all the stages along the supply chain are included to a module in which just one of them is tracked. In addition, to include in the system the specific relevant data of each specific supply chain is key. For this, the work done in the LCA calculation in the framework of Task 1.2 has major importance, as it shows the relevant information industry actors should track. This work could be also used to prioritize which process or parameters are the most important ones to be measured.

Most of the parameters of the LCA assessment are common for companies of the same activity sector. So, this work can be used not only for demonstration companies of CIRC4Life project. In addition, in section 6 of this document, relevant indicators for the sectors studied and the different stages of them are detailed. This information is also relevant when planning the implementation of a traceability system in your company.

It has been shown that one of the difficulties of this system is to capture information from suppliers and providers. In this case, there are two options while trying to obtain more accurate information: to reduce the scope and to improve the accuracy, or to increase it while losing accuracy. The use of average data and LCA datasets can be useful to have an approximate picture of the ecological impact of products, however, when a traceability system is implemented, the accuracy is much higher and using this data can lead to a loss of it. In reality, a gradual improvement is possible, starting from only static data and adding more and more dynamic and product specific data, as soon as the relevant sources can be used.

The Circular Economy Brokerage System is a good example to illustrate how a traceability system can be useful and valuable for companies. In the system, the eco-points value of the resources offered has been included as optional information. A company with an implemented traceability method can provide this information, which adds value in comparison to those companies who do not have a traceability method implemented. Furthermore, this will be helpful for those who are willing to establish new trade relationships with other actors in the Brokerage System, as the resources offered would have more reliability. Transparency builds trust.

On the other hand, the brokerage system can improve the tracking along the supply chain. The analysis of actors who make trade collaboration with each other provide natural EPCIS events to be tracked. As it has been described in section 2.3, one of the main results to be given by the brokerage system is information about which actors are interesting to establish relationships between them. With the activity results, patterns can be identified and analysis of supply chains and interactions between actors can be improved.

However, at this point, it would not be realistic to say that something similar to this approach has been achieved in CIRC4Life project.

In order to widespread the eco-points and eco-credits method and make it an approach to be used by external agents is still something that needs work to do. The specific capturing and querying applications of the traceability module have been developed for the specific cases of the demonstration of this project, but by using the standard EPCIS interfaces, the traceability method is generically applicable.

In addition, further development of the brokerage tool and engagement of a relevant quantity of users is necessary to draw conclusions.

6. Approach for business partner selection

6.1. Identification of business partners

Once a comprehensive analysis of the different activity sectors' supply chains has been conducted, not only it is necessary to identify the possibilities in order to develop a more circular process, but also the kind of actor we should take into account for it.

In sections 3 and 4, key actors which should be considered in all the sectors analysed have been identified:

- Packaging companies.
- Suppliers of raw materials and finished goods.
- Retailers.
- Logistic companies.
- ICT companies.
- Waste management companies.
- Other industries which may use by-products.
- Public administration.

Companies from all these areas should be considered when planning a circular economy business model in every activity sector. To use tools as brokerage systems or regional, national and European clusters is a useful way to get in contact with actors which may help companies to achieve a circular economy business model.

It is true that the level of relevance of each of them will be related with the specific characteristics of companies, not only from different sectors but also for companies of the same activity sector with different characteristics. So, to make particular analysis of each situation will be necessary.

The LCA or similar methodologies are highly recommended in order to obtain a clear picture of a company situation and to find opportunities in order to improve their process in terms of sustainability. Then, which processes to improve, modify or completely rethink can be appreciated according to the impacts generated. Each process is related with one or various partner groups, which will give us the information about who are the main partners we should consider.

In addition, location, ease for cooperation or other particular intrinsic characteristics, are parameters to have into account when planning your circular economy approach and possibilities of improving the business. Each partner has relevant aspect and circumstances which should be taken into account for the identification of relevant stakeholders and processes to prioritize in their business: scarcity of water, deforestation or child labour may be huge factors for some regions whereas inexistent for others.

It has to be mentioned that sustainability has three main pillars: environmental, social and economic. The social pillar is usually the weakest one, but should be considered as well when planning the circular economy approach. In CIRC4Life project, both E-LCA and S-LCA has been conducted for products of the industry partners to be developed during the demonstration stage of the project in the framework of Task 1.2. Economic aspects are transversal to any partner group and activity sector. Each company needs to consider them when planning their business relationships and activities to be developed.

6.2. Selection method

In order to select the most appropriate partners it is necessary to define a decision-making method based on relevant indicators.

As it has been explained before, the sustainability of a product is not just related with the sustainability of one company, but in the sustainability of lots of different stakeholders. When developing a circular economy approach in a company the origin of the raw materials used, how they have been extracted or the final use of

the waste are issues which usually out of the direct control, so the stakeholders selected for collaboration have a vital role.

In the previous sections, relevant stakeholders from different activity sectors have been highlighted. Once these groups have been identified, indicators have been proposed for each activity sector. The indicators have been proposed not only considering the environmental sustainability but also the social one. A specific section has been included for social indicators. These indicators are in line with the Life Cycle Assessment (LCA) conducted in Task 1.2 of the project for the industry partners.

Meat sector:

Table 5. Indicators for partners' selection in the meat sector

PARTNER GROUP	INDICATOR	UNIT
Packaging companies	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Level of use of recycled materials in packaging production	%
	Level of use of sustainable/green materials (renewables)	%
	Level of recyclability of the packaging	%
	Packaging systems with opportunities for reusing	%
Animal feed producers	Level of raw materials from sustainable agricultural production	1 to 5
	Level of use of wastes as by-products	%
	Level of use of local resources in feed preparation	%
	By-products/recycled wastes used in production of feed	%
	Level of environmental quality of production (ISO standards and other quality certifications)	1 to 5
	Use of renewable energy	% above the total energy consumption
	Resources used from regions with child labour	%
	Hygienic standards (HACAP)	Y/N
Farms	Humanitarian husbandry	Y/N
	Proximity to clients	km
	Ecological (sustainable) agriculture - criteria according to recognised standards, codes of conduct, standards and others	1 to 5
	Sustainable waste management: % of wastes recycled internally/externally % of the use of wastes as by-product (energy, fertiliser)	%
	Use of methane or diesel for the energy production	%
	High standards of biosecurity to minimize disease transmission	1 to 5
	Hygienic standards (HACAP)	Y/N
Slaughterhouse	Humanitarian slaughter	Y/N
	Sustainable waste management: % of wastes recycled internally/externally % of the use of wastes as by-product (energy, fertiliser)	%

	Consumption of electrical energy per batch of animal/animal/product	kWh
	Use of renewable energy	% above the total energy consumption
	Hygienic standards (HACAP)	Y/N
	Water recycling rate	%
Meat elaborates plants	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Sustainable waste management: selective collection of wastes and handling	%
	Water recycling rate	%
	Energy efficiency	1 to 5
	Use of renewable energy	% above the total energy consumption
	Hygienic standards (HACAP)	Y/N
Retailers	Efficient management of not used products: selective delivery to food banks/ waste utilisation/recycling companies	1 to 5
	Use of renewable energy	% above the total energy consumption
	Environmentally friendly activity	1 to 5
	Sales in bulk	%
Logistic companies	Proximity to clients and flexibility of service	km
	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Humanitarian transportation of animals	Y/N
	Energy efficient and environmentally friendly operations	CO_2 emissions
ICT companies	Facilitators of circular economy services	1 to 5
Waste management companies	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Selective collection and recovery of waste material in a given waste stream/given type of activity	%
	High quality of recovered materials (high market value)	%
	Waste managed (processed, recycled, utilised) locally	%
	Proximity to the clients in the waste value chain	km
	Environmentally friendly logistics and processes	1 to 5
Other industries which may use by-products / Recyclers	Environmentally friendly production	1 to 5
	Products based on by-products fulfil high quality criteria	Y/N

	High level of by-product utilisation in production	% by-products used as raw materials
Public administration	Environmental awareness	1 to 5
	The amount of waste streams which are separated within the municipal waste management system	unit

Vegetable sector:

Table 6. Indicators for partners' selection in the vegetable sector

PARTNER GROUP	INDICATOR	UNIT
Packaging companies	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Level of use of recycled materials in packaging production	%
	Level of use of sustainable/green materials (renewables)	%
	Level of recyclability of the packaging	%
	Packaging systems with opportunities for reusing	%
Farms	Ecological (sustainable) agriculture - criteria according to recognised standards, codes of conduct, standards and others	1 to 5
	By-products/recycled wastes used in production	%
	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Use of renewable energy	% above the total energy consumption
	Sustainable waste management: % of the use of wastes collected selectively and recycled internally or externally as by-product (energy, fertiliser)	%
	Selective treatment of water and recycling rate	%
Retailers / food services	Efficient management of not used products: selective delivery to food banks/waste utilisation/recycling companies	1 to 5
	Proximity to farm	km
	Sells in bulk	%
Logistic companies	Proximity to clients and flexibility of service	km
	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Energy efficient and environmentally friendly operations	CO_2 emissions
ICT companies	Facilitators of circular economy services	1 to 5
Waste management companies	Environmental management standards ISO standards, ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit

	Percentage of selective collection and recovery of waste material in a given waste stream/given type of activity	%
	High quality of recovered materials (high market value)	Y/N
	Waste managed (processed, recycled, utilised) locally	%
	Proximity to the clients in the waste value chain	km
	Environmentally friendly logistics and processes	1 to 5
	The method of recycling is social friendly	1 to 5
Other industries which may use by-products / Recyclers	Environmentally friendly production	1 to 5
	Products based on by-products fulfil high quality criteria	Y/N
	High level of by-product utilisation in production	% by-products used as raw materials
Public administration	The amount of waste streams which are separated within the municipal waste management system	unit
Local community	Environmental awareness	1 to 5
	Selective waste collection with selection of high-quality organic wastes	%

Lighting sector:

Table 7. Indicators for partners' selection in the lighting sector

PARTNER GROUP	INDICATOR	UNIT
Packaging companies	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Level of use of recycled materials in packaging production	%
	Level of use of sustainable/green materials (renewables)	%
	Level of recyclability of the packaging	%
	Packaging systems with opportunities for reusing	%
Suppliers of materials/products to the producer	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Use of virgin materials from sustainable sources	%
	Level of energy from renewable, sustainable sources	% above the total energy consumption
	Production is social friendly - % of resources used from regions with child labour	%
	Ecological certification of products	Y/N
Waste management companies (alternative for recycling companies)	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Percentage of selective collection of waste material in a given type of waste stream and activity	%

	Proximity to clients in waste management value chain	km
	Level in which waste management is environmentally friendly	1 to 5
	Waste managed locally (processed/recycled)	%
Recycling companies	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Percentage of recovery of usable materials in a given waste stream (dismantling of product, recovery/recycling of material)	%
	High quality of recovered/recycled material (high market value)	%
	Proximity to clients in waste processing value chain (close to waste collection points)	km
	Methods of recycling are environmentally friendly	1 to 5
	Methods of recycling is socially friendly - low nuisances for communities	1 to 5
Services companies (which implement leasing service or similar)	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Level of energy from renewable, sustainable sources	%
	E-mobility or other environmentally friendly fuels (gas, biogas)	%
	Resilient specification of offer: tailored to the client's expectations- optimisation of activities	1 to 5
ICT companies	Facilitators of circular economy services	1 to 5
Other industries which may use by-products	Opportunities for the reuse of the product	1 to 5
Public administration	Opportunities for organisation of system for selective use of products	1 to 5

Tablet sector:

Table 8. Indicators for partners' selection in the tablet sector

PARTNER GROUP	INDICATOR	UNIT
Packaging companies	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Level of use of recycled materials in packaging production	%
	Level of use of sustainable/green materials (renewables)	%
	Level of recyclability of the packaging	%
	Packaging systems with opportunities for reusing	%
Suppliers of materials/products to the producer	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Use of virgin materials from sustainable sources	%
	Level of energy from renewable, sustainable sources	% above the total energy consumption

	Ecological certification of products	Y/N
Service for selective collection of tablets	E-mobility or other environmentally friendly fuels (gas, biogas)	%
	Proximity to sources of used electronic equipment	Km
Company delivering collection bins	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	High environmental quality of collection bins	1 to 5
Recycling companies/dismantlers	Environmental management standards: ISO 14000, ISO 9000 or others standards/certifications, self-declarations, certified environmental audits	unit
	Recovery of usable materials in a given waste stream (dismantling of product, recovery/recycling of material)	%
	High quality of recovered/recycled material (high market value)	1 to 5
	Proximity to clients in waste processing value chain (close to waste collection points)	km
Repairing and upgrading services	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Proximity to clients in waste processing value chain (close to waste collection points)	km
	Level of energy from renewable, sustainable sources	% above the total energy consumption
Electronic companies (delivery of electronic components)	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	High quality of spare components	1 to 5
Collaborative Industries which may use by-products from used electronic equipment	Environmental management standards ISO standards ISO 14000 ISO 9000 or others standards/certificates, self-declarations, certified environmental audits	unit
	Level of recycled materials/components used in production	%
ICT companies	Facilitators of circular economy services	1 to 5
Municipality	Quality of the waste management system	1 to 5
	Environmental policy related to CE	1 to 5
Public user	Environmental awareness	1 to 5
	Level of engagement	1 to 5

Social aspects transversal to every sector and partner group:

Table 9. Social indicators for partners' selection

INDICATOR	UNIT
Fair salary	1 to 5
Hours of work per employee, per day	1 to 5
Extra hours above the total work hours	%
Right of Association, collective bargaining and strike	1 to 5

Gender wage gap	%
Women and men occupation	%
Child labour	1 to 5
Goods produced by forced labour	%
Accident rate at workplace	%
Promotion of social responsibility along the supply chain	1 to 5
Presence of anti-competitive behaviour or violation of anti-trust and monopoly legislation	1 to 5
Evidence of an active involvement of the enterprises in corruption and bribery	1 to 5
Violations of mandatory health and safety standards	1 to 5
Strength of national legislation covering product disposal and recycling	1 to 5
Presence of business practices that are deceptive or unfair to consumers	1 to 5
Presence of a law or norm regarding transparency (by country/sector)	Y/N
Sanitation coverage of employees	%
Presence of codes of conduct that protect human rights of workers among suppliers	Y/N

This list should be considered as a first approach for selecting the most relevant indicators for each company and activity sector. It goes without saying that each company should modify it as desired and should propose a particular approach for its own business considering particular indicators and partner groups. The unit of measure of each indicator may vary as well.

Furthermore, each company may consider different weights for the indicators. For that, a qualitative analysis needs to be conducted so each company propose the different weighting options. Using scientific methodologies as the Technique for Order of Preference by Similarity to Ideal Solution[27] (TOPSIS) would be a way of constituting a more solid approach for the definition of the selection methodology. In order to compare the value of the indicators and to deal with the different weights, the indicators value should be normalised. To use values from 1 to 5 is recommended.

Establishing weights for indicators should be an internal process, as standardizing the weights globally usually has a lack of consensus. For some perspectives, economic impacts would be more relevant meanwhile for others water/GHG will be extremely important and for others social wellness or preventing child labour would be crucial.

The different weighting options should be based in three main criteria according to the specific circumstances of companies: environmental sustainability, social sustainability and economic sustainability.

Once the different partners groups, the indicators and their weights have been identified, there are two main possibilities:

- Firstly, it is possible that a company wants to know who is the most appropriate partner for a circular economy business model of one specific partner group (e.g. which is the packaging company which can help me the most). For that purpose, the indicators proposed can be used.

[27] https://en.wikipedia.org/wiki/TOPSIS

- Secondly, a company would like to consider different partner groups and different companies among them, so different companies from different partner groups can be compared. In this case, it is important to conduct a previous analysis of the company's situation by using LCA methods or similar.

This methodology can help any company to define their circular economy model and the most useful contacts to collaborate with. A deep analysis of the company is needed in order to simplify the indicators list, the different weighting options and the specific needs in terms of sustainability in the environmental, social and economic aspect.

However, this methodology has some weaknesses that needs to be consider. In relation to the collection of relevant data from other companies, sometimes it is difficult to collect relevant information which could be used in the analysis. Even more, sometimes the companies do not have the information regarding the parameters listed in this section. Considering that, it is important to follow the principle "to do one's best" and try to collect as much information as possible. This is why indicators may be measured in a qualitative way and complex indicators have not been proposed. However, in order to conduct a LCA, more accurate data is needed, so it is possible to fully understand the strengths and weaknesses of the company and establish an action plan with the company's main priorities.

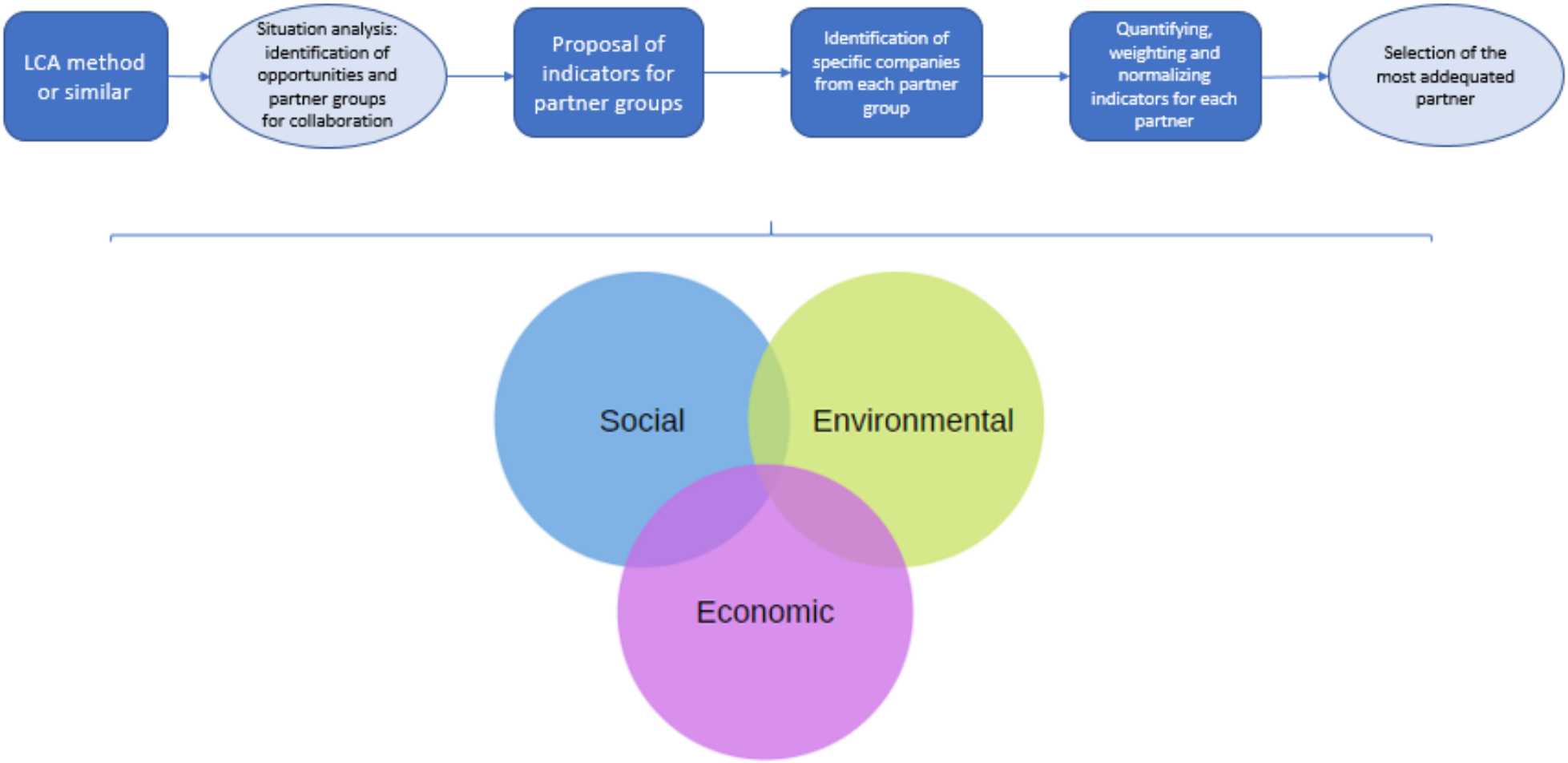

Figure 21. Selection method for partners collaboration

7. Conclusions

In this report, the interactions between stakeholders in the supply chain of different activity sectors in order to achieve co-creation of sustainable products have been studied.

Firstly, a Circular Economy Brokerage System has been developed. The Brokerage System concept is still on its first version, and its concept will be further developed in the next stages of the project. However, it establishes the basis of a new system in which companies from various activity sectors have the opportunity of collaborating, offering and purchasing resources as well as to make contact and trade relationships for further collaborations based on circular economy.

Then, supply chains of the different activity sectors have been analysed. The main wastes and trade relationships among different stakeholders of the supply chains of the meat, vegetable, tablet and lighting sectors have been identified and guidelines for the development of a circular economy approach have been proposed.

In addition, stakeholders to be considered in each stage of the supply chain have been identified, as well as the external factors and agents which may have an influence in the development of the business model. Constrictions and limitations of the different business models have been studied and successful approaches in the different activity sectors have been analysed.

Guidelines for the implementation of the traceability method in the industry sector have been contemplated. Further development is needed in this direction.

Finally, an approach for business partner selection in order to develop a circular economy approach has been developed. Indicators for the selection of partners from different partners' groups have been proposed.

Appendix I

NAME OF THE STAKEHOLDER	ACTIVITY SECTOR	LOCATION	BRIEF DESCRIPTION OF THE STAKEHOLDER	RELEVANCE
British Meat Processors Association (BMPA)	Meat sector	London, UK	Most influential group of businesses within the British meat industry. The British Meat Processors Association represents the majority of companies working in the British meat industry. Its members are responsible for supplying fresh meat and meat products to retailers, restaurants and food service companies throughout the UK.	High
British Poultry Council	Poultry industry across whole food chain	London, UK	The Voice of the British Poultry Meat Industry since 1967 - The British Poultry Council is the trade association for those involved in the production of poultry meat – chicken, turkey, duck, and goose – in the UK. Member businesses account for nearly 90% of the production in the UK and cover the whole food chain: breeding, hatching, growing, slaughter, processing, and packing.	Medium
WD Meats	Meat sector	Northern Ireland, UK	Large company supplying quality assured beef and innovative beef products to retail customers throughout UK, Europe, Africa and Asia. Slaughtering, Boning, Packing and Despatch facilities provided in-house, giving control over all stages of production.	Medium
Karro Food Group	Meat sector	UK	One of the UK's leading pork processors with processing plants across the country – supplies products to leading retailers, foodservice and manufacturing customers. Breeds own pigs but also sources from local farmers	High
TRiFOCAL resource bank (EU-funded project)	Food sector	EU	Virtual resource centre for stakeholders to easily find and share information about innovative new approaches to behaviour change that aim to prevent food waste, encourage recycling of inedible food and promote healthy sustainable eating	Medium
WRAP	Waste management. Food and electronic sectors.	UK	Support to projects in the field of circular economy and sustainable waste management, handing approx. 18 million yearly for projects relating to sustainable production and consumption and to waste and resource management - both food and electronics are addressed.	Medium
Toward a Global Rare Earth Industry Association (GloREIA)	Raw materials. Electric and electronic sectors.	EU (Headquarters in Belgium)	EU-based platform of international experts and stakeholders that will prepare and launch an International Association for Rare Earth Industries (REIA). The REIA association will also a constitute an international society for rare earths (ISRE), which specializes in bringing state-of-the-art research to REE industry to increase its competitiveness and internationalization. GloREIA contributes to novel, circular business models across REE value chains. GloREIA will also set up and manage a database of life cycle inventories with and for industry members and scientists in the REE field.	High
EIT RawMaterials	Raw materials. Electric and	EU	Body of the European Union, largest consortium in the raw materials sector worldwide. Its mission is to enable sustainable competitiveness of the European	High

	electronic sectors.		minerals, metals and materials sector along the value chain by driving innovation, education and entrepreneurship. EIT RawMaterials unites more than 120 core and associate partners and 180+ project partners from leading industry, universities and research institutions from more than 20 EU countries. Partners of EIT RawMaterials are active across the entire raw materials value chain; from exploration, mining and mineral processing to substitution, recycling and circular economy. EIT RawMaterials aims to enhance innovation by sharing knowledge, facilitating matchmaking activities, developing innovative technologies and supporting business creation	
UECBV	Meat sector	EU	The European Livestock and Meat Trades Union (UECBV) is the EU voice of national federations representing livestock markets, livestock traders (cattle, horses, sheep, pigs), meat traders (beef, horse meat, sheep meat, pig meat), and the meat industry (slaughterhouses, cutting plants, meat preparation plants).	High
INTERPORC	Meat sector	Spain	The White Layer Swine Interprofessional Organization (INTERPORC) is a non-profit organization in which all sectors of pork sector value chain are represented: production, processing and selling. It is the most important Interprofessional organization in the meat sector due to the volume of pig production in our country.	High
Food Drink Europe	Food sector	Brussels, with members around the EU	FoodDrinkEurope's contribution is based on sound scientific research, robust data management and effective communication, working within the regulatory framework to ensure that all food and drink issues are dealt with in a holistic manner. The organisation promotes its members' interests in areas such as food safety and science, nutrition and health, consumer trust and choice, competitiveness, and environmental sustainability.	Medium
FIAB – Spanish food and beverage industry	Food sector	Madrid, Spain	Since 1977, it represents the Spanish food and beverage industry, the country's first industrial sector. FIAB aims to defend the interests of the sector before the Administration and the different national and international decision-making bodies, as well as the anticipation of future challenges that affect the development of its activity. It is made up of almost fifty associations.	Medium
FDF - Food and Drink Federation	Food sector	London, UK	The Food and Drink Federation (FDF) is the voice of the UK food and drink industry, the largest manufacturing sector in the country. The UK food and drink industry accounts for 19% of the total manufacturing sector by turnover and employs over 450,000 people in the UK across 7,000 businesses. We are an incredibly diverse sector, speaking on behalf of global brands and thriving small businesses.	Medium

FEFAC- European Feed Manufacturers' Federation	Food sector / Animal feeding	Brussels, with members around the EU	FEFAC membership today consists of 23 national associations in 23 EU Member States as full members as well as Associations in Switzerland, Turkey, Norway, Serbia and Russia with observer/associate member status. The European compound feed industry employs over 100,000 persons on app. 3,500 production sites often in rural areas, which offer few employment opportunities. Farm animals in the EU-28 consume an estimated 480 million tonnes of feed a year, of which about 30% are produced by the compound feed manufacturers. Turnover of the European compound feed industry is estimated at 50 billion €.	High
CESFAC- Spanish Feed Manufacturers Confederation (CESFAC)	Food sector / Animal feeding	Madrid, Spain	Professional non-profit organization that coordinates and represents the interests of animal feed businesses and their associates before the government and third parties. CESFAC is composed of fifteen regional associations and also represents and defends their interests before the regional governments.	High
AIC - Agricultural Industries Confederation	Agriculture / Animal feeding	Peterborough, UK	The Agricultural Industries Confederation (AIC) is the agrisupply industry's leading trade association. Formed in October 2003 by a merger of three trade associations, AIC has over 250 Members in the agrisupply trade and represents £8 billion turnover at farmgate. The trade association represents several sectors within the agrisupply industry including: Animal Feed; Crop Protection and Agronomy; Fertilisers; Grain and Oilseed; Seed.	High
BFA - Belgium Feed Association	Food sector / Animal feeding	Brussels, Belgium	160 manufacturers who are producing 98% of the national production of Belgium (7 million tons), are affiliated. The Belgian feed sector is part of the food chain: feed for food. This results in representations on regional, national and international level.	High
FEAD - European Federation of Waste Management and Environmental Services	Transversal / Waste managers	Brussels, with members around the EU	FEAD, the European Federation for Waste Management and Environmental Services, represents the private waste and resource management industry across Europe. FEAD's members are national waste management associations covering 19 Member States, Norway and Serbia.	High
Environmental Services Association (ESA)	Transversal / Waste managers	London, UK	The Environmental Services Association (ESA) is the trade body representing the UK's resource and waste management industry. Companies in our sector collect the waste materials produced by households and businesses across the UK, treat it responsibly, and turn a large percentage of it into new resources or energy whilst protecting the environment.	Medium
EuRIC - The European Recycling Industries' Confederation	Transversal / Recyclers	Brussels, with members around the EU	Through its Members, EuRIC represents companies involved in the collection, processing, recycling, transport and trade of a variety of recyclables (metals, paper, plastics, glass and beyond) across Europe. By servicing its Members, EuRIC contributes to promote recycling, which is first and foremost a	High

			business activity driven by an ecosystem of thousands of Small and Medium-size Enterprises (SMEs) and fewer but equally important larger companies. All of them are local and global actors. They provide non-outsourceable job opportunities and produce locally commodities, which are traded and priced globally. Their activities offer massive environmental benefits by saving natural resources and drastically reduces energy consumption and pollution.	
The Lighting industry association (LIA)	Lighting sector	UK	The Lighting Industry Association is Europe's largest Trade Association for lighting equipment professionals. This includes lighting manufacturers, suppliers, retailers, wholesalers, designers and all professionals active in the UK lighting market.	High
Lighting Europe	Lighting sector	Brussels, with members along the EU	LightingEurope is the industry association that represents the lighting industry in Europe. It is the voice of more than 1,000 lighting companies who employ more than 100,000 people over Europe.	High
IALD (The International Association of Lighting Designers)	Lighting sector	Chicago, with members in the whole world	The International Association of Lighting Designers (IALD) is an internationally recognized organization dedicated solely to the concerns of independent, professional lighting designers.	Medium
ILP (The Institution of Lighting Professionals)	Lighting sector	UK	The Institution of Lighting Professionals (ILP) is the UK and Ireland's largest and most influential professional lighting association, dedicated solely to excellence in lighting.	High
EERA European Electronics Recyclers Association	Electronic and electric sector / Recyclers	Netherlands, with members in the whole EU	EERA is a professional association for reuse, recycling and reprocessing companies dealing with Waste Electrical and Electronic Equipment - WEEE in Europe. The vision of EERA is for a circular economy where WEEE is managed as a resource and is returned into the economy as equipment for reuse or as a raw material. INDUMETAL is a member, so maybe they can help us in order to distribute the invitation among the members.	High
Orgalim	Electronic and electric sector	Brussels, with members along the EU	European-level federation that engages with EU policymakers on behalf of our membership, speaking for 32 national industry associations and 12 European sector associations.	High
SERCOBE	Electronic and electric sector	Madrid, Spain	SERCOBE is the Spanish Association of Manufacturers of Capital Goods. It represents 120 companies and industrial groups, 4 collective members and 3 special groups, representing more than 400 Spanish companies.	High
EAMA	Electronic and electric sector	UK	The Engineering and Machinery Alliance, EAMA, is an alliance of independent trade associations.	Medium
Gambica	Electronic and electric sector	UK	GAMBICA is the Trade Association for Instrumentation, Control, Automation and Laboratory Technology in the UK.	Medium
Agroecology Europe, Belgium	Farm sector	Brussels, with members	The Association intends to place agroecology high on the European agenda of sustainable development of farming and food systems.	High

		along the EU		
Agriculture and Horticulture Development Board, UK	Food sector	UK	The Agriculture and Horticulture Development Board (AHDB). Their purpose is to inspire their farmers, growers and industry to succeed in a rapidly changing world.	High
Organic Growers Alliance, UK	Farm sector	Wiltshire, UK	The Organic Growers Alliance is a network of growers, farmers and horticulturalists. The OGA is place to exchange information and learn, it is an alliance that represents its members and it is a support network that draws strength from what members share.	High
COPA COGECA and its Spanish, British and Belgish members (COAG, NFU and BB)	Food sector	Brussels, with members along the EU	Association of European farmers and European Agri-cooperatives	High
COAG	Food sector	Madrid, Spain	First professional agricultural organization of state scope constituted in Spain (1977). It has a network of over 220 offices distributed throughout the Autonomous Communities and a permanent delegation in Brussels. It defends the social and professional model of agriculture of Spain.	Medium
National Farmers' Union of England and Wales (NFU)	Food sector	UK	The National Farmers' Union (NFU) is a member organisation/industry association for farmers in England and Wales. It is the largest farmers' organisation in the countries, and has over 300 branch offices.	High
Boerenbond (BB)	Food sector	Leuven, Belgium	Farmers Union.	Medium
The Real Junk Food Project	Food sector	UK	It aims to reduce food waste and make groceries accessible for those who cannot afford it - thus the pay only what you can concept. Has been struggling to gain enough revenue.	High
COPRESA	Food sector / Animal feeding	Region of Murcia, Spain	Biowaste manager. The company owns a meat by-products transformation plant.	High
LIMPIEZAS BLAZQUEZ	Cleaning sector	Region of Murcia, Spain	Biowaste manager.	High
OLISEFI	Food sector / Waste management	Tarragona, Spain	The company obtains by-products from the food industry to develop raw materials for the animal feeding sector.	High
HARINAS BUFORT	Food sector / Waste management	Alicante, Spain	The company obtains by-products from the food industry to develop raw materials for the animal feeding sector.	High
HARIMSA	Food sector / Waste management	Region of Murcia, Spain	The company obtains by-products from the food industry to develop raw materials for the animal feeding sector.	High
PROMIC	Food sector / Waste management	Barcelona, Spain	The company obtains by-products from the food industry to develop raw materials for the animal feeding sector.	High
ANDRÉS SERRANO, S.A.	Food sector / Waste management	Alicante, Spain	The company obtains by-products from the food industry to develop raw materials for the animal feeding sector.	High

ALINATUR	Food sector / Pet animal food	Region of Murcia, Spain	The company develops pet food by using meat by-products among others.	High
SAIPOL MEDITERRANEE, S.L.	Food sector / Animal feeding	Barcelona, Spain	The company obtains rapeseed by-products to develop raw materials for the animal feeding sector.	Medium

Appendix II

- English version:

Subject line: Invitation to test circular economy free access brokerage tool for companies (EU-funded project CIRC4Life)

CIRC4Life Brokerage Tool

Dear Mr, Mrs ____,

I contact you in the context of the CIRC4Life project, which is an innovative EU research project that involves 17 partners from 8 different EU countries. It aims to develop and implement circular economy approaches by creating new sustainable products and services through their value and supply chains.

Circular economy is an alternative to the current traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover materials and regenerate products and materials at their end of life.

In order to facilitate communication with other companies interested in implementing circular economy practices, we have developed a **free access online brokerage tool**, which we invite you to test. This tool will allow companies from various activity sectors to offer and purchase different kind of resources (wastes, by-products, raw materials, etc.) while contributing to environment sustainability by giving a second life to resources that otherwise may go to recycling plants or landfill as value raw materials for another purpose and giving them a second life. Furthermore, the tool allows companies to find synergies in order to develop circular economy innovative business models.

We encourage you to register in this tool in order to establish relations with other actors who may help you in your business. If you think that this system could be interesting to any other actor you know, please feel free to distribute this information.

Some of the main benefits of the tool includes are:

- ✓ Easy access to resources from various activity sectors.
- ✓ Contact with other companies.
- ✓ Wide range of resources of various activity sectors.
- ✓ A suitable platform to offer your wastes, by products or stock material.
- ✓ A perfect way of saving costs while preserving the environment.

Please, use the following link to access to the tool: https://circ4life-brokerage.iccs.gr

If you have any comments or suggestions, please do not hesitate to get in touch.

For more information about the project, please visit http://www.circ4life.eu/

- Spanish version:

Asunto: Invitación a la herramienta de economía circular para intercambio de recursos entre empresas (Proyecto cofinanciado por la UE CIRC4Life)

Herramienta de intercambio de recursos CIRC4Life

Estimado/a ____,

Me pongo en contacto con usted en el contexto del proyecto CIRC4Life, un innovador proyecto europeo de investigación en el que participan 17 socios de 8 países europeos diferentes. El proyecto persigue desarrollar e implementar un enfoque de economía circular mediante la creación de nuevos productos y servicios sostenibles a lo largo de toda la cadena de valor.

La economía circular es una alternativa a la tradicional y actual economía lineal (hacer, usar, tirar) que persigue mantener los recursos en uso durante el máximo tiempo posible, conseguir el máximo valor de ellos en su etapa de uso y recuperar y reutilizar productos y materiales al final de su vida útil.

Para facilitar la comunicación entre empresas interesadas en implementar prácticas de economía circular, hemos desarrollado una herramienta de intercambio de recursos online de libre acceso, la cual le invitamos a conocer. Esta herramienta permitirá a empresas de variados sectores de actividad ofrecer o comprar diferentes tipos de recursos (residuos, subproductos, materias primas…) a la vez que colaborar con el medio ambiente, mediante la utilización como materias primas de recursos que podrían acabar en el vertedero o plantas de reciclaje, dándoles así una segunda vida. Además, esta herramienta permitirá a las empresas encontrar sinergias para desarrollar innovadores modelos de negocio basados en la economía circular.

Le animamos a utilizar la herramienta para establecer relaciones con otros actores que pueden ayudarle a mejorar en su negocio. Si cree que esta herramienta puede ser útil para cualquier otra empresa que conozca, no dude en compartirla con ellos.

Algunos de los principales beneficios que la herramienta incluye son los siguientes:

- ✓ Acceso fácil a recursos.
- ✓ Contacto con otras empresas.
- ✓ Amplio rango de recursos de diferentes sectores.
- ✓ Una adecuada plataforma donde ofrecer residuos, subproductos o material en stock.
- ✓ Una forma perfecta de ahorrar costes y preservar el medioambiente.

Por favor, utilice el siguiente enlace para acceder a la herramienta: https://circ4life-brokerage.iccs.gr.

Si tiene algún comentario o sugerencia, no dude en ponerse en contacto con nosotros.

Para más información, visite la web del proyecto: http://www.circ4life.eu/