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A circular economy approach for lifecycles of products and services

Report on policy alignment

Deliverable 8.2

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DOCUMENT AUTHORS AND AUTHORISATION	
Document Responsible	Vasileios Rizos and Julie Bryhn, CEPS
Contributors	Monica Alessi, CEPS Edoardo Righetti, CEPS Noriko Fujiwara, CEPS Cristian Stroia, CEPS Beata Michaliszyn, IETU
Reviewed by	Sten-Erik Björling, Enviro Data Beata Michaliszyn, IETU
Approved by	NTU

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Summary

The circular economy is at the core of the transformation of Europe's industrial landscape and the move towards more sustainable economic models. Next to the central role it now has in EU policy strategies like the Green Deal and economic growth and recovery, it is also increasingly being integrated in business strategies, practices and supply chains. Despite its growth in industrial applications, a variety of barriers limit the adoption of circular practices by businesses. However, several opportunities also exist and have helped inspire the uptake of circular business models.

The CIRC4Life project has developed three circular economy business models (CEBMs) and demonstrated them in the electrical and electronic equipment (EEE) sector and in the agri-foods sector. This report reviews current policies and legislation, assesses the barriers and enablers identified during implementation of the CEBMs and presents evidence-based policy recommendations for boosting circular practices in the EU.

The research team first carried out a mapping exercise, as an initial step towards identifying the main EU policies relevant to the scope of the project (such as regulations, directives, standards and voluntary agreements) and the obstacles and risks to project implementation. The mapping of policies focuses on Spain and the UK as the two countries where the project's CEBMs have been demonstrated. The team then identified barriers and enablers through case studies involving semi-structured interviews with selected businesses of different sizes that have implemented circular business models in the EEE and agri-food sectors.

The analysis of barriers reveals that businesses have had to adapt to the impacts of the Covid-19 pandemic, with most companies affirming impacts on demand, supply chains and operations. Yet, not all impacts have been negative, with some reporting opportunities – especially in the EEE sector.

The main barriers to implementing circular economy practices have been identified as being related to the supply chain, policy and regulation, consumer and societal awareness, along with financial and economic hurdles across the two sectors. The analysis also provides evidence on the critical enablers that can support the transition to circular business models, with the interviewed companies identifying consumer and societal awareness as the most important one in both sectors, followed by policy and regulation, and company organisation.

Finally, based on the insights gathered, four key policy recommendations emerge that are applicable for both the EEE and agri-food sectors:

- **R.1 Increase the use of different forms of financial support for circular activities and businesses.** Despite the various instruments at EU and national level in place to provide support for such activities, significant barriers to implementing CEBMs persist. Forms of financial support that can be further utilised include tax incentives and increased use of both green public procurement and research & innovation funds.

- **R.2 Better align requirements stemming from different pieces of legislation with an impact on circularity.** In both the EEE and agri-food sectors it has been observed that requirements stemming from diverse policies, often from different policy domains, frequently may not support circularity goals. These findings indicate that efforts should be made to identify these policy conflicts and trade-offs as well as better align the goals of various pieces of legislation that have an impact on circularity.

- **R.3 Improve consumers' understanding of the benefits of circular solutions.** Although various companies identify a positive consumer trend towards circular solutions as an important enabler, there is still a consumer segment that is not interested or does not trust such solutions. This suggests that

awareness-raising measures, communicating in easy-to-understand language the environmental benefits of such solutions and how these are calculated, can have a positive impact on demand. Product labels can also serve as a reliable source of information about the environmental impact of products and increase consumers' motivation to choose products produced through more circular processes.

- **R.4 Support transparency and traceability across the supply chain through solutions involving all actors.** A lack of transparency and traceability regarding products and their associated environmental impacts, components and substances represent a barrier for companies operating a variety of CEBMs. While traceability tools and solutions already exist, all actors would need to be involved – from suppliers of primary materials, to producers and recyclers – for such solutions to roll out. In addition, such solutions would need to be designed in a way that all actors across supply chains could adopt them, including small companies that do not have large capacities or the technical know-how.

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Acronyms and abbreviations

Abbreviation	Description
CCAA	Comunidades Autónomas (Autonomous Communities), Spain
CE	Circular economy
CEBM	Circular economy business model
CO_2	Carbon dioxide
CSR	Corporate social responsibility
Defra	Department for Environment, Food and Rural Affairs, UK
EEE	Electrical and electronic equipment

Abbreviation	Description
EPR	Extended producer responsibility
GHG	Greenhouse gas
GPP	Green public procurement
LE	Large enterprise
LED light	Light emitting diode
LCA	Lifecycle assessment
PEMAR	Plan Estatal Marco de Gestión de Residuos
POPs	Persistent organic pollutants
PR	Public relations
R&I	Research & innovation
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Directive (EC 1907/2006)
RoHS	Restriction of Hazardous Substances Directive (2011/65/EU)
SDG	Sustainable Development Goal
SME	Small and medium-sized enterprise
QR code	Quick response code
WEEE	Waste electrical and electronic equipment

1 Introduction

Within a period of less than ten years, the circular economy has taken centre stage in the European policy debate on the need to transform the European industrial landscape and move towards a more sustainable economic model. It first emerged in high-level EU policy strategies as a concept supporting the objectives of economic growth and competitiveness,[1] while more recently it has been promoted as a crucial element of both the Green Deal, the EU's flagship policy initiative (European Commission, 2019), and the EU's efforts to achieve a green post-pandemic recovery (European Commission, 2020a). The European Commission's commitment to supporting the development of a circular economy has been demonstrated through two circular economy action plans, including a series of concrete actions and legislative initiatives (see European Commission, 2015; 2020b). Various national governments across the EU have also responded to this momentum around the concept and published dedicated circular economy strategies and programmes.[2]

The concept has broad appeal among businesses as shown by numerous accounts in research reports, articles and the media of companies deciding to integrate circularity aspects into their strategies or implementing dedicated circular economy business models[3] (CEBMs) (Velenturf & Purnell, 2021; Rizos et al., 2018). Circular economy strategies have been documented across a variety of sectors, including fast-moving consumer goods, electrical and electronic equipment (EEE), automotive, agri-food, chemicals, material recovery and recycling, textiles, the built environment, utilities and furniture (Elia et al., 2020). Among the specific circular economy practices observed in these sectors are less resource-intensive production techniques (Desing et al., 2020), reduction of waste generation across all stages of a product's lifetime (Merli et al., 2018) and innovations aimed at extending the utilisation of products (Linder & Williander, 2017).

Although the ecosystem of circular economy industrial applications is rapidly evolving across the EU, there is a general consensus among scholars that there is still great untapped potential to increase circularity in many sectors (see, for example, Trigkas et al., 2020; Shahbazi et al., 2016; Kirchherr et al., 2018). This is confirmed by evidence for different sectors indicating unsustainable consumption patterns and high levels of waste generation across the EU: for instance, Stenmarck et al. (2016) have estimated that about 88 million tonnes of food waste are produced across the various stages of food production and consumption, while according to Forti et al. (2020) the generation of e-waste amounts to 12 million tonnes. Limited progress towards the adoption of circularity practices by businesses has been attributed in the existing literature to a range of different barriers, but empirical evidence about these barriers and also about factors that enable CEBMs is still not widely available (Trigkas et al., 2020; Salmenpera et al., 2021).

CIRC4Life is an EU-funded project that, during its course of 42 months, has developed and demonstrated new CEBMs in two sectors: the EEE and agri-food/farming sectors. The new business models have targeted four different product groups, namely computer tablets, LED lights (for the EEE sector), organic vegetables and meat

[1] See for example the European Commission's (2014) Work Programme for 2015.

[2] The European Circular Economy Stakeholder Platform provides a record of some of these strategies at the national but also regional level: https://circulareconomy.europa.eu/platform/en/strategies.

[3] Given that the circular economy is an evolving concept with no agreed definitions (De Jesus & Mendonça, 2018; Kirchherr et al., 2018), in the literature there are varying definitions of what constitutes a CEBM. While it is beyond the scope of this report to provide another definition of the CEBM, in our analysis we have taken into account the following circular economy processes identified by Rizos et al. (2017): recycling; efficient use of resources; utilisation of renewable energy sources; remanufacturing, refurbishment and reuse of products and components; product life extension; product as a service; sharing models and a shift in consumption patterns.

products (for the agri-food sector). It has involved various activities, including improved production methods, leasing models, take-back systems and digital tools supporting the consumption of sustainable products (Wilson & Lindén, 2021a). The objective of this report is to present evidence on barriers and enablers when implementing the CIRC4Life CEBMs as well as from additional cases of firms putting such models into practice. Drawing on this evidence, the report provides recommendations for further scaling up circular economy practices across the EU.

In the remainder of the report, section 2 provides an overview of relevant policies and legislation at the EU level, as well as in Spain and the UK where CIRC4Life demonstrations have taken place. Section 3 is devoted to identifying barriers and enablers in the implementation of CEBMs. This section presents trends in both the EEE and agri-food sectors before moving on to describe the methodology used for analysis of evidence from the case studies of firms adopting CEBMs. Section 4 concludes with policy messages and recommendations.

2 Inventory of policies and regulations

2.1 Introduction

This section presents an inventory of policies and regulations at the EU level as well as in Spain and the UK, which are the two countries where the CIRC4Life circular business models have been demonstrated. This inventory has two key objectives: i) present the key policies and regulations relevant for the project and which should be taken into account throughout its duration, and ii) identify any potential regulatory risks and barriers that could pose challenges to the project. The collection of information for this inventory was based on desk research as well as interviews with experts from the sectors addressed by the project and national ministries. The list of interviewed experts is presented in Appendix 3. The research for this task and interviews were conducted between September and December 2018.[4] Additional research was conducted in July 2020 to revise the section on policies in Spain.

The following subsections and tables outline the policies and regulations identified by the team as well as the potential risks and barriers. In addition, the team prepared an inventory in the form of an Excel file that includes all the collected information and enables searches for relevant policies through a number of available filters. Specifically, the Excel file allows for easy filtering of the inventory, by type, government level, sector, identified risk level and whether an upcoming revision is due, through the use of 'slicers' – essentially buttons. Moreover, the information is presented in separate sheets showcasing the information specific to the EU, Spain and the UK, as well as the agri-food and EEE sectors in each. These sheets also include an easy filtering function using slicers. An introductory sheet explaining the features and the risk assessment is included, as well as a sheet particularly designed to encourage and collect feedback from the consortium. Appendix 1 presents screenshots of parts of the inventory and its available features.

2.2 EU policies

2.2.1 Mapping of key policies

Based on desk research, interviews and consultations, 73 EU policies, regulations, directives, standards and voluntary agreements were identified as relevant to the project.[5] As can be seen in Figure 1, the majority of these are regulations, but a substantial number of policies and directives were also identified during the mapping exercise. Only one standard and one voluntary agreement were identified at the EU level; however, at national or international levels, these are more prevalent.

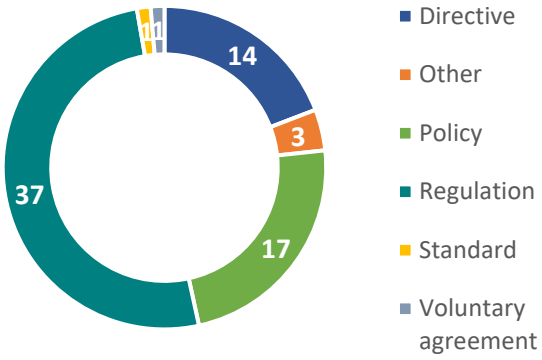

Figure 1: Distribution of mapped EU policies

Almost half of the identified policies and legislation are relevant for the agriculture and food value chain, while around a fifth is relevant for the EEE sector chain. The remaining policies are relevant to all sectors. The specific

[4] Section 2 was prepared in the context of this earlier stage of the project, prior to its extension in light of Covid-19.

[5] The following categories were applied during the mapping: policies, regulations, directives, standards, certification systems, voluntary agreements and others. The category of policies refers to strategies and communications published by the European Commission at the EU level.

policies and legislation identified in the mapping exercise are presented below Table 1, while detailed descriptions can be found in Appendix 2.

Sector	Type	Name
All	Directive	Directive on Copyright in the Digital Single Market
	Directive	Directive 2004/12/EC of the European Parliament and of the Council of 11 February 2004 amending Directive 94/62/EC on packaging and packaging waste
	Directive	Copyright Directive 2001/29/EC
	Directive	Directive 94/62/EC of 20 December 1994 on packaging and packaging waste
	Directive	Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives
	Policy	EU action plan for the circular economy, 2015
	Policy	Zero waste programme for Europe, 2014
	Policy	Life cycle assessment (LCA) Recommendation, 2013
	Policy	"A resource-efficient Europe – Flagship initiative", 2011
	Policy	Europe 2020 strategy
	Policy	Thematic Strategy on the sustainable use of natural resources, 2005
	Policy	Monitoring framework on progress towards a circular economy at EU and national level
	Policy	EU strategy for plastics in a circular economy, 2018
	Policy	Communication on options to address the interface between chemical, product and waste legislation, 2018
	Policy	Eco-innovation Action Plan (Eco-AP), 2011
	Policy	Strategy for corporate social responsibility (CSR), 2011
	Policy	Thematic Strategy on the prevention and recycling of waste, 2005
	Policy	Integrated product policy, 2003
	Policy	Innovation Union initiative
	Regulation	General Data Protection Regulation (EU) 2016/679
Agri-food	Directive	Proposal for a Directive on unfair trading practices in business-to-business relationships in the food supply chain
	Directive	Directive (EU) 2018/851 amending Directive 2008/98/EC on waste
	Directive	Nitrates Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)
	Directive	Directive 64/432/EEC of 26 June 1964 on animal health problems affecting intra-Community trade in bovine animals and swine
	Other	Commission Notice – Guidelines for the feed use of food no longer intended for human consumption C/2018/2035
	Other	2001/25/EC: Commission Decision prohibiting the use of certain animal by-products in animal feed (notified under document number C(2000) 4143)
	Policy	Common agricultural policy (CAP)
	Regulation	Regulation (EU) 2018/848 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007
	Regulation	Regulation (EU) 2017/172 amending Regulation (EU) No 142/2011 as regards parameters for the transformation of animal by-products into biogas or compost, conditions for imports of petfood and for the export of processed manure
	Regulation	Regulation (EU) 2016/429 'Animal Health Law'
	Regulation	Regulation (EU) 2015/1905 amending Annex II to Regulation (EC) No 183/2005 as regards the dioxin testing of oils, fats and products derived thereof
	Regulation	Regulation (EU) No 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulation (EC) No 1698/2005

Agri-food	Regulation	Regulation (EU) No 1308/2013 establishing a common organisation of the markets in agricultural products and repealing Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007
	Regulation	Regulation (EU) No 1307/2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Regulation (EC) No 637/2008 and Regulation (EC) No 73/2009
	Regulation	Regulation (EU) No 1306/2013 on the financing, management and monitoring of the common agricultural policy and repealing Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008
	Regulation	Regulation (EU) No 1169/2011 on the provision of food information to consumers
	Regulation	Regulation (EU) No 142/2011 implementing Regulation (EC) No 1069/2009 and implementing Directive 97/78/EC
	Regulation	Regulation (EC) No 1069/2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation)
	Regulation	Regulation (EC) No 767/2009 on the placing on the market and use of feed, amending Regulation (EC) No 1831/2003 and repealing Council Directive 79/373/EEC, Commission Directive 80/511/EEC, Council Directives 82/471/EEC, 83/228/EEC, 93/74/EEC, 93/113/EC and 96/25/EC and Commission Decision 2004/217/EC
	Regulation	Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control
	Regulation	Regulation (EC) No 834/2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092
	Regulation	Regulation (EC) No 1141/2007 concerning the authorisation of 3-phytase (ROVABIO PHY AP and ROVABIO PHY LC) as a feed additive
	Regulation	Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs
	Regulation	Regulation (EC) No 183/2005 laying down requirements for feed hygiene (Text with EEA relevance)
	Regulation	Regulation (EC) No 396/2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC
	Regulation	Regulation (EC) No 852/2004 on the hygiene of foodstuffs – common basis for the hygienic production of all food including products of animal origin
	Regulation	Regulation (EC) No 853/2004
	Regulation	Regulation (EC) No 854/2004 laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption
	Regulation	Regulation (EC) No 1831/2003 on additives for use in animal nutrition
	Regulation	Regulation (EC) No 2160/2003 on the control of salmonella and other specified food-borne zoonotic agents
	Regulation	Regulation (EC) No 2003/2003 relating to fertilisers
	Regulation	Regulation (EC) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety
	Regulation	Directive 2002/32/EC on undesirable substances in animal feed
	Regulation	Regulation (EC) No 999/2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies
	Standard	Optional quality term ‘product of island farming’
	Voluntary agreement	4 per 1000
Electrical and electronic equipment	Directive	Directive 2013/56/EU amending Directive 2006/66/EC on batteries and accumulators and their waste management
	Directive	WEEE Directive 2012/19/EU on waste electrical and electronic equipment
	Directive	Restriction of Hazardous Substances Directive (RoHS) 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment
	Directive	Ecodesign Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products (general, voluntary)

	Regulation	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (EC) No 1907/2006
	Other	Commission Decision (EU) 2016/1371 establishing the ecological criteria for the award of the EU Ecolabel for personal, notebook and tablet computers (notified under document C(2016) 5010)
	Regulation	Draft regulation – Ares(2018)5145935: Ecodesign requirements for light sources
	Regulation	Energy efficiency – ecodesign rules for electronic displays (TVs, monitors, signage)
	Regulation	Ecodesign requirements for electronic displays
	Regulation	Energy efficiency – energy labelling for electronic displays (TVs, monitors, signage)
	Regulation	Regulation (EU) 2017/1369 setting a framework for energy labelling and repealing Directive 2010/30/
	Regulation	Regulation (EU) No 617/2013 implementing Directive 2009/125/EC with regard to ecodesign requirements for computers and computer servers
	Regulation	Regulation (EU) No 333/2011 establishing criteria determining when certain types of scrap metal cease to be waste under Directive 2008/98/EC
	Regulation	Regulation (EC) No 66/2010 on the EU Ecolabel
	Regulation	Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006

Table 1: Overview of EU policies and legislation

2.2.2 Barriers and risks

As part of the mapping exercise, the team identified 23 different policies or pieces of legislation that could pose a barrier or risk to the project. Out of these, clear evidence of risk to project implementation was found for 7, while for 16, only theoretical and potential evidence of risk was identified. Most of these risks are specific to one of the sectors in which the project has been implemented, with the exception of the Copyright Directive, which may affect the project as a whole due to how it sets limitations for the data mining component of the project. The specific barriers or risks associated with each policy and piece of legislation are outlined in Table 2, which gives an overview of those where clear or potential risks were identified.

Concerning the **EEE sector**, most of the risks identified through desk research and interviews with stakeholders are theoretical or potential. However, clear evidence of risk was found in four pieces of legislation at the EU level. Specifically, the Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) Directives set out requirements with which the business models demonstrated by the project may need to comply. According to the stakeholders interviewed, the risks could stem from lack of enforcement and inspections for compliance, arguably making those that comply less competitive, as well as recycling targets that may be difficult to comply with if a product has not existed on the market for a sufficient amount of time to reach the waste stream, e.g. LED lights. Additionally, the draft legislation currently being considered on ecodesign requirements for lighting sources may pose barriers according to the stakeholders interviewed, who argued that requiring the removability of certain parts could decrease the durability of the products and require more material. Ecodesign requirements may also pose challenges for tablet producers, according to DigitalEurope.[6]

More potential or theoretical barriers and risks were identified in relation to the **agriculture and food sector**. Within this sector, nine different pieces of legislation could potentially affect the project (yellow colour code), while two have clear associated risks (orange colour code). According to the stakeholders interviewed,

[6] See https://www.digitaleurope.org/wp/wp-content/uploads/2018/11/DE-Comments-on-the-Draft-Ecodesign-Regulation-on-Electronic-Displays-201702032.pdf.

Regulation (EU) 2016/429, the Animal Health Law, could pose risks through its requirements on how waste and by-products must be treated before being used for feed, possibly making certain circular approaches such as bioenergy and fertilisers more cost effective than re-entering the animal feed channel. Regulation (EC) 1069/2009 on health rules as regards animal by-products and derived products not intended for human consumption sets out requirements for the collection, transport, storage, handling, processing and use or disposal of animal by-products. As such, it may have implications for the project. Other regulations and policies have called for compliance throughout the project but are unlikely to pose significant barriers. For example, Regulation 1169/2011 sets out requirements for information provided to the consumer that the project and producers needed to be aware of but is unlikely to pose significant barriers to the project.

Still, the extent to which specific mapped legislation and policies are most relevant for the project also depends on the direction of project development, as specific legislation related to biogas, pet foods and so on are only applicable if such courses of action are chosen.

Name	Sector	Potential barriers/risks	Risk*
Copyright Directive 2001/29/EC	All	The implementation of the exception on scientific research (Article 3(a) of Directive 2001/29/EC) differs across the EU and the lack of a clear EU provision on TDM for scientific research purposes creates uncertainties in the research community.	
Directive on Copyright in the Digital Single Market	All	This could broaden the scope of TDM activities in the EU, due to extending the exceptions for scientific research, including research organisations engaged in public-private partnerships. See details in description.	
Regulation (EU) No 2016/429 'Animal Health Law'	Agri-food	Bans use of untreated waste for food. Food waste needs to go through a hygienisation process in order to be able to use it for nutrition purposes. Treatment/hygienisation of waste and by-products required for producing feed, etc. is well defined in legislation. It is easier to use the waste for other purposes such as for bioenergy, heat, electricity, biodiesel and fertilisers. Re-entering the animal feed channel may not be cost effective due to the need to comply with specific high-level criteria.	
Regulation (EC) No 1069/2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal By-products Regulation).	Agri-food	Burdens identified in the EU stakeholder consultation in 2016: requirements concerning feed safety – application of procedures based on the hazard analysis and critical control points principles, specific labelling, segregated storage and transportation of the food no longer intended for human consumption. For certain uses, e.g. feed, traceability may be required.	
Proposal for a Directive on unfair trading practices in business-to-business relationships in the food supply chain	Agri-food	If adopted, it could rebalance the strict benchmarking between (particularly organic) farmers and retailers.	
Directive (EU) 2018/851 amending Directive 2008/98/EC on waste	Agri-food	Perhaps – see Article 9.	
Directive 64/432/EEC on animal health problems affecting intra-Community trade in bovine animals and swine	Agri-food	The utilisation of waste for animal feed or food is forbidden unless it is treated according to requirements.	
Common agricultural policy (CAP)	Agri-food	In current discussions about the new CAP there is a view that member states should be allowed to set their own goals after they receive their share of the budget. But according to the IFOAM, this may lead to a fragmented EU market.	
Regulation (EU) 2018/848 on organic production and labelling of organic products and repealing Regulation (EC) No 834/2007	Agri-food	This regulation defines some thresholds for organic producers (in terms, for example, of artificial inputs). If producers exceed these thresholds, the product cannot be considered organic. However, according to IFOAM, if the land of small producers is located near to the land of larger conventional ones there is a risk that there will be some leakage of artificial nutrients onto their land.	
Regulation (EU) No 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulation (EC) No 1698/2005	Agri-food	The set-up puts small-scale farmers at a disadvantage, as farmers are rewarded on a per-hectare basis.	
Regulation (EU) No 1169/ on the provision of food information to consumers	Agri-food	Sets out requirements for the information provided to the consumer, including that it cannot be confusing, ambiguous or misleading, etc.;	

		mandatory labelling of expiration dates and so on for all packaged products.	
Regulation (EU) No 142/2011 implementing Regulation (EC) No 1069/2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and implementing Directive 97/78/EC as regards certain samples and items exempt from veterinary checks at the border under that Directive	Agri-food	Lays down implementing measures for Regulation (EC) No 1069/2009. See risks/barriers for this regulation.	
Regulation (EC) No 2003/2003 relating to fertilisers	Agri-food	A potential burden is that the new regulation will pose more stringent restrictions for nutrients. On the positive side, the regulation will include provisions for harmonisation of the current labels that exist in different member states.	
WEEE Directive 2012/19/EU on waste electrical and electronic equipment	Electrical and electronic equipment	The 65% target may pose problems for the LED market due to the 10-year lifespan, as few will have reached their end of life and thus waste stream. Lacks adequate checks and the ability to enforce regulations, making those who comply less competitive compared with those who do not. Online sales of lighting products pose a particular issue, with an estimated 20% of online sales failing to pay a WEEE fee. Another barrier stems from the lack of a systemic approach in EU policies. Existing policies address a specific issue/sector and aspects such as improved waste management, product design and waste prevention separately. For instance, the requirement to recycle and reuse electronics does not consider hazardous chemical substances used in the past. An example is flame retardants based on brominated compounds, which enable the electronics fulfil fire-resistance.	
RoHS Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment	Electrical and electronic equipment	The Commission is expected to publish its opinion regarding exemptions for the lighting industry in the use of mercury, lead and cadmium by the end of the year. Exemptions may end, resulting in possible obligations on removing substances from products.	
Draft regulation – Ares(2018)5145935: Ecodesign requirements for light sources	Electrical and electronic equipment	May require manufacturers and importers to ensure that light sources and separate control gears can be readily removed without permanent mechanical damage from any product containing them. Industry has been consulted, but its opinion (that this is excessive and imposes requirements beyond WEEE and may result in a less circular business model) may not be taken into account. Industry advocates for consumer awareness rather than requirements on removability.	
Ecodesign requirements for electronic displays	Electrical and electronic equipment	According to DigitalEurope a wide range of products that have small sales volumes will be included in the scope of this draft regulation, if they happen to integrate electronic display components bigger than 1 dm2, thus also tablets. Their concerns are that there has been no impact assessment. Specific concerns related to tablets should be investigated as they are not set out in the linked position paper.	
Directive 2013/56/EU amending Directive 2006/66/EC on batteries and accumulators and their waste management	Electrical and electronic equipment	Batteries and accumulators are usually included in WEEE (tablets) and, in some cases, it is not possible to separate them (info provided by REC).	
Ecodesign Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products	Electrical and electronic equipment	Lacks adequate checks and the ability to enforce regulations by market oversight authorities for lighting products. See #74 Draft regulation – Ares(2018)5145935: Ecodesign requirements for light sources. May also have impacts on tablets.	
Energy efficiency – ecodesign rules for electronic displays (TVs, monitors, signage)	Electrical and electronic equipment	Draft regulation setting out ecodesign requirements for electronic displays. Argued by DigitalEurope to have excessively stringent requirements on energy efficiency, repair and end-of-life information as soon as a product is placed on the market. May apply to tablets, though depending on developments, the project may be in line.	

Regulation (EU) No 617/2013 implementing Directive 2009/125/EC with regard to ecodesign requirements for computers and computer servers	Electrical and electronic equipment	If notebook computers, tablets, slates and mobile thin clients have an internal battery that is not easily accessible by a normal user (e.g. without dismantling part of the product or without using professional tools), this limitation has to be indicated both on the external package and on the website where the technical specifications are listed. This alert must also be clearly indicated in the technical documentation provided in the product package. The text on the packaging must be clearly visible and legible and must be provided in the official language(s) of the country where the product is marketed.	
Directive 2008/98/EC on waste and repealing certain Directives		Establishes the legislative framework for the handling of waste, which the project must comply with. It defines key concepts such as waste, recovery and disposal, and puts in place the essential requirements for the management of waste. The costs of disposing of waste must be borne by the holder of waste, by previous holders or by the producers of the product from which the waste came.	

Table 2: Barriers stemming from EU legislation

* The table provides an overview of the policies and legislation for which either of the following applies:

- *orange colour code* – clear evidence of risk to project implementation was found in the literature review or in interviews; and
- *yellow colour code* – theoretical and potential evidence of risk to project implementation was found in the literature review or in interviews.

The policies and legislation for which no or only minor evidence of risk to project implementation was found in the literature review or in interviews are not included in the table.

2.3 Policies in Spain

2.3.1 Mapping of policies

Spain is a highly decentralised state, which has devolved power to the Autonomous Communities (Comunidades Autónomas or CCAAs) in variable degrees within the limits of the Constitution.[7] Each CCAA has its own set of devolved powers, which may differ greatly from one to the other in their level of autonomy from the central government and are embodied in their respective autonomous statutes. As a result, Spanish legislation is produced at both the national level and at the level of the CCAAs (OECD, 2016, Country Profile – Spain).[8] Based on desk research, interviews and consultations, 30 Spanish policies (including both the national and CCAA levels) were identified as relevant to the project (i.e. strategies, laws, royal decrees, orders and voluntary agreements) – as illustrated in Figure 2. Figure 3 shows the hierarchy of Spanish legislation. The

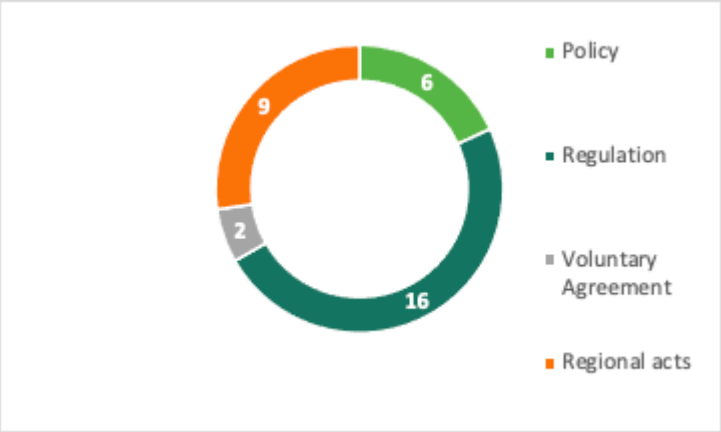

Figure 2: Distribution of mapped Spanish policies

[7] Spain has 17 autonomous communities and 2 autonomous cities.

[8] See the OECD Country Profile – Spain, 2016 (www.oecd.org/regional/regional-policy/profile-Spain.pdf).

majority of policies identified during the mapping exercise were regulations, as well as a substantial number of policy strategies and two voluntary agreements.

The CCAAs concerned in this project are the Basque Country (demonstration of CEBMs for electronic tablets), the Region of Murcia (meat supply chain) and the Valencian Community (domestic LED lights). The section on Spain therefore addresses regulation at the national level as well as the level of these three CCAAs.

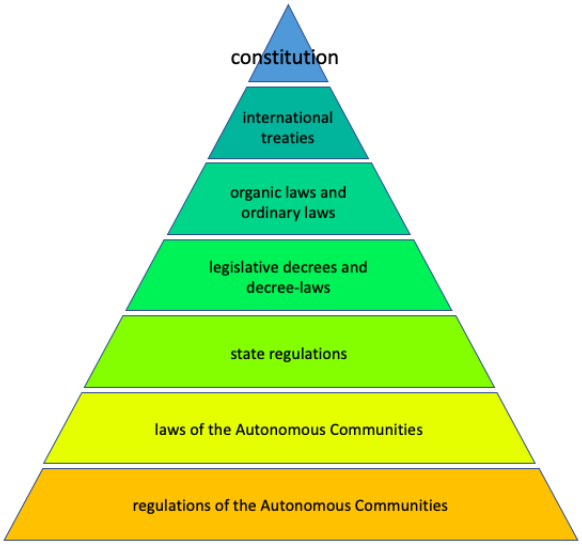

Figure 3: The hierarchy of legislation in Spain

Source: translated from dudaslegislativas.com/tipos-de-leyes-y-normas/.

At the national level, six of the identified policies and legislation are relevant for the agriculture and food value chain, and five are relevant for the EEE sector chain. The remaining nine policies and the two voluntary agreements are relevant to all sectors. The specific policies and legislation identified in the mapping exercise are presented below, while detailed descriptions can be found in Appendix 2.

The three CCAAs CIRC4Life is focusing on (the Basque Country, Region of Murcia and Valencian Community) are very active on the circular economy and have set their own targets. Both the Basque Country and the Region of Murcia are in the process of drafting their own circular economy strategies. The three CCAAs have also transposed EU and national law on environmental protection and waste management. Below is an overview of Spanish policies and legislation at both the national (Table 3) and CCAA (Table 4) levels.

Sector	Type	Name
All	Policy	España Circular 2030 – Estratégia Española de Economía Circular (EEEC)
	Policy	Primer Plan de Acción de Economía Circular 2021-2023
	Policy	Plan Estatal Marco de Gestión de Residuos (PEMAR) 2016-2022
	Policy	Estratégia Estatal de Innovación (e2i)
	Policy	Estratégia Española de Bioeconomía
	Regulation	Ley Orgánica de Protección de Datos Personales y Garantía de los Derechos Digitales
	Regulation	Ley 2/2011, de 4 de marzo, de Economía Sostenible
	Regulation	Ley 22/2011, de 28 de julio, de residuos y suelos contaminados

Electrical and electronic equipment	Regulation	Real Decreto 782/1998, de 30 de abril por el que se aprueba al Reglamento para el desarrollo y ejecución de la Ley 11/ 1997, de 24 de abril, de Envases y Residuos de Envases
	Regulation	Ley 11/1997, de 24 de abril, de Envases y Residuos de Envases
	Regulation	Real Decreto 293/2018, de 18 de mayo, sobre reducción del consumo de bolsas de plástico y por el que se crea el Registro de Productores
	Voluntary agreement	Pacto por una Economía Circular
	Voluntary agreement	Declaración de Sevilla
	Regulation	Real Decreto 1364/2018, de 2 de noviembre, por el que se modifica el Real Decreto 219/2013, de 22 de marzo, sobre restricciones a la utilización de determinadas sustancias peligrosas en aparatos eléctricos y electrónicos
	Regulation	Real Decreto 27/2021, de 19 de enero, por el que se modifican el Real Decreto 106/2008, de 1 de febrero, sobre pilas y acumuladores y la gestión ambiental de sus residuos, y el Real Decreto 110/2015, de 20 de febrero, sobre residuos de aparatos eléctricos y electrónicos
	Regulation	Real Decreto 219/2013, de 22 de marzo, sobre restricciones a la utilización de determinadas sustancias peligrosas en aparatos eléctricos y electrónicos
	Regulation	Real Decreto 283/2001, de 16 de marzo, por el que se modifican determinados artículos del Reglamento del Impuesto sobre Sociedades en materia de deducción por inversiones destinadas a la protección del medio ambiente
	Regulation	Ley 43/1995, de 27 de diciembre, del Impuesto sobre Sociedades
Agri-food	Policy	Plan Nacional de Control Oficial de la Cadena Alimentaria (PNCOCA) 2021-2025
	Regulation	Orden APM/189/2018, de 20 de febrero, por la que se determina cuando los residuos de producción procedentes de la industria agroalimentaria destinados a alimentación animal, son subproductos con arreglo a la Ley 22/2011, de 28 de julio, de residuos y suelos contaminados
	Regulation	Real Decreto 1338/2011, de 3 de octubre, por el que se establecen distintas medidas singulares de aplicación de las disposiciones comunitarias en materia de higiene de la producción y comercialización de los productos alimenticios
	Regulation	Real Decreto 1086/2020, de 9 de diciembre, por el que se regulan y flexibilizan determinadas condiciones de aplicación de las disposiciones de la Unión Europea en materia de higiene de la producción y comercialización de los productos alimenticios y se regulan actividades excluidas de su ámbito de aplicación
	Regulation	Real Decreto-ley 4/2001, de 16 de febrero, sobre el régimen de intervención administrativa aplicable a la valorización energética de harinas de origen animal procedentes de la transformación de despojos y cadáveres de animales
	Regulation	Real Decreto 306/2020, de 11 de febrero, por el que se establecen normas básicas de ordenación de las granjas porcinas intensivas, y se modifica la normativa básica de ordenación de las explotaciones de ganado porcino extensivo

Table 3: Overview of policies and legislation in Spain – national level

Sector	Region	Name
All	Basque Country	Plan de prevención y gestión de residuos de la CAPV 2020 Draft plan for 2021 to 2030 under debate
	Basque Country	Estratégia de Economía Circular de Euskadi 2030
	Basque Country	Programa marco ambiental de la CAPV 2020 In the process of being updated for 2030
	Basque Country	Ley 3/1998, de 27 de febrero, general de protección del medio ambiente del País Vasco
	Region of Murcia	Plan de Residuos de la Región de Murcia 2016-2020
	Region of Murcia	Estratégia de Economía Circular de la Región de Murcia 2030 (ESECIRM)
	Valencian Community	Plan Integral de residuos de la Comunidad Valenciana
	Valencian Community	Ley 10/2000, de 12 de diciembre, de Residuos de la Comunitat Valenciana Soon be replaced by a new law:

		Ley para la prevención de residuos, transición ecológica y fomento de la economía circular en la Comunitat Valenciana
Agri-food	Basque Country	Estratégia para la Protección del Suelo 2030

Table 4: Overview of regional policies and legislation in Spain – Autonomous Communities' level

2.3.2 Barriers and risks

While analysis of the barriers to implementing circular business models is developed further in section 3 of this report, this subsection attempts to give a first look at barriers and risks identified during the desk research and interviews conducted for the preparation of the inventory of policies and regulations.

In the aftermath of the EU's 2015 circular economy package (known as "Closing the loop"), Spain has actively worked on translating it into national legislation. The key policy approved in June 2020 was the draft Spanish circular economy strategy, España Circular 2030 (EEEC), which was first submitted for public consultation in February 2018. A number of weaknesses in the draft strategy for consultation were identified in this study by stakeholders during the interviews, including an excessive focus on recycling rather than on waste avoidance, ecodesign and a deeper industrial transformation. Also a lack of sanctions, insufficient incentives and lack of resources to implement the strategy were noted. In the new strategy, those weaknesses have been largely removed in line with the increased ambitions of the Spanish government in greening the economy linked to the Green Deal and the 2030 EU target for emissions reduction. While the strategy may lack some detail on product policies at the design stage, this seems to be covered by the forthcoming Spanish industrial policy 2030, which will incorporate the circular economy and sustainability as central aspects. España Circular 2030 also includes an important section to change consumption patterns.

The main goals for 2030 are as follows:

- reducing by 30% domestic material consumption in relation to national GDP, taking 2010 as a reference;
- cutting waste by 15% with regard to 2010 waste levels;
- reducing food waste throughout the entire food chain, with a 50% reduction per person in retail and households and 20% in production chains and supplies from 2020, thus advancing towards the Sustainable Development Goal;
- promoting reuse and reuse-enabling activities until reaching 10% of municipal waste;
- reducing greenhouse gas emissions to under 10 million tonnes of CO_2 eq; and
- improving water use efficiency by 10%.

Six areas of action are prioritised, namely for the construction sector and buildings, industry, consumer goods, food and agriculture, tourism and textiles.

The circular economy strategy is accompanied by an action plan to put it into practice, which presents the objectives and actions in three-year programmes, the first being from 2021 to 2023. The programmes have been affected by the Covid-19 crisis; the expected support from the EU's recovery programme (NextGenerationEU) has also influenced the level of ambition – as more resources will be available to foster the objectives.

Another important reform that has been undertaken is that of waste legislation.

An instrumental policy related to adoption of circular economy models is the State Waste Management Framework Plan (PEMAR) 2016-2021, which transposes EU legislation and is the instrument guiding waste policy in Spain. The PEMAR supports the circular economy in Spain through improvements in waste management and application of the hierarchy principle to waste management. The plan contains, among others, minimum objectives to be met in the CCAAs for prevention, preparation for reuse, recycling, recovery and elimination. The specific rules are left to the discretion of the CCAAs to adapt to their specific circumstances.

The PEMAR was fully integrated in the draft Spanish circular economy strategy, and as such will not be the cause of conflicts when implementing Spanish circular economy policy. In line with increased ambitions, the proposal for a new law on waste and contaminated soils was presented to Spain's parliament in May 2021.

The key weaknesses that were identified by stakeholders in 2018 for implementation in the CCAAs are the lack of public awareness (for example, on the proper separation of residues), insufficient market oversight resulting in poor compliance, as well as the lack of incentives and sanctions. The CCAAs have been addressing these issues in the last few years and their local legislation is also being updated in line with the higher ambitions of the country as a whole.

A number of royal decrees deal with topics on the circular economy in fields relevant to CIRC4Life, such as:

- packaging and management of packaging waste;
- dangerous substances in electric and electronic equipment (in order to allow the reuse of such devices);
- management of electric and electronic waste, including recycling and reuse targets (Spain is the only EU member state to set targets for reuse, and has promoted the establishment of 'centres for reuse', in Law 22/2011 Art. 21,[9] and Royal Decree 27/2021, de 19 de enero[10]);
- the tracking of proper separation of food waste at the household level;
- the separation of risk material in order to reuse food waste for energy or animal feed, although proper tracking of risk material remains problematic; and
- the definition of by-products derived from agri-food waste. For these, strict phytosanitary rules may render the task difficult.

One of the main concerns expressed by stakeholders and emerging from the mapping is linked to insufficient oversight, and a lack of sanctions and incentives. Consequently, producers often ignore requirements (for example, those to provide information to the recycling processing plants about the characteristics of products). This results in a negative impact not only on the objectives of the circular economy strategy but also for companies that comply or attempt to adopt innovative business models, particularly SMEs. They incur additional costs, leading to a loss of competitive advantage in relation to those ignoring the requirements. Lack of the right sanctions, oversight and incentives actually creates disincentives for companies to introduce circular economy practices. Nevertheless, the increased ambitions of the government combined with the EU's

[9] Ley 22/2011, de 28 de julio, de residuos y suelos contaminados, in «BOE» núm. 181, de 29/07/2011 (www.boe.es/buscar/pdf/2011/BOE-A-2011-13046-consolidado.pdf).

[10] Real Decreto 27/2021, de 19 de enero, por el que se modifican el Real Decreto 106/2008, de 1 de febrero, sobre pilas y acumuladores y la gestión ambiental de sus residuos, y el Real Decreto 110/2015, de 20 de febrero, sobre residuos de aparatos eléctricos y electrónicos., in «BOE» núm. 17, 20 January 2021, pp. 4851-4901 (https ://www.boe.es/eli/es/rd/2021/01/19/27).

pandemic support is considerably boosting the level of action at the national and regional levels, and new legislation at both levels is in turn strengthening the instruments for implementation.

The interviews indicated that issues emerge at all levels of the value chain, from the producer to the consumer to waste management. Examples in the area of waste management for electronic appliances include:

- producers and waste treatment companies face excessive bureaucracy, which makes their operations difficult;
- recycling points are often situated in remote locations and private households have little incentive to deliver their recyclable items to them;
- collection and storage points, as well as treatment systems, are poorly managed, i.e. goods brought to recycling are often damaged during handling, thus reducing the reuse value; theft is also common;
- waste management requirements and definitions are different across CCAAs, making it complex to operate nationwide and transport recyclable materials to treatment plants in other CCAAs;
- the lack of ecodesign rules make the separation of components in the recycling process too costly, which leads to lower material recycling levels; and
- some non-recyclable plastics could be removed further from products if ecodesign rules were stricter.

Many of these concerns are being addressed in the new strategies at the national and regional levels and the Spanish plan for the use of NextGenerationEU support contains important reforms in those areas, including reforms to modernise the administration.

In the area of food waste management, the difficulties are compounded by the strict phytosanitary rules. While reducing safety levels is not the objective, the rules may need to be reviewed for the development of business models that may mitigate food waste. This will remain a challenge, as rules in the agri-food sector tighten due to reforms of the common agricultural policy being introduced by the EU, which include sustainability and food safety actions. For the area covered by CIRC4Life, stakeholders highlighted the following concerns: i) the rules for disposal of food products after their best-before date discourage processing the products for animal feed; these issues will likely be taken into account as the Spanish agenda for the circular economy widens; and ii) the rules in place can make food collection and processing too complex and expensive for business models to be cost effective.

Measures to mitigate the challenges outlined would therefore need to address, among others, the following issues:

- improved market oversight;
- an effective system of sanctions and incentives (e.g. VAT reductions);
- increased public awareness;
- enhanced coordination across CCAAs; and
- an analysis of possible instruments to facilitate the further processing of waste food for animal feed without jeopardising food safety.

Table 5 and Table 6 show an overview of the policies and legislation that were found to have either a clear (orange) or potential (yellow) risk for project implementation.

Name	Sector	Potential barriers/risks	Risk*
Ley Orgánica de Protección de Datos Personales y Garantía de los Derechos Digitales	All	This law reduces the possibility of data mining on citizens' behaviour.	
Ley 11/1997, de 24 de abril, de Envases y Residuos de Envases	All	Lack of public awareness of the proper separation of residues can lead to costs or the loss of materials (e.g. glass in a carboard container).	
Estratégia Española de Bioeconomía 2030 (Spanish strategy for bioeconomy)	All	Developed independently and therefore not well integrated in the circular economy strategy; will coexist with the strategy and undetected conflicts may arise.	
Orden APM/189/2018, de 20 de febrero, por la que se determina cuando los residuos de producción procedentes de la industria agroalimentaria destinados a alimentación animal, son subproductos con arreglo a la Ley 22/2011, de 28 de julio, de residuos y suelos contaminados	Agri-food	Phytosanitary rules can pose very difficult challenges for the reuse of organic matter, e.g. if waste meat deteriorates to become a 'contaminated' product. Costs for the project may be too high.	
Real Decreto 1338/2011, de 3 de octubre, por el que se establecen distintas medidas singulares de aplicación de las disposiciones comunitarias en materia de higiene de la producción y comercialización de los productos alimenticios	Agri-food	As for RD 640/2006, potential project-level risk for the meat demo, whenever meat becomes a 'contaminated' product. European phytosanitary rules are very strict. Costs for the project may be too high. The traceability law is not well developed for food residues.	
Real Decreto 1086/2020, de 9 de diciembre, por el que se regulan y flexibilizan determinadas condiciones de aplicación de las disposiciones de la Unión Europea en materia de higiene de la producción y comercialización de los productos alimenticios y se regulan actividades excluidas de su ámbito de aplicación	Agri-food	Potential project-level risk for the meat demo, whenever meat becomes a 'contaminated' product. European phytosanitary rules remain very strict despite the latest legislation (replacing the 2006 legislation), which includes measures to introduce flexibility. Costs for the project may still be too high. Some concerns may remain, such as traceability measures not being well developed for food residues, which this new legislation does not seem to address.	
Real Decreto-ley 4/2001, de 16 de febrero, sobre el régimen de intervención administrativa aplicable a la valorización energética de harinas de origen animal procedentes de la transformación de despojos y cadáveres de animales	Agri-food	Ensuring the proper tracking and identification of deterioration and/or contamination of waste meat brought to recycling.	
Real Decreto 306/2020, de 11 de febrero, por el que se establecen normas básicas de ordenación de las granjas porcinas intensivas, y se modifica la normativa básica de ordenación de las explotaciones de ganado porcino extensivo	Agri-food	The previous Regulation 324/2000 applied to prior steps of the value chain than the ones addressed in the demo. The same remains valid in this updated law, which has implications for the demonstration project.	
Real Decreto 1364/2018, de 2 de noviembre, por el que se modifica el Real Decreto 219/2013, de 22 de marzo, sobre restricciones a la utilización de determinadas sustancias peligrosas en aparatos eléctricos y electrónicos	Electrical and electronic equipment	Lack of market oversight, and lack of sanctions and incentives. Producers who comply are at a competitive disadvantage. Extending the durability of products drives small companies out of business.	

Real Decreto 110/2015, de 20 de febrero, sobre residuos de aparatos eléctricos y electrónicos	Electrical and electronic equipment	Ineffective oversight, lack of sanctions and incentives. As a result, producers often ignore the requirement to provide information to the recycling processing plants about the characteristics of products. Producers and waste treatment plants that comply with the legislation are at a competitive disadvantage compared with those not complying. Also, excessive bureaucracy also makes operations difficult. Recycling points are often situated in remote locations and private households have little incentive to bring their recyclable items. Collection and storage points and treatment systems are poorly managed, i.e. goods brought for recycling are often damaged, thus reducing the reuse value; theft is also common. Waste management requirements and definitions are different across CCAAs, making it complex to operate nationwide and transport recyclable materials to treatment plants in other CCAAs. Lack of oversight and sanctions for the collection points and waste treatment plants. As a result, the waste treatment plants complying with the law are at competitive disadvantage with those that do not comply. Lack of incentives for private households to bring their recyclable items.	
España Circular 2030 – Estratégia Española de Economía Circular (EEEC)	All	Criticisms still valid for the final strategy compared with the draft are the lack of incentives, such as lower or no VAT for recovered and refurbished goods. The following risks that stakeholders noted for the demonstrations are - Risk 1, meat demo – biological residues are not taken into account in the strategy for reuse in the animal feed or the cosmetic sectors. Phytosanitary legislation can pose complex challenges; - Risk 2, the lack of clear rules for design at the production stage makes the reuse and recycling stages difficult; and - Risk 3, for the electronic components the ability to recover the materials is very costly and complex if the design stage is not addressed in view of disassembly and recycling. However, given the large number of components from global markets this would need standards at global level.	

Table 5: Barriers stemming from legislation in Spain – national level

* The table provides an overview of the policies and legislation for which either of the following applies:

- *orange colour code* – clear evidence of risk to project implementation was found in the literature review or in interviews; and
- *yellow colour code* – theoretical and potential evidence of risk to project implementation was found in the literature review or in interviews.

The policies and legislation where no or only minor evidence of risk to project implementation was found in the literature review or in interviews are not included in the table.

Name	Sector	Potential barriers/risks	Risk*
Basque Country: Plan de prevención y gestión de residuos de la CAPV 2020	All	Many recyclable and hazardous wastes still go to landfills, because business returns are too low. These may be addressed by the new plans in preparation. Some plastics cannot be recycled, which makes it difficult to reach targets. A significant proportion of plastics used in electronics are hazardous for human health or the environment and need to be destroyed rather than recycled. However, the only factory dedicated to this in Spain has now closed.	
Basque Country: Programa marco ambiental de la CAPV 2020	All	The same observations made above apply, as well as for the two other CCAAs of Valencia and Murcia.	
Basque Country: Ley 3/1998, de 27 de febrero, general de protección del medio ambiente del País Vasco	All	For implementation in CCAAs, the most important challenge is the lack of market oversight. This puts at a disadvantage the companies which comply with the legislation (e.g. on ecodesign), especially SMEs. A number of them were driven out of business prior to the Covid-19 crisis. Competition is not only at national, but also at EU and international levels (especially China). Extended durability is also an issue for SMEs. Offering maintenance solutions is difficult for such companies.	
Region of Murcia: Plan de Residuos de la Región de Murcia 2016-2020	All	The same observations made for the Basque Country apply.	

Estratégia de Economía Circular de la Región de Murcia 2030 (ESECIRM)	All	The strategy of the Region of Murcia is close to approval. A public consultation has been completed, which highlighted various problems in the region: lack of public awareness; lack of transparency at the level of local authorities; lack of resources; insufficient emphasis on reuse (almost exclusive focus on recycling); lack of incentives like targeted taxation; unclear definition of waste vs by-products; the need for increased focus on ecodesign, eco-innovation and sustainability (i.e. focus on 'future products' rather than just the recycling of existing ones); and lack of incentives for companies to take into account the lifecycle of products. This feedback is being taken into consideration for inclusion in the strategy. The new strategy for 2030 should be approved this year.	
Valencian Community: Plan Integral de residuos de la Comunidad Valenciana	All	The same observations made for the Basque Country apply.	
Valencian Community: Ley 10/2000, de 12 de diciembre, de Residuos de la Comunitat Valenciana	All	The same observations made for the Basque Country apply.	

Table 6: Barriers stemming from legislation in Spain – Autonomous Communities' level

* The table provides an overview of the policies and legislation for which either of the following applies:

- *orange colour code* – clear evidence of risk to project implementation was found in the literature review or in interviews; and
- *yellow colour code* – theoretical and potential evidence of risk to project implementation was found in the literature review or in interviews.

The policies and legislation where no or only minor evidence of risk to project implementation was found in the literature review or in interviews are not included in the table.

2.4 Policies in the UK

2.4.1 Mapping of policies

Policies and regulations in the UK are organised at both the national level and at the level of each country's legal system. The country concerned in the CIRC4Life project is England, where two demonstrations have been developed, for the production of organic vegetables and for the design, production, selling, recycling and reuse of industry LED lighting.

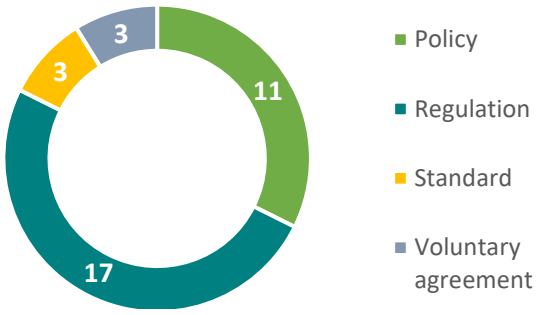

Figure 4: Distribution of UK mapped policies

The majority of strategic documents identified during the mapping exercise are regulations and policies as well as voluntary agreements, programmes and standards (Figure 4).

Across the UK, at both the national level and level of England alone, seventeen different regulations, eleven policies, three standards and three voluntary agreements were identified. The three regulations and two standards are relevant for the agriculture and food value chain. Six regulations, one standard and two voluntary agreement are relevant for the electrical and electronic equipment sector. The seven policies, five regulations and one voluntary agreement are relevant to all sectors. Three regulations and two policies for all sectors refer to England.

The specific policies and legislation identified in the mapping exercise are presented in Table 7 and Table 8Table 8: Overview of regional policies and legislation in England

, and detailed descriptions are presented in Appendix 2.

Sector	Type	Name
All	Policy	New industrial strategy
	Policy	"A Green Future – Our 25 Year Plan to Improve the Environment", HM Government
	Policy	Clean growth strategy
	Policy	"Resource Revolution: Creating the Future, WRAP's plan 2015-2020"
	Policy	"Resource Security Action Plan: Making the most of valuable materials"
	Policy	"Public procurement policy: Transforming Governmental Procurement", HM Treasury
	Policy	HM Government, "Industrial strategy: Building a Britain for the Future"
	Policy	National Industrial Symbiosis Program UK (NISP)
	Policy	Waste and resources action programme (WRAP)/Zero waste Scotland
	Regulation	Government buying standards ('Buy Sustainable – Quick Wins') as part of public procurement policy
	Regulation	Consumer Protection from Unfair Trading Regulations 2008
	Regulation	Climate Change Act
	Regulation	Environmental Protection Act
	Regulation	Controlled Waste Regulations
	Voluntary agreement	The Courtauld Commitment
Agri-food	Regulation	UK Agriculture Bill 2017-19
	Regulation	Organic Products Regulations 2009
	Standard	Soil Association Certification (UK)
	Regulation	General Food Regulations 2004
	Standard	Organic, Fairtrade
Electrical and electronic equipment	Regulation	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
	Regulation	Energy conservation: Energy Information Regulations 2011
	Regulation	Ecodesign for Energy-Related Products Regulations, and the amendment from 2013
	Regulation	General Product Safety Regulations (UK)
	Regulation	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
	Regulation	Waste Electrical and Electronic Equipment Regulations 2013, Statutory Instruments, 2013 No. 3113 Environmental Protection
	Standard	PAS 141:2011 Reuse of used and waste electrical and electronic equipment (UEEE and WEEE), process management, specification
	Voluntary agreement	Electrical and Electronic Equipment Sustainability Action Plan 2025 (esap 2025)
	Voluntary agreement	EPEAT

Table 7: Overview of UK policies and legislation – national level

Sector	Type	Name
All	Policy	Resource and waste strategy for England
	Regulation	Controlled Waste (England and Wales) Regulations 2012
	Regulation	Environmental Permitting (England and Wales) Regulations, Landfill Allowance Trading Scheme (England)
	Regulation	Waste Management Licencing Regulations (England and Wales) (amendment and related provisions) No. 2) Regulations 2005

	Policy	"Prevention is better than cure: the role of waste prevention in moving to a more resource efficiency economy", HM Government (but only covers England)

Table 8: Overview of regional policies and legislation in England

2.4.2 Barriers and risks

The circular economy debate in the UK has evolved over the last three to four decades from a number of converging strands of thinking and activity, with their origins mainly in Europe.[11] The development of EU policy in the field of waste management has a major impact on UK policies and regulations.

Businesses are ahead of the policy debate on the circular economy in the UK, in terms of their promulgation of the ideas and their understanding of the opportunities and barriers. This is evidenced by think tank/business partnerships such as the Ellen MacArthur Foundation, the Great Recovery Project of the Royal Society for Arts, Manufactures and Commerce (in the partnership with the Technology Strategy Board, Innovate UK and FabLab London) and the Green Alliance's Circular Economy Task Force.[12]

Until recently, UK waste management has been regulated in the first place by EU legislation, including the EU Waste Framework Directive and EU Landfill Directive.[13] There is not much UK-specific regulation on top of it. The UK is committed to moving towards a more circular economy, having a long history of environmental protection supported by a strong legal framework pre-dating membership of the EU. The UK government has stated that leaving the EU has not changed its ambitions on the quality of the environment (Defra et al., 2020).

The waste policies in the UK are fully devolved: there are slightly different policy frameworks in the four United Kingdom countries. Crucial UK legislative documents include:

- Controlled Waste Regulations 1992, which introduce the definition of waste and the duty of care on producers/operators for the collection, treatment and disposal of waste; and
- Environmental Protection Act 1990, which applies the EU Waste Framework Directive in England, Wales and Scotland. It defines the structure and authority for waste management and the control of emissions, and strengthens controls and enforcement, with stricter penalties. It outlines the need for a national waste strategy, the need for an enhanced legal and institutional setting for waste management, and sets the producers' responsibility in relation to the reuse, recovery and recycling of waste.

As regards strategic documents, the most important one from the perspective of the CEBM development, is the UK government's "25 Year Plan to Improve the Environment", which outlines broader steps to encourage recycling and the more thoughtful use of resources. Another important document is the long-awaited resource and waste strategy for England, which provides the mix of cohesive policy and fiscal drivers to support the resources sector as well as set out the government's approach to promoting circular business models in England. The strategy is in line with the UK government-led 25-year environment plan. The government's other

[11] See Hill (2015), pp. 3-13.

[12] See Hill (2016).

[13] The EU Landfill Directive does not play an important role in the circular economy. It is the best understood directive now in a majority of cases in the UK. It is not going to affect the reuse or refurbishment activities. It is more important for those dealing with actual waste further down the value chain.

modern document is its industrial strategy – a long-term plan, developed in collaboration with businesses across the country, towards building a productive and wealth-creating economy.

Barriers and risks derived from the legislation and policy were identified based on analysis of strategic documents, literature study and an interview with an expert.

According to the interviewed expert, there are not necessarily any major barriers for organic farming at the moment. Organic farming is well recognised in the UK and there is a reasonably supportive regulatory framework. Nevertheless, there are some uncertain matters regarding future regulation for organic farming in relation to Brexit. However, the Department for Environment, Food and Rural Affairs' (Defra) 25-year environment plan from 2018 states that the UK government's intention is to maintain high standards for the environment and for agriculture and to improve the standard of land management in UK farming. From that perspective, organic farming would be positively supported by the regulatory framework in the UK for the next few years.

In the case of the EEE sector, an example of a barrier for the development of circular business models indicated by the interviewed expert is uncertainty over the implications of the legal definition of waste and products in the Waste Regulations for specific products. It poses problems for enterprises refurbishing used EE products. In principle, the used-up products are defined by law as potentially becoming waste, which then demands that companies follow the appropriate regulations. In the context of the CIRC4Life project, this is important for CEBMs offering rental services instead of selling products. For example, companies renting out lights are responsible by law for receiving the wastes generated by consumers. According to the Waste Regulations, these companies need to fulfil several obligations and be authorised for the collection, transport and processing of wastes – obtaining permission for these activities from the regulator.

The identified barriers stemming from legislation in the UK are presented in Table 9 below. As part of the mapping exercise, it shows four regulations that could pose only a theoretical barrier or risk to the project. Further analysis of barriers and opportunities for the project is presented in section 3.

Yet, it is important to add that most of the barriers for businesses adopting CEBMs are market barriers rather than regulatory ones. According to studies for the Life-funded REbus[14] project, which finished in 2017, a lot of the barriers simply arose from companies tending to see the innovative circular business models as untried and untested and therefore as high risk. Businesses on the whole were thus prone to sticking to existing, conventional business models. If they considered implementing a CEBM, they would have to try it and test it in an accepted way. This tendency was also highlighted by the interviewed expert.

[14] See REBus: Pioneering resource efficient business models (REBMs) (www.rebus.eu.com).

Name	Sector	Potential barriers/risks	Risk*
Controlled Waste (England and Wales) Regulations 2012	All	There are no clear and comprehensive definitions of waste and products in the regulations. This is a problem for enterprises dealing with refurbishment of used EE products. The other obstacle for CEBM development is that companies offering the rental of lights are responsible for reception of wastes generated by the consumer and have a recycler status. According to the regulations, these companies need to fulfil several obligations, some of which are connected with the preparation of waste management plans. They need permission for the transport and processing of waste.	
General Product Safety Regulations (UK)	Electrical and electronic equipment	Suppliers of products, including second-hand goods, should act with due care, which may entail carrying out product testing in order to help ensure the product's compliance with the applicable safety requirements. For some manufacturers, the associated additional costs could be a barrier.	
Waste Electrical and Electronic Equipment Regulations 2013, Statutory Instruments, 2013, No. 3113 Environmental Protection	Electrical and electronic equipment	Imperfect/porous system of enforcing the regulations may pose a burden for lighting manufacturers. They could be less competitive on the market due to the bad practices of those manufacturers who do not pay the required fees.	
Consumer Protection from Unfair Trading Regulations 2008		Suppliers of products, including second-hand goods, should act with due care, which may entail carrying out product testing in order to help ensure the product's compliance with the applicable safety requirements. For some manufacturers, the associated additional costs could be a barrier.	

Table 9: Barriers stemming from legislation in the UK

* The table provides an overview of the policies and legislation for which either of the following applies:

- *orange colour code* – clear evidence of risk to project implementation was found in the literature review or in interviews; and
- *yellow colour code* – theoretical and potential evidence of risk to project implementation was found in the literature review or in interviews.

The policies and legislation where no or only minor evidence of risk to project implementation was found in the literature review or in interviews are not included in the table.

3 Barriers and enablers to the implementation of circular economy business models

3.1 CEBMs in the electrical and electronics equipment value chain

Overview and challenges

Boosted by fast-paced innovation and falling costs, world demand for electronic products has dramatically increased over the last few years. On average, the total weight of global EEE consumption increases annually by 2.5 million metric tonnes (Forti et al., 2020). Some estimates put the global consumer electronics market at around US$1.1 trillion, growing at a rate of 6% until 2024, when it will be worth $1.7 trillion.[15] In Europe, the electrical and electronic industry is among the fastest growing and most competitive engineering industries (CSES et al., 2020), and in 2018 it employed over 2.7 million people in 89,000 enterprises, with a turnover of more than €700 billion (Eurostat, 2021a). The other side of the coin of this booming consumption, however, is that due to their short lifecycles, fast obsolescence and few repair options available these products are fuelling a great amount waste, commonly referred to as WEEE or 'e-waste'. WEEE is currently one of the most rapidly growing waste streams in the world, with an annual growth rate of 4%. In 2019, the world generated 53.6 Mt of WEEE, an average of 7.3 kg per capita. In Europe, where WEEE is the fastest growing waste stream, WEEE generation reached 16.2 kg per capita in 2019, the highest level worldwide (Forti et al., 2020).

The waste generated by disposed EEE represent a both a serious threat and an economic opportunity. On the one hand, non-environmentally sound disposal and treatment of this waste stream pose high risks for people and the environment. WEEE contains several hazardous substances, such as heavy metals (e.g. mercury, cadmium and lead), that can harm human health and the environment by entering into human food chains and bio-accumulating in living tissues (Miliute-Plepiene & Youhanan, 2019). In particular, the risks of exposure and harmful health effects are higher in unregulated waste recycling sites, where an improper management of this waste stream can affect workers' health. For instance, workers can be exposed by inhaling toxic fumes and particulate matter, through skin contact with chemicals or by ingesting contaminated food and water (Forti et al., 2020). In addition to this, the production, use and disposal of electronics entails environmental impacts, including those arising from emissions of air pollutants and greenhouse gases (GHGs). For instance, the refrigerants that are found in some temperature exchange equipment, such as fridges and air-conditioners make a contribution to global warming (Forti et al., 2020).[16] It is estimated that the production and use of electronic devices, including PCs, laptops, monitors, smartphones and tablets will have a 14% share of global emissions by 2040 (PACE & WEF, 2019).

Meanwhile, the improper handling of WEEE results in a significant loss of scarce and valuable raw materials. In addition to metals (e.g. aluminium, iron and tin) and plastics, which are very important in terms of weight, electronics also contain several precious metals (e.g. gold, silver, copper and nickel), rare earth elements and critical raw materials[17] such as cobalt, indium and palladium (Miliute-Plepiene & Youhanan, 2019). Recovering and recycling these materials can present economic opportunities: in 2019, the value of raw materials in the

[15] See https://www.globenewswire.com/news-release/2018/06/29/1531798/0/en/Global-Consumer-Electronics-Market-Will-Reach-USD-1-787-Billion-by-2024-Zion-Market-Research.html

[16] In 2019, a total of 98 Mt of CO_2eq were released into the atmosphere from discarded fridges and air-conditioners that were not managed in an environmentally sound manner, 0.3% of global energy-related emissions (Forti et al., 2020).

[17] These materials are defined as critical due to the increasing mismatch between supply and demand, high price volatility or politically-induced limitations of supply (Bakas et al., 2016).

global WEEE was equal to approximately US$57 billion, with Europe alone accounting for US$12.9 billion (Forti et al., 2020).

Despite the health and environmental concerns related to the disposal of WEEE, the value of raw materials in WEEE and the growing worries about the supply of virgin raw materials for electronics, recycling rates of this waste stream are still low. In 2019, only 17.4% of the WEEE generated was recycled globally (Forti et al., 2020). In Europe, the continent with the highest recycling rate, roughly 40% of WEEE is currently collected and recycled (Eurostat, 2021b).[18] In high-income countries that are responsible for the vast majority of WEEE generation,[19] around 8% of the non-recycled WEEE is landfilled or incinerated, between 7 to 20% is shipped as second-hand products to low- or middle-income countries and the rest is, for the most part, mixed with other waste streams (Forti et al., 2020).

These numbers highlight the need to substantially increase WEEE collection and recycling rates, especially in view of the rapid growth of this waste stream in the near future.[20] Moreover, due to issues related to environmental pressure from primary mining, market price fluctuations and scarcity and supply risks for certain materials, it has become necessary to improve the mining of secondary resources in WEEE and reduce the pressure on virgin raw materials (Forti et al., 2020). CEBMs for electronics can maximise the amount of WEEE that moves back into the production of new electronic products and components, thereby limiting the amount of unrecoverable waste generated by the system and providing enormous economic benefits, for both consumers and producers (PACE & WEF, 2019). As described below the benefits of CEBMs go beyond collecting WEEE and recovering materials from end-of-life products, as they can also extend the lifetime of devices and components.

Circular economy business models for electrical and electronic equipment

A variety of circularity approaches and models can be implemented in the EEE sector including production and design of circular products, repair, refurbishment, reuse, product-as-service and leasing models, collection and recycling. The sections below provide a short description of these approaches.

Design and production of electronic products

The design of electronic products is the first crucial phase where circularity principles can be applied. For example, products can be designed with the objective to improve their durability and repairability and thereby extend their lifetime. Durability can be enhanced through proper selection of materials and high-quality components that can guarantee a longer lasting use of products.[21] Repairability, on the other hand, can be facilitated by simplifying the way different parts of products are assembled or attached to each other and by promoting modular designs (EEA, 2020). Modularity as a design approach holds potential to improve both durability and repairability of electronic devices, as it enables the easy repair, upgrade or substitution of single defect components of the product, avoiding its full replacement (Schischke et al, 2019). Within CIRC4Life, an

[18] According to Eurostat (2021c), 7.13 out of 16.2 kg of waste generated per capita is currently recycled in EU.

[19] Europe and US alone contribute to almost one-half of the total waste generated annually (Gnanasagaran, 2018).

[20] Parajuly et al. (2019) have put forward several scenarios for the future growth of WEEE, depending on the degree of implementation of circular business practices and policy instruments. Assuming that the quantity of WEEE will inevitably increase as a result of a growth in GDP, in the business-as-usual ("Linear Growth") scenario, where a standard growth-based agenda remains the priority and conventional business models remains dominant, the annual global amount of WEEE generated is expected to reach 75 Mt by 2030 and 111 Mt by 2050.

[21] One example is the design of LED light bulbs, which are more durable and energy-efficient than conventional light bulbs (Rizos et al., 2017).

example of application of modular designs has been given by Kosnic Lighting, an English lighting manufacturing company that has managed to extend the lifetime of its products by developing a fully modular LED lamp (NTU, 2020).

Besides improving durability and repairability, during the design phase potential social and health concerns related to electronic products can be addressed. First, the design can focus on keeping hazardous substances as much as possible out of products, in order to limit the potential harmful effects discussed above. Moreover, as demonstrated in CIRC4Life, the design could be conducted through a co-creation process in order to integrate stakeholder feedback in the development of new products or services. This has been the case, for instance, of ONA, a lamp manufacturing company that as part of a CIRC4Life demonstration has collected consumer opinions through surveys, reviews and workshops in order develop products that could better fit their preferences and needs (Kosnic & ONA, 2021).

As regards the production phase, circularity of electronic products can be enhanced by configuring the production process in such a way as to limit, to the extent possible, the amount of materials and energy used and reduce the generation of waste. For instance, greater resource efficiency in the production process can be achieved by decreasing the material input required by each product (i.e. reduce the material intensity), improving energy efficiency and curtailing the losses of material that occur at different stages of the process (Lacko et al., 2019).

Reuse, repair, refurbishment and remanufacturing

Along with the prioritisation of ecodesigns, companies could further increase products' lifetime by promoting their reuse. The reuse of electronic products – that is, their repurposing using a range of product life extension strategies such as repair, refurbishment and/or remanufacturing (Bovea et al., 2016), is considered to be the best end-of-life option in terms of environmental impacts and socioeconomic benefits (Gurunathan et al., 2021). However, repair, refurbishment and remanufacturing options for electronics are still limited, and the result is that devices that could be reused are often discarded. This might be due to complex designs, software restrictions or simply because the repair costs are high compared with the purchase of new devices (EEA, 2020; PACE, 2021a). Moreover, users' perception of used devices still represents an obstacle for the uptake of this solution. Among the main reasons deterring consumers from buying second-hand products are the simple preference for new models over old ones, the fear of inferior performance or lower quality of used devices (and the consequential lack of trust in the second-hand market) and the idea that new products ensure better value for money (Cerulli-Harms et al., 2018). Furthermore, data safety concerns often lead people to store their devices in their homes indefinitely[22] (Ellen MacArthur Foundation, 2018).

In view of these obstacles, the reuse rate of EEE can be significantly increased through repair and refurbishment services extending the lifetime of electronic devices. In addition, producers of electronics could offer buy-back or return options to customers for old products, incentivising them financially and by guaranteeing the proper management of their data (PACE & WEF, 2019). Many of the data safety issues related to used products, in fact, can be addressed through guarantees and transparency in the second-hand market, which offer assurance and confidence for customers (Ellen MacArthur Foundation, 2018). In addition, the use of communication strategies has proved to be effective in raising awareness and changing people's perception of used electronics (Miliute-Plepiene & Youhanan, 2019).

[22] A study in Norway showed approximately 10 million of mobile phones are kept in households without being used (Miliute-Plepiene & Youhanan, 2019).

Product-as-service and leasing models

The use phase of electronic products is already seeing rather big changes due to two interlinked drivers: the process of dematerialisation and the shift from a culture of owning products towards one focused on their use (EEA, 2020). On the one hand, the rapid changes in technology, such as cloud computing and the internet of things, hold great potential to dematerialise the electronics industry, thus freeing up new resources (PACE & WEF, 2019).[23] Furthermore, by transferring the workload of devices from the actual hardware and to remote data centres, hardware capabilities become less important than connectivity and services, and this can provide benefits in terms of increasing product use cycles (Ellen MacArthur Foundation, 2018; Demestichas et al., 2020).

On the other hand, new ownership models focused on the provision of services rather than ownership of physical products are becoming more widespread. Examples are leasing and rental models, where on the basis of contracts customers gain continuous access to electronic devices, which at their end of life are returned to the service provider.[24] A second type of model is given by product-as-service systems, where service providers retain the ownership of the electronic product throughout its use by the consumer, who only purchases the service itself. Finally, one last related model is the so-called sharing economy, which entails the provision sharing platforms where the products are shared among many users (EEA, 2020). These business models can be effective in reducing WEEE, as they incentivise service providers to make sure that resources are used optimally over a device's lifecycle, including when it is time for products to be reused by another customer or disposed of and recycled, to choose the most durable products available and to keep their value for as long as possible by repairing and remanufacturing them when necessary. Moreover, by shifting from a one-off transaction to an ongoing service (the so-called subscription economy) these business models can build a much closer and stronger customer relationship (PACE & WEF, 2019).

Collection and recycling

As explained above, the end-of-life phase of EEE is characterised by very low collection and recycling rates. In terms of collection, in the EU only 40% of WEEE is collected and enters official treatment, leaving large amounts untreated (Eurostat, 2021b). Among the main causes already mentioned above are data safety concerns, which may lead consumers to store indefinitely their old devices instead of disposing of them (Rizos et al., 2019; Ellen MacArthur Foundation, 2018), a lack of awareness on how to handle and where to dispose of electronic waste (PACE & WEF, 2019) and a lack of a fully developed WEEE management infrastructure (Forti et al., 2020). As regards recycling, the key challenge in raising recycling rates lies in the high complexity of electrical products, which can be made up of more than 1,000 different substances and contain up to 6 different elements. This can have an impact on the cost-effectiveness of recycling and recovering processes (Forti et al., 2020). In the EU, recycling of WEEE mainly focuses on the recovery of base metals such as aluminium, copper, gold, silver and steel, which are easier to extract due their high concentration level in electronic devices. The recycling efficiency rate of these metals is in fact above 50% and can rely on the availability of well-established industrial processes. At the same time, the recovery of other metals such as gallium, germanium, indium and rare earths is still challenging because they are used in very limited fractions in EEE, and the lack of proper recycling infrastructure results in recycling rates below 1% (EEA, 2021).

[23] One potential side effects of an expansion of the internet of things, however, is the increase in emissions due to the higher energy consumption of the network of devices.

[24] In the context of CIRC4Life, for instance, a service leasing model was implemented by Kosnic Lighting, who now offers its products for leasing periods of 3 to 5 years, under the payment of a monthly subscription (Kosnic & ONA, 2021).

In view of the above challenges, a circular approach for the end of life of electronic products would require, first, to improving the collection systems of WEEE in terms of both accessibility and the quality of collected waste. For this purpose, the CIRC4Life project has developed a new collection system based on two 'intelligent' bins specifically designed for electronic waste and conceived a reward system to incentivise consumers to dispose of their electronic waste (Wilson & Lindén, 2021a).[25] Second, a significant upgrade of the recycling sector would be needed, in order to expand the range and the quantity of materials that can be recovered (PACE & WEF, 2019). By investing in new recycling technologies, companies would in fact maximise the amount of valuable WEEE that could move back into the production of new electronic products and components, gaining a considerable economic benefit (Forti et al., 2020).

3.2 CEBMs in the agri-food value chain

Overview and challenges

Production of food globally has been associated with significant environmental impacts such as CO_2 emissions increased pressure on land use, water and energy consumption (FAO et al., 2020). In more detail, the global food system[26] is among the highest contributors to climate change, releasing from 10.8 to 19.1 of $GtCO_2eq$ per year, equivalent to 21-37% of total net anthropogenic GHG emissions (IPCC, 2019). In the EU, 30% of GHG emissions comes from the food system, with the contribution of single countries ranging from 25 to 42% (Crippa et al., 2021). On top of this, food systems, and especially intensive agricultural practices, are responsible for 32% of global terrestrial acidification, 78% of global eutrophication (Poore et al., 2018) and 80% of global deforestation (FAO, 2016). Environmental impacts are also associated with the high resource intensity of food production systems: for instance, around 37% of the global land (FAOSTAT 2021) and two thirds of global freshwater resources (Poore et al., 2018) are devoted to agriculture. What is more, the food production process is becoming increasingly energy intensive, with a third of food systems' emissions being associated with energy consumption (Crippa et al., 2021).

The environmental impacts of food production are further amplified by high levels of losses across supply chains; according to UNEP (2021), nearly 17% of all food produced for human consumption in the world is wasted or lost along food supply chains, corresponding to about 931 million tons in 2019. In Europe, it has been estimated that around 20% of overall food production is lost or wasted (Stenmarck et al., 2016), while per capita food waste is among the highest in the world, with 280 kg/year[27] (FAO, 2018). Besides being an important economic loss,[28] food lost and wasted translates into a significant waste of natural resources: estimates indicate that it accounts for roughly 30% of the world's agricultural land area, 20% of freshwater consumption and 40% of the energy consumption of the food supply chain (FAO, 2011; FAO, 2013). As such, food waste represents a threat for both the sustainability and security of the whole food system, especially at a time when chronic hunger, food insecurity and malnutrition remain severe problems in many parts of the world[29] (FAO, 2018).

[25] This system was demonstrated in Spain via the CIRC4Life project partner Indumetal Recycling, a Spanish company specialised in the integral management of WEEE.

[26] According to the IPCC, the "global food system" entails "all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socioeconomic and environmental outcomes at the global level" (IPCC, 2019, p.10).

[27] Europe's levels are second only to North America, where per capita food waste generation is at 300 kg/year.

[28] In 2012, the market value associated with food loss and waste was estimated at US$936 billion (FAO, 2015).

[29] In 2019, around 690 million people (approximately 8.9% of world population) suffered from undernourishment, and close to 750 million people faced severe food insecurity (FAO et al., 2020).

A sustainable production and consumption food system has been defined as a food system that "delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised" (Nguyen 2018, p.1). The application of circular economy principles to the agri-food system can contribute to developing a food system where: food is produced in ways that regenerate nature; food is not lost or wasted and commonly wasted resources are used productively (PACE, 2021b). As such, a more circular agri-food system can both unlock economic opportunities and bring significant societal and environmental benefits. The Ellen MacArthur Foundation (2019), for instance, estimates that achieving a fully circular food system in cities would generate economic benefits worth of US$2.7 trillion per year by 2050, besides saving 4.3 billion tonnes of CO_2 emissions and 39.3 billion cubic metres of freshwater resources. Additional benefits would include health costs saved from avoided pesticides-related illnesses, the diffusion of healthier diets and lower level of water contamination and waste pollution (Ellen MacArthur Foundation, 2019).

Circular economy business models for the agri-food sector

Among the key processes that can be adopted by businesses in the agri-food sector and contribute to increased circularity of resources are production and design, collection and recycling. These processes are described below.

Design and production

The design phase of food products mainly relates to the choice of the ingredients and to products' configurations. Designing food products based on circular economy principles, therefore, entails selecting ingredients and configurations that can guarantee a low environmental impact and high resource efficiency. One example of application of circular designs, for instance, is given by an American company called Apeel, which developed plant-derived coatings that keep fruits and vegetables fresh up to three times longer than they would normally last, minimising food waste across the value chain (Vieira et al., 2020). In terms of ingredients selection, Ellen MacArthur Foundation (2021) identifies four specific, circular design opportunities that can be applied by food companies: selecting ingredients with lower environmental impact, for instance by switching from animal to plant-based ingredients; diversifying the ingredients, in order to promote genetic diversity and boost food supply resilience; upcycling the ingredients, that is using ingredients that would normally be discarded; and using regeneratively grown ingredients, meaning those ingredients that guarantee "positive long-term outcomes for nature and farmer health and livelihoods" (Ellen MacArthur Foundation, 2021 p. 34). In the framework of CIRC4Life, for example, a company that has successfully implemented a more circular selection of ingredients as part of its demonstration activities is ALIA. By replacing soybean and other environmentally damaging sources of protein with cereals and other by-products from local industries for feed production the company has managed to improve the sustainability of its meat products (Wilson & Lindén, 2021b).

Collection and recycling

The collection and recycling of commonly wasted resources represents another great opportunity to increase the circularity of the food system. Recycling nutrients contained in food waste can in fact reduce the need for new resources and minimise nutrient losses (UNEP, 2016). Today, less than 2% of the valuable nutrients in food by-products and waste generated in cities are recycled back to agriculture (Ellen MacArthur Foundation, 2019) but recently there has been an increasing interest in the development of waste processing technologies and approaches aimed at food waste reuse and recycling. Among the potential applications, food waste and by-products can be used (i) as fertilisers, reducing or substituting the need for synthetic alternatives (UNEP, 2019); (ii) as a source of textile or bioplastic fibres, reducing resource use impacts associated with textiles value chains (Esteban et al., 2018); or (iii) for animal feed production, either directly or through insect-based bioconversion of food waste (Fowles et al., 2020). An example from CIRC4Life in terms of food recycling is given by Scilly

Organics, an organic farm that has used organic waste to produce compost and increase soil fertility (ALIA, 2019).

3.3 Methodology

This section describes the methodology adopted for identifying specific barriers and enablers faced by companies implementing CEBMs in the EEE and agri-food value sectors. The study adopts a qualitative approach based on thorough analysis of case studies (Voss, et al., 2002) with the objective of collecting rich empirical evidence on barriers and enablers. Each case study represents a company that implements a CEBM or is offering a circularity solution that fits in one or more of the categories identified in sections 3.1 and 3.2. As explained below, a multiple case studies were selected for each sector with the aim of covering the different CEBM models implemented in the CIRC4Life project but also capturing the variety of CEBMs and circularity approaches observed in the EEE and agri-food value sectors.[30]

3.3.1 Case study selection and sample

In order to build a sample of case study companies we employed the method of 'judgement sampling' (see Patton, 2002) and aimed at selecting information-rich cases that would help us acquire in-depth information for our analysis. The identification and selection of case studies took place in two phases. During the first phase the companies that have implemented CEBMs and been part of the CIRC4Life EU-funded project were selected and provided the backbone of the analysis for both the EEE and agri-food value sectors. CIRC4Life features 17 partners across the EU, of which 6 are companies implementing CEBMs or solutions for circularity (4 in the EEE value chain and 2 in the agri-food). These include design and production of new products (EEE and agri-food sectors), reuse, repair and refurbishment (EEE sector), leasing and product-as-service models (EEE sector), and collection and recycling (EEE and agri-food sectors). All companies involved in the project were selected and interviewed to provide their perspectives from applying circularity approaches in the project (see more details in section 3.3.2 below). In a second phase the research team complemented the samples for both sectors with further company cases to collect additional empirical findings from companies implementing CEBMs similar to the ones developed in the project and to increase the robustness of the results. These were identified through desk-based research, use of the network of CIRC4Life companies involved in the various activities[31] of the project as well as through asking the representatives from case study firms to recommend other companies putting CEBMs into practice in their sector.[32]

As shown in Table 10 and Table 11, we selected 41 companies for the analysis, of which 31 operate in the EEE sector and 10 in the agri-food sector. The sample for the EEE sector was larger in order to sufficiently cover all the diverse circularity approaches for electronics carried out in the CIRC4Life project. In addition, to reflect the variety of challenges and opportunities experienced by different firms, an effort was made to interview both small and medium-sized enterprises (SMEs) and large enterprises (LEs), as well as to cover different geographical regions in Europe.[33] A general overview for the EEE and agri-food sectors can be seen below in Figure 5.

[30] Other authors that have applied multi-case study analysis to investigate barriers and enablers to implementing circularity approaches include Rizos et al. (2016); Tura et al. (2019) and Vermut et al. (2019).

[31] Such activities included interactive 'living labs' that were used to test circularity solutions developed in the project with a variety of stakeholders including scientists, companies, public authorities, civil society and policymakers (see: Purola et al., 2019).

[32] In the literature the method of expanding the sample through suggestions by the selected case study representatives is often referred as 'snowball sampling method' (see, for example, Saunders et al., 2009).

[33] Note that UN area codes were used for classifying the regions, see https://unstats.un.org/unsd/methodology/m49/.

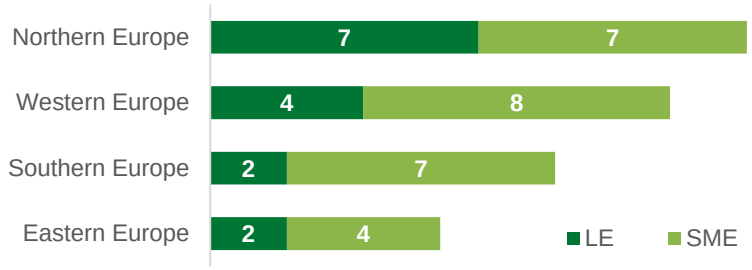

Figure 5: Number of firms included in the sample (by region and size)

Table 10 below provides information about the 31 firms included in the analysis for the EEE sector. The sample included both SMEs and larger companies, with a slight majority of the former (58%). Companies located in northern and western Europe represented around 74% of the sample, while companies from southern and Eastern Europe about 26%. The majority of companies interviewed in the EEE sector (71%) have integrated several circular activities into their business models, while 29% has only one. Regarding the representativeness in the sample of different circular processes, 15 companies were involved in collection or sorting activities, 14 in refurbishment or remanufacturing, 12 in circular design and production, 11 in reuse, 8 in repair, 7 in product-as-service or leasing models and 6 in recycling.

Firm	Region	Size	CE activities
1	Northern Europe	LE	Multiple
2	Northern Europe	SME	Multiple
3	Western Europe	LE	Multiple
4	Northern Europe	SME	Multiple
5	Western Europe	LE	Multiple
6	Southern Europe	LE	Multiple
7	Northern Europe	LE	Single
8	Western Europe	SME	Multiple
9	Northern Europe	SME	Multiple
10	Northern Europe	LE	Single
11	Western Europe	LE	Multiple
12	Northern Europe	SME	Multiple
13	Northern Europe	SME	Multiple
14	Western Europe	SME	Single
15	Northern Europe	SME	Multiple
16	Western Europe	SME	Single
17	Western Europe	SME	Multiple
18	Northern Europe	LE	Multiple
19	Eastern Europe	LE	Multiple
20	Southern Europe	SME	Multiple
21	Southern Europe	SME	Single
22	Western Europe	LE	Single
23	Southern Europe	SME	Single

24	Northern Europe	LE	Multiple
25	Southern Europe	SME	Multiple
26	Southern Europe	SME	Single
27	Northern Europe	LE	Multiple
28	Southern Europe	SME	Multiple
29	Western Europe	SME	Multiple
30	Northern Europe	LE	Multiple
31	Western Europe	SME	Single

Table 10: Overview of case study EEE firms

Among the 10 companies included in the analysis for the agri-food sector, 7 qualify as SMEs while 3 are large companies (see Table 11). Contrary to the EEE sector, the majority (70%) of sampled agri-food companies are located in southern and Eastern Europe, while around 30% are in northern and western Europe. The sample was also divided in terms of whether companies implement one or multiple circular approaches. The following processes were represented in the sample: 9 companies were active in circular design and production, 7 in recycling and 4 in collection.

Firm	Region	Size	CE activities
1	Northern Europe	SME	Multiple
2	Southern Europe	LE	Multiple
3	Eastern Europe	SME	Multiple
4	Western Europe	SME	Multiple
5	Southern Europe	SME	Multiple
6	Eastern Europe	SME	Single
7	Eastern Europe	LE	Single
8	Eastern Europe	SME	Single
9	Western Europe	LE	Single
10	Eastern Europe	SME	Single

Table 11: Overview of agri-food case study firms

However, due to an absence of responses from some firms on certain topics, the sample sizes for all aspects analysed are not always equivalent to the full sample size for each sector. For example, while all 31 interviewed EEE companies provided input on policy suggestions and gaps, only 8 out of the 10 interviewed companies in the agri-food companies did.

3.3.2 Data collection and analysis

For the collection of data on barriers and enablers from each company, the research team utilised semi-structured interviews, which allowed in-depth discussions with company experts about the barriers and enablers they face in the implementation of their circular business model. In order to provide a basis for the discussion, the team prepared and sent to participants in advance of the interview a questionnaire. The questionnaire first provided an introduction covering the general objectives of the assessment conducted in the context of the CIRC4Life project and then included four parts. The first part invited participants to explain

the circularity elements in their business approach. This helped the research team to develop a good understanding of whether the company carries out one or multiple circular activities as well as to categorise them. Then there was a section where participants could indicate whether the Covid-19 crisis has affected their circularity activities and their overall business strategy. The third part was devoted to the barriers and enablers encountered by the sampled companies. Based on a literature review,[34] the team developed a list of categories of general barriers and enablers in order to help collect and later analyse the data in a structured way. The general categories of both barriers and enablers that were featured in the questionnaire were the following: 'policy and regulation', 'economic/finance factors', 'supply chain', 'technology', 'consumer and societal awareness', 'company organisation' and 'others'. The discussion based on this part of the questionnaire followed an open format where participants could freely provide their perspectives since there was no limitation to strictly follow the categories in the questionnaire. In addition, there was no limitation on the different barriers and enablers that each company could raise, with many of them identifying multiple barriers in assorted categories. The fourth part of the questionnaire first invited participants to provide their general views about the effectiveness of the current EU policy framework and then describe specific gaps that should be addressed by policy action. In addition, participants received a consent form that described the study methodology and clarified that all collected data will be presented in the report in an anonymous way.

Interviews for the EEE sector were organised between April and October 2020, while for the food sector they took place a few months later from March to June 2021. There was one interview for each case study, thus 31 interviews for the EEE sector and 10 for the agri-food sector, which lasted between 45 minutes and 1.5 hours. In several interviews, and especially for the EEE sector, the company was represented by more than one expert; 37 different experts were present in the interviews for the EEE sector and 11 for the agri-food sector. The majority of interviewed experts held senior positions (see Table 12 below).

Sector	EEE sector	Agri-food sector
Position*	Director/Head of Department (16); Manager/Senior Expert (11); CEO/Owner (5); Consultant/Expert (5)	CEO/Owner (6); Manager/ Senior Expert (2); Director/Head of Department (2); Consultant/Expert (1)

Table 12: Positions of interviewed experts

* Numbers in brackets indicate how many interviewed experts held each position. Note that interviewed CEOs/owners came from SMEs.

Following each interview, the research team prepared a detailed interview write-up[35] and grouped the various barriers and enablers according to the identified general categories described above. The next step in the process involved coding the specific barriers, enablers and Covid-19 impacts in order to group the collected data. This allowed the team to determine the share of companies that experienced different impacts from the Covid-19 crisis, barriers, enablers and policy gaps, and to draw common patterns across the various case studies.

[34] To develop the list of barriers and enablers the team draw on previous work by Rizos et al. (2016) and Rizos et al. (2015) as well as other authors such as Shahbazi et al. (2016), Kirchherr et al. (2018), De Jesus et al. (2018) and Vermunt et al. (2019).

[35] Given that at the time of the interviews for the EEE sector the interviewed companies involved in the CIRC4Life project were still in the phase of developing some of the circularity aspects in their business model, write-ups for this companies were further complemented in the period May-June 2021 with additional information retrieved from the companies.

3.4 Results

This subsection presents the results of the analysis of data collected from interviewed companies. There are two parts for each of the two value chains covered by the study. The first part is devoted to the impacts, from both an operational and strategic point of view, of the Covid-19 crisis and lockdowns experienced by the sampled companies. Then the second part presents the key barriers and enablers encountered by the companies in implementing their CEBMs.

3.4.1 EEE value chain

3.4.1.1 Covid-19 impacts

Impacts from the Covid-19 pandemic have been felt across the globe. Beyond impacts on societies and people, businesses have also had to adapt to health and safety measures. This was indeed observed in our sample for the EEE sector, with almost 70% of the companies[36] reporting an impact on demand, either positive or negative (see Figure 6 below). Over half of the companies also experienced an impact on their supply chain as well as on organisation and operations due to the pandemic (see Figure 6).

Figure 6: EEE firms mentioning Covid-19 impacts (% of firms), N=30[37]

Notably, demand impacts were mainly positive, with almost half of the interviewed companies seeing an increase in demand due to the pandemic (see Figure 6). Several of the interviewees remarked that the change to teleworking and staying at home had resulted in more companies and people looking to buy electronic equipment, such as laptops, headphones and smartphones. This had a positive impact on demand for companies involved in reuse, repair and refurbishment activities. Among them, some highlighted that the lower price of their products may have been increasingly attractive due to increased financial uncertainty among some customers. Public stimulus also contributed to increased demand for at least one company. On the other hand, eight companies (27%) experienced a decrease in demand. The reasons for this varied among companies, which, located in different countries, experienced disparate situations and restrictions. Especially those relying on physical retailers to sell their products faced a significant drop in demand as shops closed, which nonetheless

[36] As described in footnote 37 below, this figure refers to the firms that provided answer to the questions on the Covid-19 pandemic.

[37] Note that one out of the 31 sampled companies did not provide input to this question, and as such the percentage is calculated as a share of the total number of companies that answered the question which in this case was 30. In addition, multiple categories may be counted for each firm, thus the bars are independent from each other and may not add up to 100%.

largely returned to normal after reopening. Within the CIRC4Life project, one company noted a direct drop in demand for a short period, explained by financial uncertainty tied to the pandemic among their corporate customers. However, two of the companies that experienced a decrease in demand also experienced an increase. For these companies, this reflected changes in demand for alternative product lines. For example, sales of desktop computers decreased, while sales of laptops increased.

Supply interruptions were experienced by almost half (47%) of the companies. Two main causes were generally mentioned for this: the closure of factories and reduced supply of used devices. The former affected both manufacturing and access to spare parts for repairs. This also affected the companies in CIRC4Life, which experienced manufacturing delays because of periodic factory closures due to Covid-19 restrictions. Still, as restrictions eased, the factories in their supply chain were largely able to resume their operations. Several of the companies also found ways to mitigate the issue by diversifying their supply chains and cooperating with companies that were not facing the same restrictions at the same time. With regard to the reduced supply of used devices, this was a particular problem faced by refurbishment and remanufacturing companies. According to the companies, reasons for this could have been that it became more difficult for customers to deliver their used devices or that it became less of a priority for them to do so. This was also raised by one company involved in CIRC4Life, which faced an interruption in the supply of used devices because of collection sites closures due to the pandemic. Yet, during the project implementation collection was still made possible from schools, which allowed for testing the circular business model (Wilson & Lindén, 2021a). Meanwhile, and within the overall sample, three companies involved in recycling, refurbishment and repairs experienced an increase in collected devices. One of the theories provided was that people and companies may have had more time to go through their old devices and drop them off or discard them in a proper manner.

Almost a third (30%) of the companies had negative effects on their operations as a result of the pandemic. The risk of getting Covid-19 and associated measures to limit the number of people in offices or factory buildings were the main reasons for this. Having to close down or limit operations for certain periods was also noted by some. Within CIRC4Life, restrictions on physical distance posed constraints in terms of reaching and interacting with customers, as well as showcasing product prototypes. This posed some challenges to the introduction of new circular business models and new more circular products. It also affected demand to some extent, as it became more difficult to find and engage with new customers. Increased digitalisation of operations and a focus on online retail was another impact of the pandemic, which was reported by seven of the companies interviewed. This applied to internal functions being moved online where possible through telework, as well as to an increased focus on engaging with customers directly online. Both aspects were expected to continue to some degree post-pandemic.

In general, the uncertainty associated with how long the pandemic and restrictions would last, especially in the first phase of the pandemic, was another factor. This made it difficult to make choices on how to adapt at an early stage of the pandemic.

Category	Impact	Firms
Demand	Increased demand	47% (14)
	Decreased demand	27% (8)
Organisation/operations	Negative effects on operations	30% (9)
	Increased online operations / digitalisation	23% (7)
	Changes to logistics/transportation	10% (3)
Supply chain	Supply interruptions	47% (14)

	Improved supply	10%	(3)

Table 13: EEE firms mentioning Covid-19 impacts (% of firms (number))

The majority of the companies in the EEE sector that provided input (62%) did not change their sustainability strategy or the way they integrate circular approaches in their business model as a result of the pandemic, as can be seen in Figure 7. This was also the case for all but one of the CIRC4Life companies in the EEE value chain. For many of the companies interviewed, the circular economy is a core part of their business model, and thus not subject to change due to Covid-19. Indeed, one out of five (21%) specifically noted that the crisis provided an additional validation of the added value of their business model. In particular, some of the interviewees felt that the pandemic had illustrated the need for circular and sustainable solutions. The need for electronic products was also highlighted, as it can facilitate telework and online communication and learning.

Nevertheless, several companies were also motivated to change their strategies because of the pandemic. Specifically, 14% took the opportunity to increase their focus on sustainability (see Figure 7). While this was often expressed as a general sentiment, one interviewee remarked that the pandemic had illustrated the need to adapt to future crises and that greater emphasis on circular approaches could help prepare the company for future crises. Another found that the pandemic had allowed them to fast-track internal sustainability approaches. Moreover, 14% of the companies pointed to an increased focus on resilience and risk planning. This often involved looking at the supply chain and addressing risks by developing risk plans, as well as re-evaluating the profitability of certain areas of their business in light of increased uncertainty. In a similar vein, 10% of the companies specifically aimed to diversify their supply chains and concentrate on more local markets to reduce risks. Within CIRC4Life, one company was inspired to re-evaluate its processes and interactions with customers, and as a consequence decided to invest in demonstration or showcase spaces.

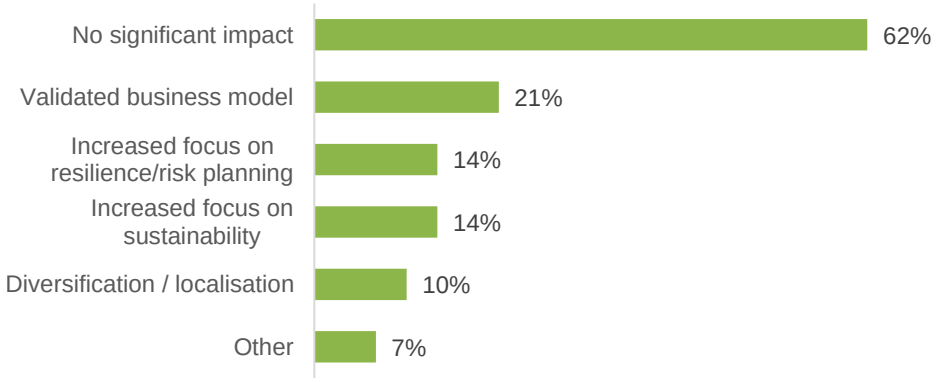

Figure 7: EEE firms mentioning strategy changes from Covid-19 (% of firms), N=28[38]

3.4.1.2 Barriers

Supply chain barriers were experienced by an overwhelming majority (90%) of the companies interviewed, as can be seen in Figure 8. Closely following was policy and regulations, which more than 75% of the companies

[38] Note that not all firms provided input to this question, and as such the percentage is calculated as a share of the total that answered the question. In addition, multiple categories may be counted for each firm, thus the bars are independent from each other and may not add up to 100%.

found to engender some form of challenge to their circular activities. More than half of the companies also mentioned consumer and societal awareness (65%) and finance or economic factors (58%) as barriers. The least mentioned barrier categories were technology and company organisation, followed by other factors.

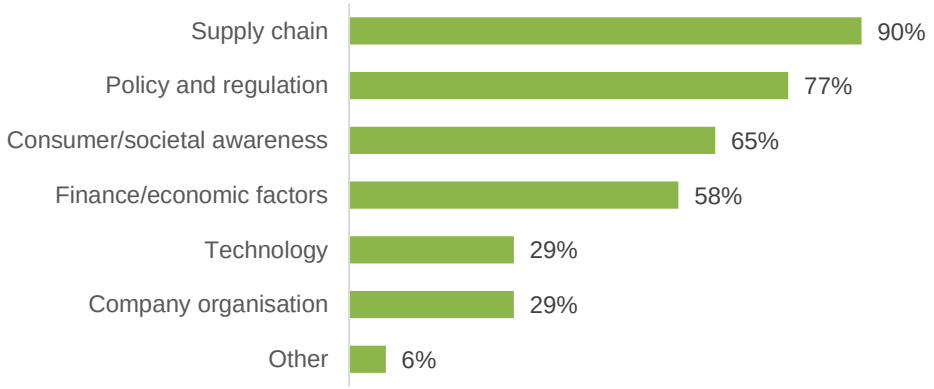

Figure 8: EEE firms mentioning the barrier category (% of firms), N=31[39]

Within the supply chain category, hard-to-access products, components or materials was the most common barrier faced by the EEE companies interviewed (see Table 14). For those engaged in refurbishment, remanufacturing or repair services, this often related to struggles to attain used devices or the right spare parts. Consumers holding onto their devices[40] without disposing of them, as well as challenges to attain a wide variety of models being demanded were barriers particularly related to smaller electronic equipment. Within CIRC4Life, one company also noted that the quality of what is collected can also be an issue: if parts of a device are broken during collection, it can be difficult to refurbish. These problems were also experienced by three companies involved in the production of new equipment. Among them, one company that uses parts from old equipment in the production of new equipment reported problems in ensuring access to the relevant equipment. Another company experienced a barrier in retaining access to components over time in order to support use of their products for a longer period, while another one reported lack of access to recycled materials.

Closed or restricted company loops was a barrier that appeared for around one out of five of the EEE companies interviewed. This blockage was generally brought up by companies involved in refurbishment and repair services, which mentioned that getting certified by the manufacturer could be complicated. This was connected to the difficulty of accessing certified spare parts and the reported higher costs of these compared with non-brand alternatives. According to three of the companies, using non-certified parts could lead to liability issues. One company also noted that a lack of circular or easy-to-repair designs made their jobs more challenging. Another noted that registration of serial numbers in the cloud hinders the movement of used devices between markets, as the devices may be locked to the market in which they were first sold.

[39] Note that multiple categories may be counted for each firm, thus the bars are independent from each other and may not add up to 100%.

[40] The mobile phone devices remaining unused in households are often described as 'hibernating' devices, see Rizos et al. (2019).

Six companies also found a lack of transparency in their supply chain to be problematic. This was mentioned especially by companies involved in collection, recycling and production. With regard to recycling, not knowing the exact content of each component creates difficulties, as some may make them unsuitable for recycling. While certain products do have labels, these are sometimes of insufficient quality or readability. For those involved in production, lack of transparency for materials was the main issue. Tracing the materials across the supply chain can be hard, especially for smaller companies. Within CIRC4Life, lack of transparency in the supply chain also created obstacles. In line with the overall sample results, within the project not knowing the exact materials and substances in products and components hampered recycling and refurbishment/reuse. Estimating the EEE products' impacts without having information from the supply chain was another dilemma experienced in the project.

Lack of a circular mentality and compliance with circular approaches was a barrier faced by five of the companies interviewed. For some, this related to difficulties in convincing partners to adopt circular methods or activities. In a couple of cases the companies offered training for their partners, while another chose to monitor compliance. Two other companies found that they had little influence on the lack of circular approaches taken by supply chain partners. For one company in CIRC4Life, this mainly related to the struggle to influence supply chain partners that also deliver to several other companies. This barrier illustrates that in complex and large supply chains, it can be tough for smaller actors to convince large suppliers to adopt more circular approaches. However, as showcased by another CIRC4Life company, such barriers related to the lack of a circular mindset among partners can also be experienced in shorter supply chains. Specifically, the company faced difficulties in convincing a supplier of the importance of providing them with materials that have been properly sorted beforehand.[41] (see section 3.4.1.3).

Barrier	Firms	
Difficulty in accessing products/components/materials	39%	(12)
Closed/restricted company loops	19%	(6)
Lack of transparency	19%	(6)
Lack of compliance and circular mentality among partners	16%	(5)
Other	16%	(5)
Reverse logistics issues	13%	(4)
Unofficial and/or illegal activities	10%	(3)
Quality issues regarding recycled material	6%	(2)
Transportation challenges	6%	(2)

Table 14: EEE firms mentioning supply chain barriers (% of firms (number))

The second most common category of barriers was policy and regulation. Within this category, legislation or initiatives specific to EU member states was highlighted as an impediment by around a quarter (26%) of the companies interviewed in the EEE sector. While these varied from country to country, many were considered to have unintended negative consequences for circular initiatives or were perceived not to adequately take into account the particularities of circular activities according to the interviewees. The low cost of landfilling was

[41] It should be noted though that despite these issues the long relationship based on trust with the supplier was also an enabling factor for the implementation of this company's CEBM (see section 3.4.1.3).

identified as a barrier within CIRC4Life, as it does not incentivise investments in circular and more sustainable approaches.

At the EU level, a common barrier was EU chemicals legislation, with seven companies specifically mentioning the REACH Regulation 1907/2006, RoHS Directive 2011/65/EU and Regulation (EU) No 2019/1021 on persistent organic pollutants (POPs). Among them, three companies reported that the requirements and administrative demands related to these pieces of legislation often create hurdles to recovering and recycling plastic from EEE. They also noted that this material frequently ends up in incinerators. One other company reported that due to these policies it is hard for them to access recycled plastic in order to use it in the production of new EEE.

The WEEE Directive was mentioned as a barrier by five companies. The flexibility in implementing the directive at the national level, according to some of the companies, has led to slightly different rules and enforcement across member states. This arguably gives rise to difficulties for companies operating across different countries. One company also found that due to existing rules, proof that the equipment is functional is required in order to move it across borders, thereby complicating intra-EU trade of used equipment for repairs. While local repairs are possible, the cost levels in higher-wage countries could make some repairs economically unprofitable according to the company. Extended producer responsibility (EPR) schemes were also brought up by five companies as posing challenges to their circular activities, which generally related to the way in which the national frameworks for EPR schemes have been set up in different countries. In one country, targets are only set for short periods, which makes planning and investments for participates in the EPR schemes awkward. Investments are also constrained by the absence of long-term contracts provided by the existing schemes due to their competition based on price. In another country, it was brought up that the EPR scheme has a very rigid structure regarding the management of collected EEE equipment, leaving little room for developing new sorting and recycling plants in different regions.

Targets for the UK EPR compliance schemes are set on an annual basis and are specified a few months into the year in which they apply, thus making planning and investment tougher for companies tasked with ensuring these are met. Without visibility of future targets, longer-term planning for investments becomes difficult.

Several other barriers were brought up during the interviews, including the absence of specific policy actions[42] and lack of enforcement or compliance with existing legislation, which were mentioned by three companies each. Three companies also found that there is an excessive focus on waste and recycling in existing circular economy policies at the expense of other processes such as refurbishment and reuse. For companies engaged in international trade and sales, customs and other trade issues were seen as a barrier. Lack of legislation on circularity or sustainability in third countries, as well as enforcement, were related challenges.

Barrier	Firms	
Member state legislation/initiatives	26%	(8)
EU chemicals legislation (REACH, RoHS, POPs)	23%	(7)
WEEE Directive	16%	(5)
EPR regime	16%	(5)
Lack of certain policy action	10%	(3)

[42] Specifically, the following missing policy actions were reported: lack of requirements/regulations for sharing data across supply chains, lack of policies to support lower-skilled jobs required for refurbishment, repairs and reuse of EEE and lack of policy support for refurbishment activities in general.

Lack of enforcement/compliance	10%	(3)
Legal barriers to reusing devices or components	10%	(3)
Excessive focus on waste and recycling	10%	(3)
International trade and customs	10%	(3)
Lack of circular/green public procurement	10%	(3)
Lack of legislation or enforcement in third countries outside EU	6%	(2)
Other	6%	(2)
Lack of common standards and definitions	6%	(2)
Bureaucracy and administration	6%	(2)

Table 15: EEE firms mentioning policy & regulation barriers (% of firms (number))

Within the consumer and societal awareness category, lack of interest or trust in circular solutions was the barrier most commonly experienced. Indeed, over half of the companies interviewed in the EEE sector saw this as a hindrance, although as described in the enablers section below many also noted that interest in circular solutions has been increasing. One of the common reasons mentioned, especially by companies involved in refurbishing or remanufacturing, was that they found people to be sceptical about the quality and reliability of refurbished products. Preference for owning a device was also observed by companies offering leasing models. Within CIRC4Life, problems also arose during activities aimed at communicating sustainability information to the customers. In particular, the eco-point method and app that were developed as part of the project were seen as complex by some, which complicated the project's efforts to promote circular products over others. Nevertheless, with efforts to clarify and increase awareness, some of this was improved.

In more general terms, lack of awareness of sustainability issues and the circular economy was brought up by four companies. This also related to a lack of awareness of how to properly recycle WEEE. This issue was likewise identified within the CIRC4Life project, as well as the existence of limited incentives for consumers to engage in more sustainable behaviour. As such, efforts were made during the project to communicate the importance of circular solutions and raise awareness as well as to provide incentives for reuse or recycling (see Wilson & Lindén, 2021a).

In a similar line, four companies specifically mentioned that they found the main drivers of purchasing decisions to be price and a desire to have completely new devices. Competing only on price could be challenging for companies implementing CEBMs, which may occasionally have different costs from companies with more linear activities.

Barrier	Firms	
Lack of interest/trust in circular solutions	52%	(16)
Preference for new/cheaper products	13%	(4)
Lack of awareness	13%	(4)
Other	6%	(2)
Misleading/inaccurate information	6%	(2)

Table 16: EEE firms mentioning consumer/societal awareness barriers (% of firms (number))

The higher costs of more sustainable or circular approaches was mentioned by over a quarter (26%) of the companies interviewed, and was the most common barrier among the financial and economic factors (see Table

17). The reasoning provided by the companies varies. Some found that utilising used equipment or parts could be expensive, while others reported that the processes of collecting, sorting and depolluting EEE are costly. One other company involved in collection and refurbishment of EEE reported that the financing terms offered to them by companies selling their used equipment required paying the full amount in advance, which is usually not the case when buying new equipment. Related to this are also specific predicaments associated with the leasing and product-as-service models, which were noted by two companies. One found that such models lead to particular financial challenges due to the fact that production costs are covered at a much later time compared with selling a device, while the other experienced issues in collecting payments from clients and occasional theft of devices that were provided to clients as part of the leasing model.

Another barrier that was mentioned by eight companies was that of accessing financial resources, either for operations or investment. This was particularly mentioned by SMEs, of which three highlighted that initial investment costs were high or hard to finance. Two SMEs also mentioned that finding the necessary finance to scale up a circular economy activity was a challenge. Some also found it difficult to access funding for specific activities, with one noting they did not have the resources for quantifying their environmental impact. Nevertheless, one large enterprise also brought up this issue, noting that sustainability or circular initiatives were often the first to have their resources reduced in difficult times.

Competition, especially with linear companies and products, was mentioned as a barrier by almost one out of five companies (19%). This often related to the higher cost of circular approaches (as mentioned above). Similarly, the low cost of virgin materials was seen as a constraining factor on the increased use and availability of secondary raw materials by five companies involved in different circular activities.

Barrier	Firms	
Higher cost of more sustainable/circular approaches	26%	(8)
Lack of access to financial resources	23%	(7)
Competition (incl. with non-circular products/processes)	19%	(6)
Low cost of virgin materials	16%	(5)
Other	10%	(3)
Payment issues related to leasing	6%	(2)

Table 17: EEE firms mentioning finance/economic barriers (% of firms (number))

Barriers mentioned within the technology field varied significantly between companies. Nevertheless, four companies mentioned one as being a lack of consistency or predictability. In more detail, three companies reported that due to the increasing variety of models, the designs and technologies for developing and putting refurbishment and remanufacturing processes in place for EEE is becoming a complex task. As reported by one recycler, this can also complicate depollution and recycling processes, which may have to be adapted to new materials or designs. Design or product characteristics posed specific issues for three companies, some of which noted that embedded and slim designs made repairs more difficult, among other things. Software issues were mentioned by two companies, one of which faced particular snags related to software licencing. While not listed in the barriers included in Table 18 below, it is worth noting that limitations related to data inconsistencies were encountered in CIRC4Life and specifically during the collection of information for the LCA (e.g. energy expenditure, time and transportation). This was due to the local suppliers using data stored in different (non-

standardised) formats and methods, which complicated the process (ONA, 2021). Finally, four companies noted a variety of other barriers that have been listed in Table 18 as 'other'.[43]

Barrier	Firms
Lack of consistency/predictability	13% (4)
Other	13% (4)
Issues related to design/product characteristics	10% (3)
Issues related to software	6% (2)
Limited availability of technological solutions	6% (2)

Table 18: EEE firms mentioning technology barriers (% of firms (number))

With regard to company organisation, lack of time and internal resources was the most commonly mentioned barrier within the category. This was experienced by both SMEs (three) and larger companies (two). For the larger companies, it generally related to prioritisation of resources for different circular activities and initiatives and having to choose which to prioritise. For SMEs, it more generally related to lack of time and internal resources. In larger companies, which often did not start up as a company with circular activities but have moved towards more circular processes in later years, lack of knowledge of the circular economy together with a linear mindset was also seen as a barrier. One company noted that this created tensions between different departments within the company, because of a lack of mainstreaming of circularity targets and benefits across the company as a whole.

Barrier	Firms
Lack of time and internal resources	16% (5)
Linear mindset/lack of circular economy knowledge	13% (4)
Linear company processes	13% (4)

Table 19: EEE firms mentioning company organisation barriers (% of firms (number))

3.4.1.3 Enablers

As shown in Figure 9, consumer and societal awareness was the category most commonly mentioned as an enabler. Indeed, most of the sampled EEE companies (81%) reported that they had experienced enablers within the category. Policy and regulation was the second most frequently mentioned category of enablers and barriers mentioned by over half of the companies (61%). Company organisation was another key enabler in the sample noted by more than half of the companies (58%). Finance and economic factors were highlighted by 42% of the companies, while the supply chain category was mentioned by almost a third (32%). Technology and 'other' were the categories least mentioned.

[43] These included technical constrains in further improving the resource efficiency of EEE, new technology cycles providing only marginal resource and energy efficiency benefits, the existence of a technology gap between what the manufacturers design/produce today and what the recyclers collect for recycling years later and challenges for refurbishing and reusing IT equipment due to the different layouts of keyboards across countries.

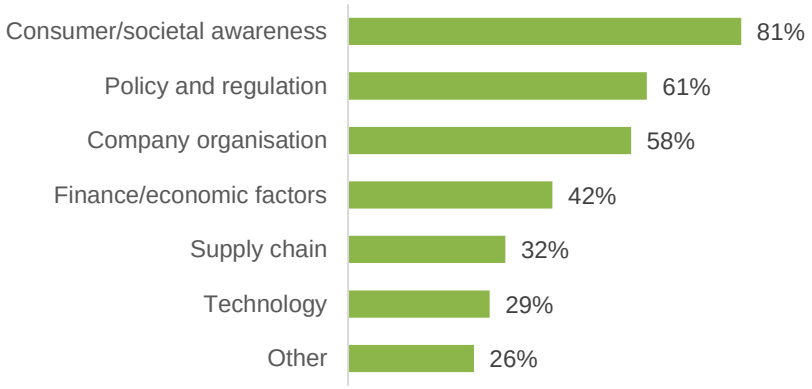

Figure 9: EEE firms mentioning the enabler category (% of firms), N=31[44]

Increasing demand for circular or sustainable products was mentioned as an enabler by over half of the firms (52%) interviewed in the EEE sector (see Table 20). Considering the fact that the same number of firms mentioned lack of trust or interest in circular solutions as a barrier, this illustrates that there are different attitudes among customers. Some companies highlighted that the demand from certain consumer segments that are interested in circular solutions has been crucial to developing their circular business models. This was also experienced in the CIRC4Life project, where involving customers in the design and production of new circular products and services through co-creation methods was used in the project to help ensure a more collaborative process – in which the supply of new circular products and services matches consumer demand and concerns (see Wilson and Lindén, 2021a and ONA, 2021). Similarly, increasing awareness of environmental and sustainability issues more generally was noted by 14 firms. This was considered a more general enabler in the way that it may make people more interested in circular solutions or more aware of how to dispose of their devices in a way that extends the life of the devices or properly recycles them. However, some companies noted that increased awareness did not necessarily guide purchasing decisions. Awareness programmes, which also play into this, were specifically mentioned by two companies as having had a positive effect on people's awareness. Another two SMEs mentioned that customer loyalty was an enabler, which for one of them had helped them to use crowdfunding when needed.

Enabler	Firms	
Increasing demand for circular/sustainable products	52%	(16)
Increasing awareness	45%	(14)
Awareness programmes	6%	(2)
Customer loyalty	6%	(2)

Table 20: EEE firms mentioning consumer and societal awareness enablers (% of firms (number))

[44] Note that multiple categories may be counted for each firm, thus the bars are independent from each other and may not add up to 100%.

With regard to the category of policy and regulations, public funding (including project funding) was the enabler most commonly mentioned. Among the eight companies that pointed to this enabler, most had benefited from EU project funding and some also from national funding programmes. Such funding had helped them mitigate the challenges of limited financial and other resources, and enabled them to go beyond their usual operations, innovate and focus on circularity. For one company, such support had also been fundamental in starting up and developing the company, centred around circularity. Within CIRC4Life, project support was naturally a chief enabler. Through the funding, as well as cooperation and knowledge transfer among partners, the companies involved were able to demonstrate different new CEBMs. Seven companies reported a multitude of policies at various levels that acted as enablers for them, which are listed in Table 21 as 'other'. These included the EU single market, voluntary industry agreements underpinned by EU legislation, the Conflict Minerals Regulation (EU) 2017/821, the Paris Agreement and the Sustainable Development Goals (SDGs).

Notably, the WEEE Directive was brought up as an enabler by five companies. Considering five companies also mentioned it as a barrier, this illustrates that there have been mixed impacts from the directive according to the companies interviewed. Two of the companies noted that setting targets for reuse and recycling had been an important enabler, while one believed that it specifically had been key in ensuring the collection and recycling of small WEEE. Two companies highlighted the prioritisation of reuse over recycling as an enabler.

Different pieces of member state legislation and policies were highlighted as having positive effects by five companies. In some cases, this related to legislation and policy with the intention of promoting a circular economy, such as partial reimbursement of repair costs at the sub-national level, green public procurement, national ecolabels, and broad circular policy and strategies. More generally, the EU's circular economy action plan and the European Green Deal were brought up as enabling circular business models by four companies. A variety of standards were furthermore mentioned by four companies as enablers. These included the standards on collection and treatment of WEEE by the European Committee for Electrotechnical Standardization (CENELEC) as well as the EPCIS standard were used in CIRC4Life for sharing, in a standardised form, information about products across supply chains.[45]

Enabler	Firms
EU/national funding (incl. projects)	26% (8)
Other	23% (7)
WEEE Directive	16% (5)
Member state legislation/initiatives	16% (5)
Standards	13% (4)
EU circular economy package & European Green Deal	13% (4)
Ecodesign Directive	6% (2)
Reporting requirements	6% (2)

Table 21: EEE firms mentioning policy and regulation enablers (% of firms (number))

More than half of the companies mentioned enablers within the overall category of company organisation, with internal commitment, motivated employees and internal innovation being the most common. The former was

[45] For more details see Schmittner and Schwering, 2019.

mentioned by nine companies, both large and SMEs. For some, it related to having dedicated departments or business lines focused on sustainability, while for others the knowledge and commitment of their employees or company as a whole were highlighted. Enablers related to internal innovation were varied and included new or adapted activities, such as launching new business models, services or dedicated branding. One company overcame issues related to accessing spare parts by developing their own depot, while another decided to acquire its own plastic shredder to further expand its circular activities. In addition, four companies mentioned their size as an enabler but provided contrasting views, since three noted that their small size benefited their capacity to innovate, while one large company mentioned that the global size of its business enabled it to quickly take on circular economy innovations and invest in them.

Enabler	Firms
Internal commitment and motivated employees	29% (9)
Internal innovation	26% (8)
Company size	13% (4)

Table 22: EEE firms mentioning company organisation enablers (% of firms (number))

Slightly fewer than half of the companies interviewed in the EEE sector noted enablers related to finance and economic factors. Revenue or cost-saving opportunities from circular approaches was the enabler most commonly mentioned. Considering that the higher costs of circular approaches was mentioned as a barrier by a similar number of companies (eight), this illustrates that depending on the specific CEBM and market conditions in place, the financial benefits or costs entailed by circular economy processes can vary significantly. Among the nine companies that mentioned revenue or cost-saving opportunities as an enabler, several noted that the inherent value in used equipment was an important feature. Others observed that circular approaches have provided new revenue streams for their company. One company also reported that retaining ownership of the devices through their leasing model motivated further circular approaches and design. Another company noted that financial benefits may also arise for customers, who can, for instance, spread the cost over a longer period with leasing. A further notable enabler was demand for high-end EEE, which was highlighted by three companies active in refurbishment or remanufacturing. According to these companies, the presence of a high-end market for smaller electronics such as mobile phones has been an important enabler for their business model.

Enabler	Firms
Revenue/cost saving opportunities from CE	29% (9)
Demand for high-end products	10% (3)
Access to flexible sources of finance	6% (2)
Other	3% (1)

Table 23: EEE firms mentioning finance/economic enablers (% of firms (number))

Under the category of supply chains, establishing partnerships with other companies and suppliers was the most commonly mentioned enabler. Such partnerships have helped them to utilise and occasionally share outside expertise, resources and capacity, as well as to implement circular solutions through dialogue and

cooperation. In most cases, this assisted them in overcoming barriers in a variety of areas, such as finance and economic issues, technology and supply chains. For one company, for example, the establishment of a partnership helped them to overcome barriers regarding the prefinancing and manufacturing of small batches of components. Within CIRC4Life, good relations with and trust of suppliers was also an important enabler in order to facilitate the implementation of circular approaches in production. According to one of the companies, long-standing relationships with suppliers were important for getting the suppliers onboard with the new practices required.

Enabler	Firms
Establishing partnerships	29% (9)
Good relations with and trust of suppliers	3% (1)

Table 24: EEE firms mentioning supply chain enablers (% of firms (number))

Four of the interviewed companies mentioned technological or digital solutions as enablers. The solutions varied among the companies, with artificial intelligence mentioned by one, the internet of things by another, digitalisation of processes by a third and online sales by a fourth. Within CIRC4Life, several technological and digital solutions were utilised. The development of an app and eco-point system allowed communication of the sustainability impacts to the customers, helped to inspire more sustainable behaviour and provided information at the point of purchase about where and how to deposit devices for recycling or reuse. The latter was made possible by an 'intelligent' bin that enabled consumers who dispose of devices to receive financial rewards in their account and to follow what would eventually happen to the device. Although this electronic system was only demonstrated on a small scale within the project, also due to Covid-19 restrictions, there were indications that it could have a positive effect on consumer willingness to engage in circularity activities (Wilson & Lindén, 2021a). Traceability solutions were specifically highlighted by two companies, of which one stressed that innovations in blockchain technology could be a key enabler in the future by allowing tracing and verification of recycled content in remanufactured devices.

Enabler	Firms
Technological/digital solutions	13% (4)
Traceability solutions	6% (2)
Benefits related to design	6% (2)
Longer innovation cycles for hardware	6% (2)

Table 25: EEE firms mentioning technology enablers (% of firms (number))

3.4.2 Agri-food value chain

3.4.2.1 Covid-19 impacts

Within the agri-food sector, more than a half of the interviewed companies reported Covid-19 impacts on demand and organisation/operations. In addition, half of the companies reported impacts on supply chain.

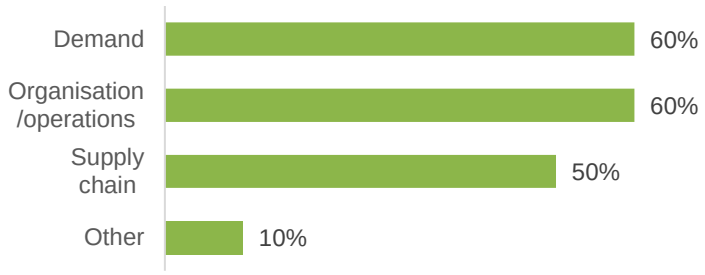

Figure 10: Agri-food firms mentioning Covid-19 impacts (% of firms), N=10[46]

With regard to demand impacts, four companies noted decreased demand (see Table 26). One company within CIRC4Life found that the lack of tourists and the lockdown restrictions caused a significant decrease in demand, such as orders at cafes and other premises. Another one reported that the sales of products have decreased in stores and despite the progressive lifting of the restrictions the number of orders has not returned to the level before the pandemic. One other company noted a decrease of grain prices in the agricultural commodities market. By contrast, three companies experienced increased demand for their products and services. Among them, one company found that following the first wave of the pandemic there was greater demand from big clients for innovative products produced through more circular processes, while another one mentioned that due to the rise in demand they had decided to diversify the products they offered. Additionally, two companies had to adapt to a change in the products demanded because people changed their habits and started preparing meals at home.

Six companies observed negative effects on operations. One company that was also involved in CIRC4Life found that restrictions of direct contacts made it more difficult to gather clients' opinions and feedback for the development of their CEBM. Another company mentioned that the market launch of their product produced through food residues had to be postponed due to the closure of companies that were supplying them with these residues. One reported that due to severe restrictions they were not able to continue promoting organic farming through educational activities, while another company mentioned that active participation in trade fairs, conferences and workshops to promote its product significantly decreased, with this lack of direct contact having a negative impact on the knowledge development of employees.

Five companies highlighted supply interruptions. Among them, one company mentioned that it was impossible to receive the food waste required for its product, thereby forcing it to cease all operations. Another one noted similar challenges in receiving the food residues required for its CEBM. Notably, two companies experienced a disruption in the supply of packaging materials. Finally, one company reported difficulties in engaging with potential investors in order to obtain the financial resources required for its CEBM, which has been included in the 'other' category in Table 26.

Category	Impacts	Firms
Demand	Decreased demand	40% (4)
	Increased demand	30% (3)

[46] Note that multiple categories may be counted for each firm, thus the total does not add up to 100%.

	Change in product demand	20% (2)
Organisation/operations	Negative effects on operations	60% (6)
Supply chain	Supply interruptions	50% (5)
Other	Difficulty in accessing investment	10% (1)

Table 26: Agri-food firms mentioning Covid-19 impacts (% of firms (number))

As shown in Figure 11 below, the majority of the companies in the agri-food sector reported no significant impact on their sustainability strategies or the way they integrate circularity in their business models due to the Covid-19 pandemic, reflecting that circularity or sustainability is the key business focus for many of the sampled companies. However, there were two companies that reported a diversification of their business activities. According to the first company, its original business idea was based on a waste-to-energy approach; nevertheless, the pandemic motivated a re-think and move towards a model based on utilising food residues from local partners for the production of by-products. The second company reported that the pandemic had brought the realisation that it had the potential to cover a niche market of good destined for large companies and that its model, based on a circular approach, could be a competitive advantage in this market. Finally, one company noted that the pandemic had highlighted the importance of healthier lifestyles as well as environmental sustainability, thereby providing a token of validation of its business model based on the organic production of food. Environmental strategies and the activities undertaken have acquired special value and importance with the emphasis on healthy diet.

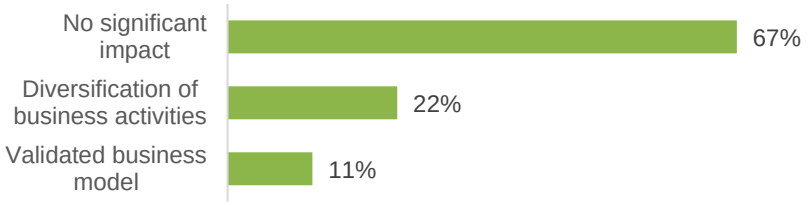

Figure 11: Agri-food firms mentioning strategy changes from Covid-19 (% of firms), N=9[47]

3.4.2.2 Barriers

Finance and economic factors along with policy and regulation were the categories of barriers identified by the largest share of sampled companies in the agri-food sector, followed by the categories of supply chains and consumer/societal awareness (see Figure 12). In addition, half of the sampled companies mentioned barriers related to technology and company organisation. It is worth noting that the majority of the companies spotlighted barriers in all these categories.

[47] Note that not all firms provided input to this question, and as such the percentage is calculated as a share of the total that answered the question for each category. In addition, multiple categories may be counted for each firm, thus the bars are independent from each other and may not add up to 100%.

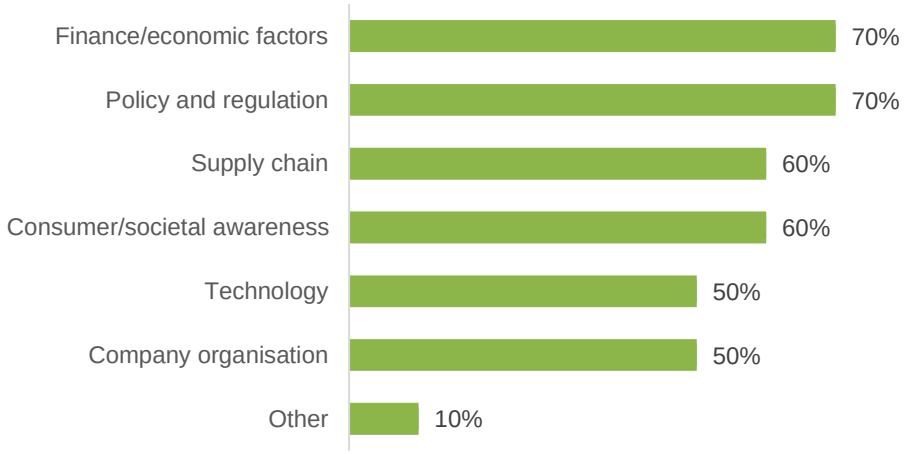

Figure 12: Agri-food firms mentioning the barrier category (% of firms), N=10[48]

Within the finance/economic factors category, five companies mentioned that more sustainable and circular approaches entail a higher cost. Some of the processes that entailed higher costs were collection and treatment of side streams from food production, the cost of buying electric machinery to replace diesel ones and costs of using biodegradable and compostable plastic packaging. One company specifically highlighted the financial challenges associated with developing new processes to use waste as raw material, while another one mentioned that price represents the main barrier when adopting a circular model for animal feed products, as farmers are highly sensitive to price changes.

Moreover, three companies reported lack of access to financial resources as a barrier. One of them mentioned that as a medium enterprise it had limited access to external funds to support the implementation of a new CEBM, while another reported difficulties in obtaining the financial support required to make its production model financially sustainable, especially in its early stages of development. There was also a start-up that found that the pandemic complicated its efforts to access investments. Two companies furthermore saw competition as a barrier. In particular, the first mentioned that as a small company offering a product produced through a circular process it faces higher labour costs, higher costs for packaging and smaller margins compared with large competitors. The second company observed that food products are not priced highly enough because they do not include negative externalities, which makes it hard for farmers to produce food more sustainably and compete with industrial producers, as they have to sell with higher margins.

Barrier	Firms
Higher cost of more sustainable/circular approaches	50% (5)
Lack of access to financial resources	30% (3)
Competition (incl. with non-circular products/processes)	20% (2)

Table 27: Agri-food firms mentioning finance/economic barriers (% of firms (number))

[48] Note that multiple categories may be counted for each firm, thus the total does not add up to 100%.

With regard to the policy-related barriers, four companies highlighted bureaucracy and administration. Among them, two companies noted that getting official recognition for their circular process based on using leftovers from agri-food production required excessive administrative requirements, while one pointed to the long-process associated with proving that using black soldier fly frass as fertiliser is safe, which was a significant burden on implementation of its CEBM. Another company noted that the national agency responsible for granting subsidies for organic production has put in place very complex procedures.

Three companies singled out member state legislation/initiatives. One company highlighted that the strict national rules in place for using leftover vegetables from restaurants for animal feed focus on the origin of these leftovers (i.e. whether they originate from restaurants) rather than their actual composition. It argued for the composition check to prioritise assessing whether it is safe to use them for animal feed. Another company mentioned a national act on biocomponents that includes restrictions on sales of biofuels between farmers, while another encountered difficulties in convincing partners to support it in its CEBM due to the national rules in place for using leftovers from agri-food production but also to the absence of a clear EU legislative framework for such processes.

Two companies mentioned EU policy in general. The first commented that although food and agricultural policy is generally moving in the right direction, more needs to be done in terms of creating a level playing field where environmental externalities are properly incorporated in the prices of food. The second one that is also involved in CIRC4Life noted that current EU rules restrict the use of agricultural residues and leftovers and suggested that having more flexibility in this respect could enhance the opportunities for circularity. Additionally, one company noted the lack of EU rules for using black soldier fly frass as fertiliser, one mentioned that due to an incoherent implementation of the Novel Food Regulation (EU) 2015/228 across member states the market for using insect proteins for animal feed is often restricted and one that public support in the form of subsidies for organic farming are insufficient.

Barrier	Firms
Bureaucracy and administration	40% (4)
Member state legislation/initiatives	30% (3)
EU policy in general	20% (2)
Lack of EU rules	10% (1)
Lack of coherence in implementing EU legislation	10% (1)
Insufficient public support/funding	10% (1)

Table 28: Agri-food firms mentioning policy and regulation barriers (% of firms (number))

From a supply chain perspective, three companies noted challenges in establishing partnerships. The first company stressed that start-ups' lack of a well-established business network make it more difficult in the beginning to find customers or partners. The second highlighted the need to look for equipment providers abroad due to a shortage of domestic suppliers. The third company reported that it was very hard to find a supply chain partner for the logistics and convince the partner to work with it, largely owing to the legal administrative burdens linked to the national rules in place for using leftovers from agricultural production. Moreover, two companies mentioned problems in convincing their partners to accept a more circular approach, one noted issues linked to the complex logistics of its business relying on the collection of agricultural production leftovers from multiple locations and finally one encountered obstacles in identifying a proper natural colouring agent required for its food product.

Barrier	Firms
Establishing partnerships	30% (3)
Difficulty convincing partners to accept circular approach	20% (2)
Collection issues (incl. quality of items)	10% (1)
Difficulty in accessing products/components/materials	10% (1)

Table 29: Agri-food firms mentioning supply chain barriers (% of firms (number))

Under the category of consumer/societal awareness, four companies referred to lack of interest/trust in circular solutions. One company noted that when it comes to ecological issues society is divided, while such issues are often politicised – leading to lack of trust among people. Another company argued that although many consumers are in general interested in products produced through more sustainable processes, in the end they prioritise the price and prefer products they are already familiar with. One other emphasised struggles to engage with customers because of challenges in getting their attention and communicating business products in a short timescale. The same company found that the CIRC4Life project had shown that it is difficult for consumers to understand the concept of LCA and its benefits. A fourth company suggested that despite some consumers changing their preferences, there remains a segment uninterested in circular approaches like using by-products as a valuable resource and therefore educational programmes are needed on the part of public administrations and governments. Additionally, two companies mentioned the lack of public awareness as a barrier, with the first noting that in its country sustainability is not covered sufficiently by the media and the second arguing that a share of the public still does not understand why their consumption should be limited and does not pay attention to how products are manufactured. Finally, one company pointed out that many consumers are still not ready to change their eating habits and adopt a healthier lifestyle (included as 'other' in Table 30).

Barrier	Firms
Lack of interest/trust in circular solutions	40% (4)
Lack of awareness	20% (2)
Other	10% (1)

Table 30: Agri-food firms mentioning consumer/societal awareness barriers (% of firms (number))

Under the category of technological barriers, complexity and the limited availability of solutions were each raised by three companies. On technological complexity, one company commented that CIRC4Life had shown that integrating the eco-point system developed by the project into supermarkets to communicate sustainability impacts to customers could be challenging. Specifically, supermarkets use certain hardware to issue receipts, which cannot easily integrate another system like that developed by the project for eco-points. Thus, consumers may end up receiving two different receipts, the supermarket one and the eco-point ticket, which is not optimal and can cause confusion. This highlights that developing integrated technical solutions from the beginning, involving all actors, can have the most optimal results. A further lesson from CIRC4Life raised by another company is that in terms of traceability, it might be difficult for small companies to use the same solutions adopted by supermarkets (i.e. QR codes) and the different needs and technical capacities of companies across supply chains should be carefully taken into account in the development of digital solutions. The same company also mentioned the complexities for a small company to collect data in different formats regarding the environmental impacts of food products. With regard to the limited availability of technical solutions as a barrier, one company noted technical challenges in minimising plastic packaging and finding more sustainable alternative solutions. Another mentioned the limited availability of reliable solutions for properly

assessing the content of residues from the food industry, and one observed limited options in the market for electric tractors to replace diesel ones.

Barrier	Firms
Technological complexity	30% (3)
Limited availability of technological solutions	30% (3)

Table 31: Agri-food firms mentioning technological barriers (% of firms (number))

Two companies mentioned an internal lack of knowledge and experience as a barrier (see Table 32 below) – with one noting a general lack of experience among its founders on business management issues (i.e. accountability, logistics, communications and marketing) and one a general lack of know-how in the company yet also among local actors, as they were the first to use a specific bio-based technology. In addition, one company mentioned that it was hard to find local people with the appropriate qualifications and experience required for its CEBM. Another reported low internal efficiency in implementing circular economy practices owing to multiple objectives in place and one mentioned that due to its small size it lacks the capacities to compete with larger companies. Finally, one involved in CIRC4Life found that despite the resources made available by the project it was sometimes difficult for a small company with limited time and capacities to follow all the technical updates of the project.

Barrier	Firms
Internal lack of knowledge/experience	20% (2)
Linear mindset/lack of circular economy knowledge	10% (1)
Linear company culture	10% (1)
Low efficiency	10% (1)
Company size	10% (1)
Lack of time and internal resources	10% (1)

Table 32: Agri-food firms mentioning company organisation barriers (% of firms (number))

3.4.2.3 Enablers

As shown in Figure 13, policy and regulation was the enabler category selected by the largest share of companies, followed by consumer/societal awareness and finance/economic factors. Moreover, half of the companies referred to company organisation. Technology and supply chains were the last two categories of enablers specified.

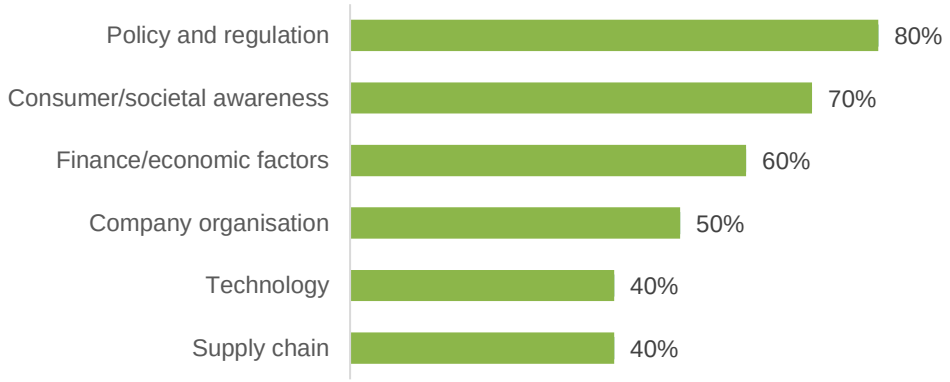

Figure 13: Agri-food firms mentioning the enabler category (% of firms), N=10[49]

Provision of EU or national funding was indicated as an enabler by seven companies. Among them, five specifically noted that available funding for projects was instrumental in the development and implementation of their CEBMs. This was also the case with the CIRC4Life project, with one company reporting that in additional to the provided financial resources the project had helped it to work with other partners and better understand (through an LCA assessment) the environmental impact of its food product. Similarly, a company involved in an EU-funded social entrepreneurship programme mentioned that during the first phase of implementing its CEBM the programme had helped it to find local contacts and create the necessary network to start the business. Two other companies identified financial support in the form of agri-environmental subsidies as an enabler.

In addition, two companies mentioned labels. The first company argued that product labels, such as ecolabels or organic farm labels, enable the consumer to make an informed decision when shopping, knowing that the quality of the product has been verified by an independent institution/organisation. Another company found that certification of its products by the EU ecolabel to be very useful because it is well-known in the country and it shows that the company's products are of better ecological quality than others on the market. Two companies furthermore suggested that high-level policy initiatives, like the EU circular economy package and the European Green Deal, are catalysing attention on circular business models and also make it easier to attract potential investors. Finally, one company identified the Single Use Plastics Directive, banning certain single-use plastic items, to be an enabler, while another one noted that the SDGs and high-level global policy initiatives generate interest in more sustainable products and also provide signals to companies about the need for more sustainable practices.

Enabler	Firms
EU/national funding (incl. projects)	70% (7)
Labels	20% (2)
EU circular economy package & EGD	20% (2)
Single Use Plastics Directive	10% (1)

[49] Note that multiple categories may be counted for each firm, thus the total does not add up to 100%.

Global climate/sustainability policy	10% (1)

Table 33: Agri-food firms mentioning policy and regulation enablers (% of firms (number))

Within the category of consumer/societal awareness, six companies highlighted increasing demand for circular/sustainable products. Four of them held that consumers increasingly look for and choose sustainable products on the market while their interest in production methods that also entail higher costs compared with traditional methods is growing as well. Additionally, two companies (one of which is also involved in CIRC4Life) specifically mentioned that business-to-business clients have been particularly interested in circular processes for corporate social responsibility reasons as well. Increasing awareness among consumers of the environmental impacts associated with the production of food was a related enabler raised by three companies. Finally, the positive influence of labels was indicated by two companies involved in CIRC4Life, which mentioned that the eco-labels developed through the project had helped them to better inform their clients about the environmental impact of their products.

Enabler	Firms
Increasing demand for circular/sustainable products	60% (6)
Increasing awareness	30% (3)
Labels	20% (2)

Table 34: Agri-food firms mentioning consumer/societal awareness enablers (% of firms (number))

With regard to economic-related enablers, five underscored the revenue/cost saving opportunities arising from applying circular economy approaches. According to two companies, the main driver for their CEBMs had been the opportunity to diversify products and to be more competitive by gaining a 'first-mover advantage' through the adoption of new solutions like the ecolabel. Another company reported that economic factors had encouraged it to change production practices and to undertake concrete actions for closing the loop, which has significantly reduced its costs. Two other companies mentioned that in their models utilising food waste or unused organic matter at low cost had provided them with economic opportunities. One other company noted that the circular business model had helped it to look critically at its business structure and reduce costs. Moreover, there was one company that reported access to financial resources as an enabler and specifically emphasised that having a group of investors that – partly motivated by the Covid-19 pandemic – decided to invest to the company's CEBM was a key enabler and had helped it to survive.

Enabler	Firms
Revenue/cost saving opportunities from CE	50% (5)
Access to financial resources	10% (1)

Table 35: Agri-food firms mentioning finance/economic enablers (% of firms (number))

Four companies found that having an internal commitment and motivated employees to be an enabler. One company remarked that internally there had been greater awareness of the environmental impacts of their activities and of the financial benefits that could be achieved through avoiding of waste/wastewater generation and better utilising raw materials. Another company identified the self-motivation to develop new innovative solutions based on utilising waste as an enabler, while yet another one stressed the importance of having

employees who are highly interested and committed to the business idea. Furthermore, one company indicated that internal training and workshops had increased both the efficiency of its employees and the quality of its products. One company identified the knowledge of a researcher who was among the co-founders as an enabler, while another one mentioned that its small size and structure based on a small number of management levels helped internal information flow. Finally, one observed that prioritising innovation within the company had helped it to become a front-runner in processing waste streams from the food industry.

Enabler	Firms
Internal commitment and motivated employees	40% (4)
Training/upskilling activities	10% (1)
Internal knowledge	10% (1)
Company size	10% (1)
Internal innovation	10% (1)

Table 36: Agri-food firms mentioning company organisation enablers (% of firms (number))

On the technology front, four companies identified technological/digital solutions as an enabler. According to two companies, food processing technologies have made great progress in terms of time and energy savings, extended shelf life in retail and stimulated the development of circular solutions – such as using by-products from food production and from processing in the preparation of new products. One company in CIRC4Life reported that tools developed as part of the project to trace the carbon footprints of products across supply chains have been very useful. What is more, one company also involved in CIRC4Life stressed that environmental accounting tools such as LCA and carbon footprint studies can help companies understand where the main impacts of their production are.

Enabler	Firms
Technological/digital solutions	40% (4)
Environmental accounting tools	10% (1)

Table 37: Agri-food firms mentioning technological enablers (% of firms (number))

Regarding supply chain enablers, four companies focused on the importance of establishing partnerships. Among them, two companies specifically highlighted partnerships with universities that had helped them establish their processes based on using waste and side streams, while one noted that its new CEBM had paved the way for collaborating with new business partners who also perceived it as an opportunity to enhance their circular business models as well. Additionally, there was one company that specified that its model relied on building good relationships with food producers, which supplied them with leftovers from food production.

Enabler	Firms
Establishing partnerships	40% (4)
Good relations with and trust of suppliers	10% (1)

Table 38: Agri-food firms mentioning supply chain enablers (% of firms (number))

4 Policy insights and recommendations

This subsection draws policy insights and recommendations based on the results of this study and features three parts. It first presents findings for each value chain drawing on the views of the interviewed experts on the effectiveness of current EU policies in the field and the key policy gaps. This information was collected during the last part of the interview discussions (see section 3.3.2). Then for both value chains there is a discussion based on the study's main observations on barriers and enablers and proposals suggestions for different forms of policy action. The subsection concludes with a number of policy recommendations.

4.1 EEE value chain

4.1.1 Policy effectiveness and gaps

Within the EEE sector, most of the interviewed companies had a positive or mixed view of EU policy effectiveness with regard to promoting circular economy approaches in the sector. Several interviewees were positive about the overall direction of EU policy and expressed optimism about future policy developments. Both the European Green Deal and the circular economy action plan were mentioned as encouraging initiatives by some of the companies. Specific policy initiatives such as the extended producer responsibility requirements and the WEEE Directive were also mentioned by some. However, many also believed there to be room for improvement and some expressed a wish for policy to develop faster. This was also reflected in the policy suggestions provided, where three companies called for increasing the speed and ambition of policy on the circular economy (see Table 39:). A few of the interviewees did not believe that EU policy had had a significant and positive impact on their activities and the market conditions in place. Among the companies interviewed, less than a third found EU policy to be ineffective. Many of these believed EU policy could go further in supporting and incentivising circular business models.

With regard to the policy gaps as observed by the interviewed companies, a wish for further financial support for circular activities or companies was highlighted by more than a third of the companies (12) as can be seen in Table 39. One of the main ideas, proposed by nine of the companies, was tax incentives in the form of VAT reductions for circular activities or other types of tax reductions for circular activities or businesses. A few companies also wished for financial support, such as public funding. Notably, none of the companies that provided this action point had also mentioned EU or national funding as an enabler. This could indicate that while some companies benefit from public funding, others may still struggle to access it. In a similar vein, four companies proposed further support for research and development, which can help provide new or improved circular solutions. The importance of project funding was moreover demonstrated in the CIRC4Life project, where through such funds several companies were able to implement and demonstrate new circular solutions, products and business models.

Increased policy support for circular business models was put forward by nine companies. For many of these, it represented a general sentiment of wishing for a move towards more policy focus on circularity for all stages of a product's life or to promote new circular business models. The proposals were both general and related to specific areas such as repairs, refurbishment and leasing. Indeed, additional policy support for leasing as a business model also emerged as an idea from a company involved in CIRC4Life. Overall, the message among many of the nine companies was often that in order to overcome many of the barriers experienced, additional policy support that promotes circular activities and companies would be welcome. At the same time, six of the

companies interviewed in the EEE sector also expressed a wish for policy initiatives to avoid an undue burden on companies or unintended negative consequences.

Awareness raising was another idea that could help improve the case for CEBMs. Eight companies raised this suggestion, with some emphasising that messaging should also focus more on the positive aspects and benefits of circular solutions. Increased awareness could lead to increased demand and calls for circular products and services as well as help ensure that people dispose of their devices correctly so that they can be reused or recycled. The importance of this was also highlighted during the CIRC4Life project implementation, in which several awareness campaigns were implemented (Wilson & Lindén, 2021a). For example, such campaigns can motivate people to deliver their devices for recycling or reuse, which would be important to enable these business models.

Certain gaps and suggestions focused on reforming or improving existing policies and legislation. Among them were proposals to reform the framework for extended producer responsibility, which was mentioned by seven of the companies. Three aspects were brought up in this regard: stronger enforcement, proposals for how to improve implementation in member states where the national schemes were considered to generate barriers (see section 3.4.1.2) and modulated fees. Ecodesign was seen as an area where EU policy could do more. Stricter, product-specific and clearer ecodesign obligations and targets were among the recommendations provided by five companies. One also mentioned that clarity and coherence would be important for it to have the best effect, while another noted a concern regarding whether imported products would also be covered. Furthermore, four companies highlighted inconsistencies in waste legislation and improvements they would like to see, including increased policy focus on reuse and other stages before products reach the waste stage as well as less room for different interpretations and implementation among member states of the WEEE Directive. Five companies also urged that policy support for improved collection of WEEE could be useful.

Support for collaboration and knowledge exchange was moreover brought up by five of the companies interviewed. Different ways of achieving this were suggested. One company proposed that workshops could be useful, one thought to consult businesses and industries further, while another highlighted that ways to connect and involve smaller companies and organisations would also be important. With regards to SMEs, another company advised that an EU platform or toolkit could prove useful. Project support is another way in which collaboration and knowledge exchange can be facilitated, by providing an arena for different actors to engage and help each other reach common goals. This was demonstrated in CIRC4Life, where the collaboration of different partners, including collectors, recyclers, companies offering digital solutions and research organisations, allowed for the development of new more circular products and demonstration of circular business models.

Six companies advised that policy could help improve transparency across supply chains. Two added that this could be a tool to help consumers make more informed and sustainable purchasing decisions. This would necessarily depend on the information shared being available to consumers in an accessible format. One also noted that improved traceability could help improve the management of EEE during its lifetime. For example, it could provide useful information to recyclers. However, concerning the idea of collecting information on sustainability or emissions in a database, some cautioned that the complexity would need to be taken into account. For example, a modular device may have higher associated emissions from production, but if its lifetime is longer, it may overall have a lower impact compared with a non-modular one with a shorter lifetime. The same company also advocated for the impact of transportation to be taken into account.

Standards or labels can be important tools for promoting a circular economy. Three companies mentioned this as a gap in current EU policy, two of which held that the lack of standardisation for circular products and materials is a gap in EU policy. The important role of labels was identified throughout CIRC4Life, where labels

were developed to showcase sustainability information about the products (see Wilson & Lindén, 2021a). Labels could provide consumers a reliable source of information when choosing products and may to some extent enable more sustainable products to compete with products produced through more linear processes.

Policy gaps and suggestions	Firms	
Increase financial support for circular activities/companies	39%	(12)
Increase policy support for circular economy business models	29%	(9)
Awareness raising	26%	(8)
Reform the EPR scheme	23%	(7)
Avoid undue burden or negative consequences from regulation	19%	(6)
Improve transparency across supply chains	19%	(6)
Promote ecodesign (obligations)	16%	(5)
Support better collection of WEEE	16%	(5)
Support collaboration and knowledge exchange	16%	(5)
Other	16%	(5)
Further support R&D	13%	(4)
Support a market for secondary materials	13%	(4)
Improve policy coherence	13%	(4)
Address inconsistencies in waste legislation	13%	(4)
Increase the speed and ambition of policy changes	10%	(3)
Facilitate movement across borders	10%	(3)
Create EU standards/labels	10%	(3)
Improve green public procurement (GPP)	10%	(3)
Reduce distance between SMEs and policymaking at EU level	10%	(3)
Promote international standardisation & policy coherence	6%	(2)
Address illegal exports of e-waste	6%	(2)

Table 39: EEE policy gaps and suggestions (% of firms (number)), N=31

4.1.2 Discussion

Several messages can be drawn based on the interviews with the 31 companies in the EEE sector and lessons from the CIRC4Life project. Increased financial support for circular activities and businesses was the suggestion provided by most of the companies interviewed, even though finance and economic factors were only the fourth most commonly mentioned category of barriers. This could reflect increased financial support possibly helping to alleviate issues in other areas. For example, barriers in other categories may entail additional costs or resources that may be easier to handle with increased financial support. Financial incentives could also help improve the business case for CEBMs overall, and could assist existing circular businesses and incentivise both new ones and linear companies to move towards circularity. Several options are available, such as dedicated project funding and economy-wide solutions like tax incentives, which were proposed by some of the companies interviewed. The importance of project funding for developing and piloting circular solutions was shown in CIRC4Life, where more circular production, efforts to promote sustainable consumption and recycling were all demonstrated. Nevertheless, not all companies may be able to access these funding sources and further support for scaling up such solutions could be useful to promote the circular economy. As such, other economic incentives may be needed.

Beyond economic incentives, several companies interviewed also wished for further policy support for circular business models and activities. Such policy support could take various forms, from obligations to incentives and efforts to increase demand. For example, targets for circular public procurement could help create a larger market for circular solutions and ensure demand for them. In terms of obligations, these could help address a variety of barriers. For example, the 'right to repair' initiative that is part of the EU circular action plan might help support various circular activities. Requirements on recycled content would be another approach that could help support especially the recycling of materials. Yet these are only a few of the measures that could be effective in supporting the circular economy. Revision of existing legislation also comes into play in this regard, such as the WEEE Directive and Ecodesign Directive, the former of which was identified as a barrier among the companies interviewed.

Most of the companies interviewed experienced supply chain barriers. Difficulties in accessing products, components or materials, restricted company loops and lack of transparency were the most common ones mentioned. As such, policy efforts to improve these aspects could be helpful in supporting circular business models. Encouraging transparency across supply chains could be one important avenue for policymakers. Depending on implementation, it could provide valuable information to consumers and actors in the value chain, such as those engaged in repairs, refurbishment and recycling. The information could also potentially be utilised to verify sustainability claims or provide other types of information about products. Indeed, in the EU's circular economy action plan, a European data space for smart circular applications is envisaged, which may provide an "architecture and governance system to drive applications and services such as product passports, resource mapping and consumer information" (European Commission, 2020b, p. 21). Still, for traceability solutions to work well, having all actors in the value chain onboard and sharing information is important, including manufacturers and suppliers of primary materials. These were not part of the CIRC4Life project and as such traceability of information regarding EEE across the supply chain was only partially demonstrated.

Related to a need for enhanced transparency, providing reliable information to consumers remains important. In this regard, labels or standards at the EU level may be most effective. Various consumer surveys that took place during the CIRC4Life project indicated that labels can increase consumer confidence in circular processes, while consumers appeared to put more trust in labels with the EU logo (see Michelena & Ledroit, 2019). While labels were developed and tested in CIRC4Life, it became clear that these would be most effective if implemented across similar products and at a larger scale. This would enable consumers to more easily differentiate between similar products and compare their sustainability information. Adoption on a larger scale could also help people become familiar with the information displayed and could thus require less effort on the side of the consumer in a longer-term perspective. For companies, one EU-wide scheme could also be advantageous over different national or regional ones, as it could simplify the systems and standards they would need to adapt to.

4.2 Agri-food sector

4.2.1 Policy effectiveness and gaps

In the agri-food sector, around half of the interviewees had a generally positive view regarding the effectiveness of the current policies in place to support circularity in the sector. Two key factors were brought up as the reasons for this positive view. The first related to the product ecolabels and especially the EU-wide ones that, according to some interviewees, have improved consumers' perceptions of the reliability of their products. The other key factor concerned the Covid-19 recovery process and the policy momentum around both the pandemic and the climate crisis, which are creating a favourable environment for investments in circularity and

sustainability. The remaining companies were either negative towards the existing policies or had an indifferent view. An issue raised was that the speed of adoption of policies is often slow and not consistent with the speed of innovation in the sector. Another was that existing policies do not support re-utilisation of food waste sources in the sector, while the Novel Food Regulation (EU) 2015/228 was identified as a piece of legislation that has not been implemented consistently across the EU.

A variety of different policy gaps were pinpointed and proposals made by the companies. Three key ideas brought forward by two companies each (see Table 40) were to "incentivise sustainable agriculture and food production", "support increased standardisation or certifications" and "increase financial support for circular activities/companies". With regard to the first action point, there was a view that in general policymakers should identify policy tools that take into account the full negative impacts of agri-food companies' business models and encourage them to produce in a more sustainable way. A specific example raised during the interviews of a policy tool that could encourage more sustainable production was a carbon tax, which would ensure that companies and consumers pay for the external costs of food production. Concerning the second suggestion on standardisation, one company argued that companies should report the environmental impact of their products in a more standardised way. As showcased during the CIRC4Life project implementation, tools to account for the environmental impacts of products across their full lifecycle stage already exist but in the absence of a standardised way to report this information consumers can get confused. It was also noted that there is currently a gap related to the lack of an official and independent system to guarantee the reliability of food producers' green declarations. Finally, in relation to the third proposal on financial support, companies mentioned the need for incentives to support investments in low-carbon technologies as well as subsidies for cultivating organic vegetables and fruits.

Moreover, there were 11 additional policy gaps and suggestions brought up by the companies, each of which was only mentioned once but which convey notable points. One interviewee raised the need to identify mechanisms to better engage small companies in EU public stakeholder consultation processes and EU policymaking in general, while another proposed improving coherence across different policy domains such as those on health, agriculture and food. In another case it was put forward that local authorities of different member states need to better collaborate so as to help countries where CEBMs are currently being developed to learn from countries where they are already well-established. One interviewee noted that policies that incentivise instead of prohibit the utilisation of food waste and agricultural by-products as raw material for different uses are required. It is worth noting that during the CIRC4Life it has not been possible to use collected meat waste for other uses beyond anaerobic digestion due to the legal rules in place. Another company held that there is a need for specific legislation for the use of black soldier fly frass as fertiliser, to be applied consistently across the EU member states. A further case elicited the view that more education/awareness campaigns, especially targeted at public administrations, are required. One interviewee noted that the pieces of legislation on the use of food waste and agricultural by-products should be reviewed and updated more frequently. In one case it was stated that excessive bureaucracy – which is a big burden for small companies like organic farms – should be avoided. Improving the use of GPP across the EU, increasing the number and quality of audits for the food industry and increasing stakeholder engagement in the process of developing new rules for using of food waste and agricultural by-products were three other suggestions aired.

Policy gaps and suggestions	Firms	
Incentivise sustainable agriculture and food production	25%	(2)
Support increased standardisation or certifications	25%	(2)
Increase financial support for circular activities/companies	25%	(2)

Reduce distance between SMEs and policymaking at EU level	13%	(1)
Improve policy coherence	13%	(1)
Support collaboration and knowledge exchange	13%	(1)
Incentivise productive use of food waste	13%	(1)
Need for specific EU legislation	13%	(1)
Awareness raising	13%	(1)
Review legislation more frequently	13%	(1)
Avoid undue burden or negative consequences from regulation	13%	(1)
Improve GPP	13%	(1)
Increase number and quality of audits	13%	(1)
Increase stakeholder engagement in policymaking	13%	(1)

Table 40: Agri-food policy gaps and suggestions (% of firms (number)), N=8[50]

4.2.2 Discussion

Based on the analysis of company case studies several key barriers and enablers to implementation of CEBMs in the agri-food sector can be identified. Although the sample size is relatively small, the interviews enable us to capture useful insights about the factors influencing adoption of circularity practices by companies in the sector and identify areas where there are policy gaps as well as how they could be addressed through concrete actions.

Finance and economic factors alongside policy and regulation were the most frequently mentioned categories of barriers in the sample. With regard to the former category, it appears that various companies face hurdles stemming from the higher costs entailed by more sustainable or circular approaches, while others have difficulties accessing the investment funds required for new circular innovations. Competition with the largest agri-food companies that have well-established production models and face lower production costs is a related challenge faced by small companies attempting to establish a circular process. This implies that despite the existence of several funding instruments across the EU, there is still large scope for introducing forms of financial support to support companies, and especially small ones, in making the transition to a CEBM and competing with other companies in the sector implementing more traditional models.

Concerning the policy category of barriers, a key factor was bureaucracy and administration, in particular the specific requirements for using leftovers from agri-food production as by-products or in another case the procedures for receiving subsidies for the production of organic food. In other cases, specific barriers stemming from national legislation were raised, such as laws prohibiting the sale of biofuels to other farmers or rules not allowing the use of food waste or agricultural production residues in by-product creation applications. This indicates that in many cases the goals of different pieces of legislation on food production and consumption may not be consistent with circularity objectives.

Supply chain and consumer/societal awareness were the two other most frequently categories of barriers. From a supply chain perspective, an important constraint experienced by the sampled SMEs is the difficulty of establishing partnerships with other organisations in order to fully roll out their CEBMs. This shows that effective implementation of a CEBM in the agri-food sector is often contingent upon the involvement of

[50] Note that not all firms provided input to this question, and as such the percentage is calculated as a share of the total that answered the question. Multiple categories may be counted for each firm; thus the total does not add up to 100%.

different supply chain actors, which can be sceptical towards a new circular solution coming from an SME with low bargaining power or a small established business network. On consumer/societal awareness, there is still a consumer segment that is not interested in agri-food products produced through more circular approaches. Reasons for this include a preference for products they were already familiar with, the cost of more sustainable products and lack of trust regarding the environmental benefits of these products. The CIRC4Life project has shown that the latter can often be attributed to the consumer's difficulty in understanding how the environmental impacts of products are calculated via lifecycle assessment tools.

Barriers can also stem from technological factors and company organisation as shown in the sample. Challenges of technological nature were particularly encountered in the CIRC4Life project. It was observed that although digital solutions like traceability tools and QR codes providing information about the environmental impacts of products can be developed and in some cases are already available, their application across all actors in the supply chain is not easy. Large (e.g. supermarkets) and small actors (e.g. farms producing organic vegetables and fruits) may have different technical capacities and their needs should be taken into account at the early stages of development of such solutions; otherwise, there may be imbalances across supply chains or even exclusion of small actors from some circular solutions. From a company organisation perspective, the project illustrated that particularly for small companies, lack of technical know-how and small internal capacities can contribute to limited engagement in circular solutions or even in initiative with financial resources available, such as CIRC4Life.

The study furthermore provides evidence on critical factors that can support the transition to a CEBM (i.e. enablers). Policy appeared to be the most important barrier in terms of frequency of mention in the sample; however, this is largely attributed to the different forms of EU or national financial support raised by interviewees such as funding for R&I projects and subsidies for more environmentally-friendly production. In conjunction with the financial constraints appearing to be a major barrier in the sector as discussed earlier, our findings underline the crucial role that access to finance through support programmes and incentives can play in motivating companies to transition to a new model. EU-wide ecolabels were perceived to have a positive influence on consumers' trust in these products. High-level strategies such as the EU Green Deal were also identified as enablers by some companies, especially for communication purposes. Consumer/societal awareness also appeared to be a fundamental enabler in the sample with many interviewees observing a positive change in the demands of both their business-to-business customers and final business-to-consumer consumers. This indicates that there is a divide between the preferences of consumers, since the low interest of a consumer segment in more sustainable products and services is also a barrier as noted above. Notably, the CIRC4Life project has demonstrated that the use of labels enabling consumers to compare the environmental impacts of different products can have a positive influence on consumer demand for these products provided that these impacts can be well-understood (as discussed earlier).

Interviewees furthermore raised economic factors as enablers. These included competitiveness advantages from entering a new market for circular approaches, opportunities for diversifying the business activities and identifying new sources of income and economic benefits through utilising food waste or unused organic matter. Company organisation was also seen as an enabler by various companies with interviewees emphasising the significance of having internal commitment towards circularity objectives as well as motivated owners and employees. Technology and supply chains were the two other enabler categories raised in the sample. With regard to the former, it appears that innovations in areas such as food processing and technologies enabling utilisation of by-products from agri-food production can encourage companies to consider the adoption of a CEBM. The use of technical tools as part of CIRC4Life, for instance traceability modules and LCA tools, also helped participating companies to better trace the carbon footprints of their products. Under the supply chain category, key enabling factors were the establishment of partnerships and

forms of industrial symbiosis where waste and by-products from some companies became a useful resource for others.

4.3 Conclusions and policy recommendations

Based on the insights gathered, four key policy recommendations emerge that are applicable for both the EEE and agri-food sectors.

R1. Increase the use of different forms of financial support for circular activities and businesses. The higher costs of more circular approaches as well the lack of access to financial resources for such innovations emerged as prominent barriers in the samples for both the agri-food and EEE sectors. In addition, the need to increase financial support for circularity was highlighted by companies from both sectors. This indicates that despite the array of instruments at the EU and national levels in place to provide support for circular activities, significant barriers of a financial nature persist. Various other studies[51] have identified lack of financial support as a barrier to the circular economy transition and our findings reiterate this conclusion. Forms of financial support that can be further utilised include tax incentives, increased use of GPP and R&I funds. With regard to the latter, EU and national programmes financially supporting circular innovations and projects like CIRC4Life was an important enabler identified, illustrating the effect of such instruments.

R2. Better align requirements stemming from different pieces of legislation with an impact on circularity. In both the EEE and agri-food sectors it was observed that requirements stemming from different policies, often from diverse policy domains, frequently may not support circularity goals. Specifically, various companies mentioned challenges in recovering and recycling materials from assorted types of EEE equipment due to the strict rules and administrative requirements emanating from EU chemicals legislation. In the agri-food sector, it was reported that using leftovers from agri-food production in by-product applications is very restricted due to the EU or national laws in place prioritising food safety. These findings indicate that effort should be made to identify these policy conflicts and trade-offs, as well better align the goals of different pieces of legislation that have an impact on circularity.

R3. Improve consumers' understanding of the benefits of circular solutions. Although companies identified a positive consumer trend towards circular solutions as an important enabler, there is still a consumer segment that is not interested or does not trust them. The CIRC4Life project has demonstrated that although there are already some solutions in the market, consumers have difficulties in understanding how their environmental impacts are assessed (e.g. through LCAs), which may have an effect on their trust. This suggests that awareness-raising measures, communicating in easy-to-understand language the environmental benefits of such solutions and how these are calculated, can have a positive impact on demand. As shown in the CIRC4Life demonstrations, product labels can also serve as a reliable source of information about the environmental impact of products and increase consumers' motivation to choose those produced through more circular processes.

R4. Support transparency and traceability across the supply chain through solutions involving all actors. A lack of transparency and traceability regarding products and their associated environmental impacts,

[51] See for example, Rizos et al. (2016), Kirchherr et al. (2018) and Salmenpera et al. (2021).

components and substances was a barrier in our study for companies operating a variety of CEBMs.[52] The European Commission envisaged in its 2020 circular economy action plan the development of a digital product passport to address this challenge, indicating that improving transparency across supply chains is a priority area. One notable lesson from CIRC4Life is that while traceability tools and solutions already exist, all actors would need to be involved – from suppliers of primary materials, to producers and recyclers – for such solutions to roll out. Otherwise, there could be missing data at different points of sale preventing the achievement of full traceability. Another lesson from a technical point of view is that such solutions would need to be designed in a way that all actors across supply chains could adopt them, including small companies that do not have large capacities or the technical know-how.

[52] Lack of transparency across supply chains has been identified by various other authors such as Vanner at al. (2014), Rizos et al. (2018) and Vermunt et al. (2019).

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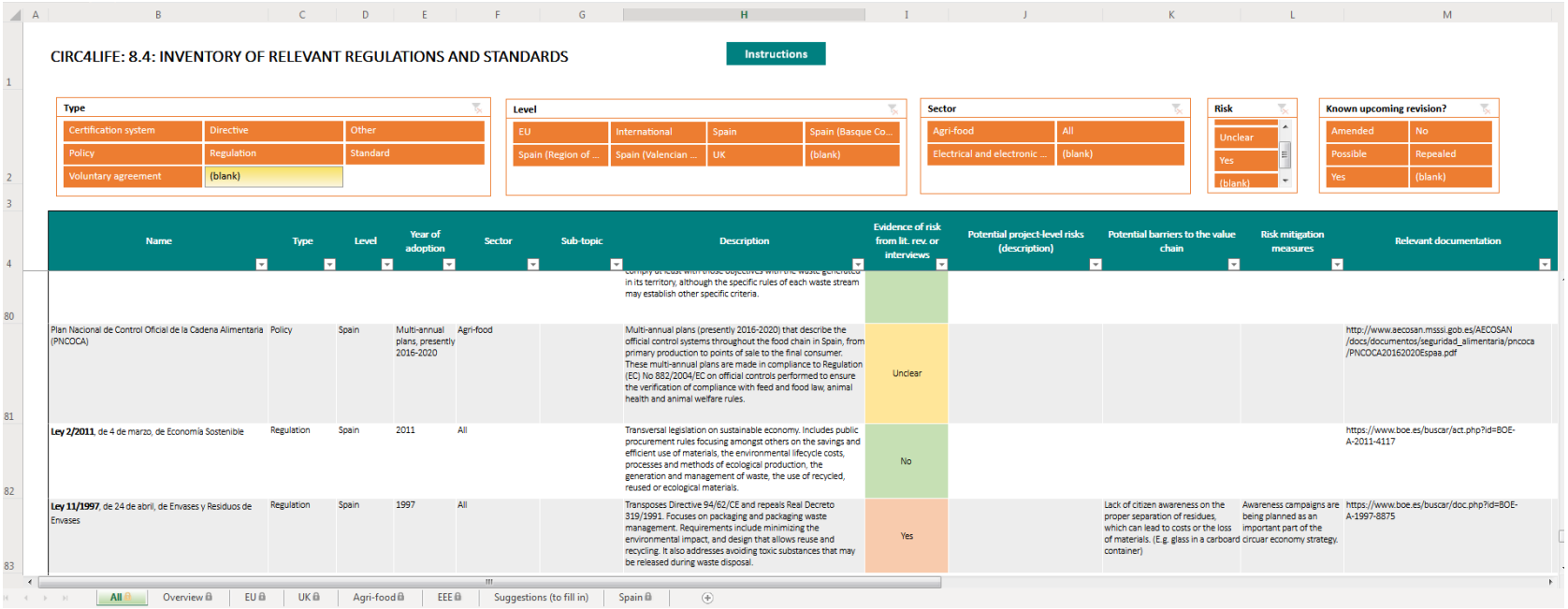
Appendices

Appendix 1: Inventory tool

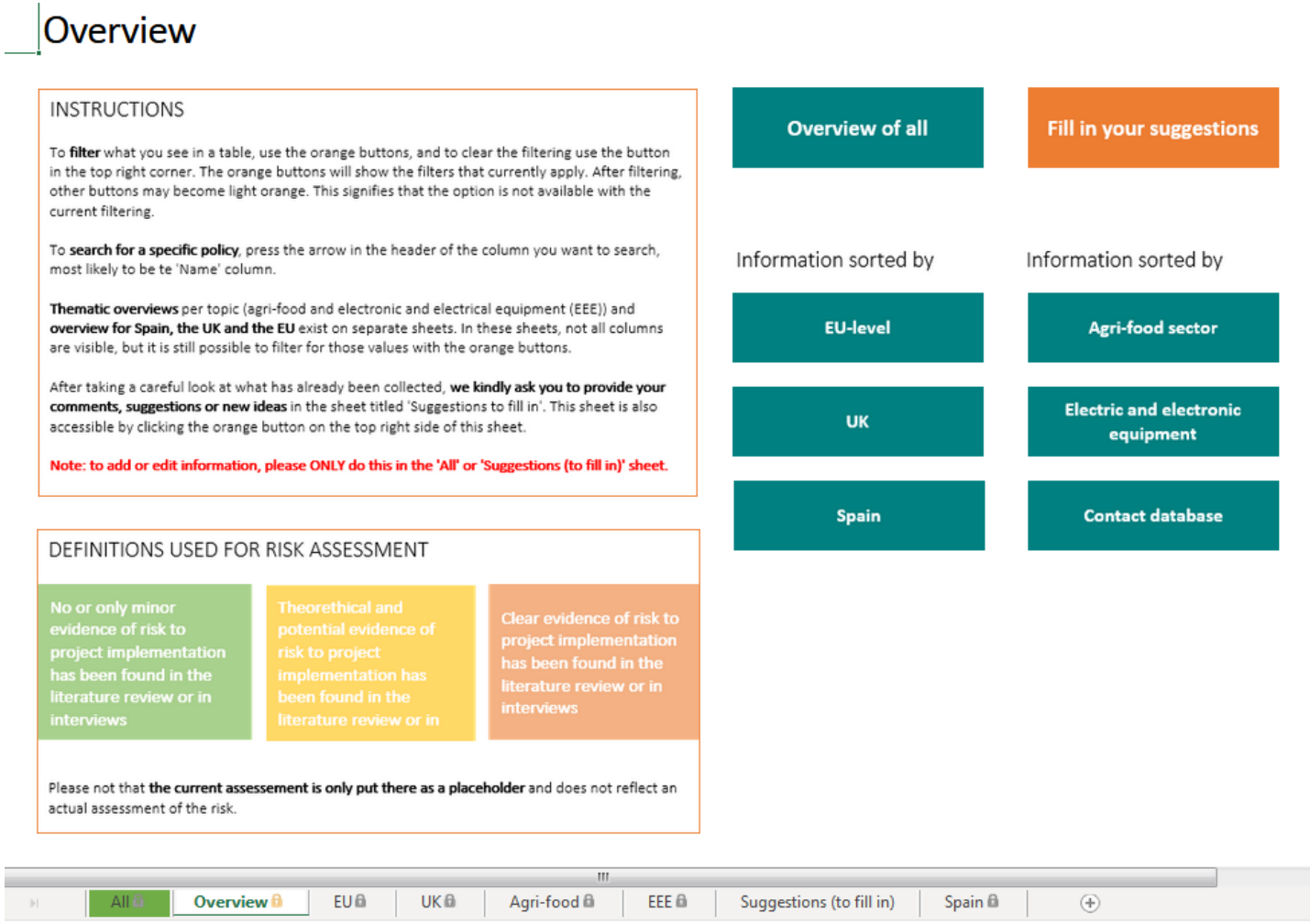
As part of the deliverable, an inventory was created in Excel, as shown below. This was shared online with the consortium, which was invited to provide suggestions and edits. All the information was gathered and structured in the 'All' tab, while further information and visualisation was presented in other tabs. All section tabs with mapped policies and regulations included filtering options.

Figure 14: Inventory tool – 'all' tab



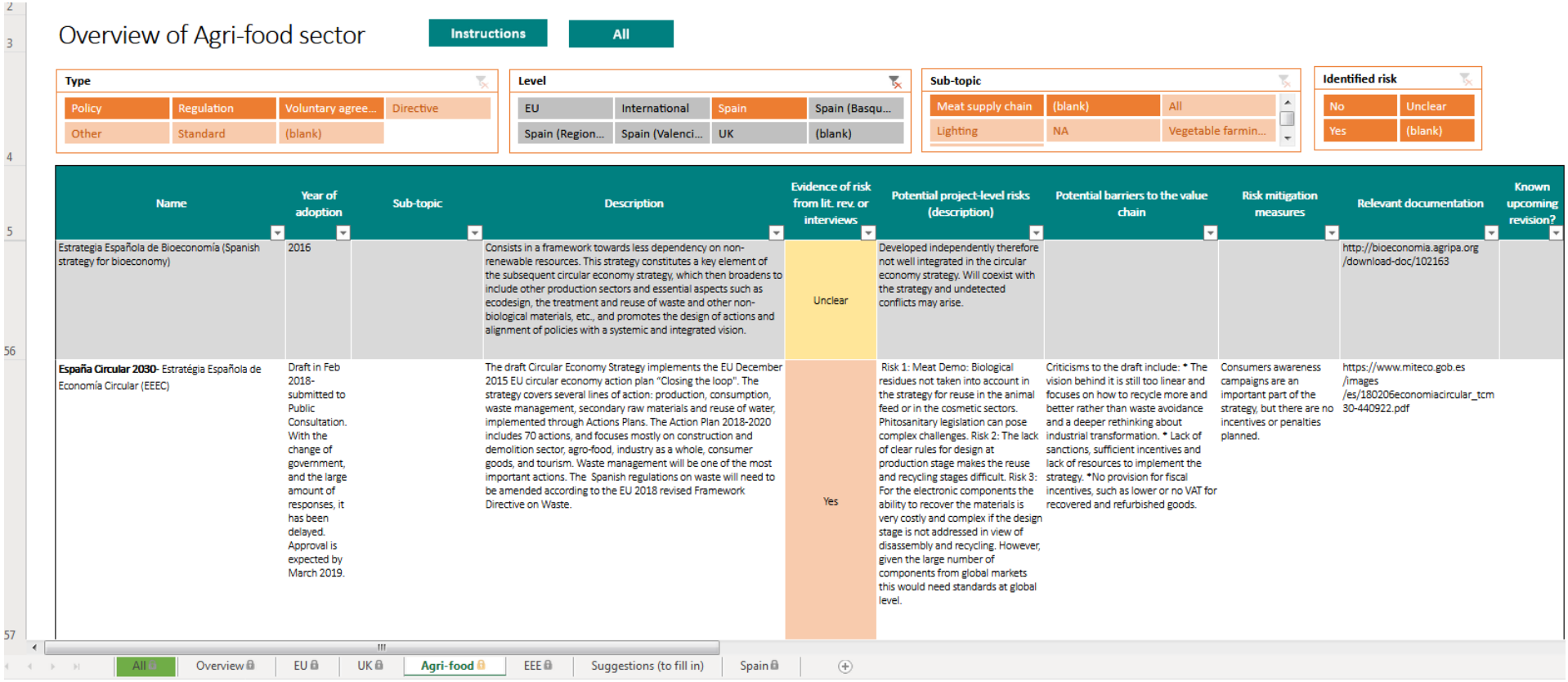
An overview tab was created to assist users of the tool and encourage project members to contribute to and utilise it.

Figure 15: Inventory tool – 'overview' tab



The content was further structured into overarching sectors, as well as the EU level, Spain and UK, to further facilitate visualisation of the content.

Figure 16: Inventory tool – example of thematic section with filtering



Appendix 2: Full overview of identified policies and legislation[53]

Table 41: EU policies and legislation

Sector	Type	Name	Description
All	Directive	Directive on Copyright in the Digital Single Market, COM(2016) 593 final – 2016/0280 (COD)	Proposal for a directive on copyright in the Digital Single Market. The draft allows for exceptions to the rights provided for in Article 2 of Directive 2001/29/EC, Articles 5(a) and 7(1) of Directive 96/9/EC and Article 11(1) of this Directive for reproductions and extractions made by research organisations in order to carry out text and data mining of works or other subject matter to which they have lawful access for the purposes of scientific research. This also applies to public-private partnerships. The exceptions would also trump any contractual provisions.
	Directive	Directive 2004/12/EC of the European Parliament and of the Council of 11 February 2004 amending Directive 94/62/EC on packaging and packaging waste	Amendments made to Directive 94/62/EC, particularly adding language on recovery and recycling, among others.
	Directive	Copyright Directive 2001/29/EC	Harmonises several exclusive rights and exceptions to copyright.
	Directive	Directive 94/62/EC of 20 December 1994 on packaging and packaging waste	Provides for measures aimed at limiting the production of packaging waste and promoting recycling, reuse and other forms of waste recovery. Final disposal should be considered a last-resort solution.
	Policy	EU action plan for the circular economy, 2015	Published as part of the circular economy package (see below), the action plan includes a series of actions to be carried out by the Commission centred on different thematic areas. In particular, it features actions targeted at all stages of the product's lifecycle as well as at five priority sectors that were selected due to their specific value chains, products, environmental footprint or importance for reducing the EU dependency on raw materials: plastics, food waste, critical raw materials, construction and demolition, biomass and bio-based products.
	Policy	Zero waste programme for Europe, 2014	Strategic communication that came alongside the first circular economy package published in July 2014. The communication included a proposal for new targets for waste reduction but also some more ambitious elements, such as a voluntary resource-efficiency target. The package was withdrawn in 2015 by the Juncker Commission and replaced by a new package published in December 2015. This communication on the zero waste programme for Europe was essentially replaced by the circular economy action plan.
	Policy	Life cycle assessment Recommendation, 2013	Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the lifecycle environmental performance of products and organisations, OJ L 124/56, 4.5.2013.

[53] Note that the research for Appendix 2was carried out between September and December 2018, prior to the project's extension in light of Covid-19.

	Policy	"A resource-efficient Europe – Flagship initiative", 2011	The flagship initiative for a "resource-efficient Europe" supports the shift towards a resource-efficient, low carbon economy and provides a long-term framework for actions in policy areas such as climate change, energy, transport, industry, raw materials, agriculture, fisheries, biodiversity and regional development. One of the central proposals under this initiative is the "Roadmap to a Resource Efficient Europe", which aims to transform the EU economy into a sustainable one by 2050. The roadmap identifies the economic sectors that consume the most resources, and suggests tools and indicators to improve resource efficiency.
	Policy	Europe 2020 strategy	In 2010, the EU launched its Europe 2020 strategy to put the EU economy on a sustainable trajectory. The transformational changes proposed in the strategy are underpinned by five headline targets and three priority themes, namely smart growth, sustainable growth and inclusive growth. The themes are supported by seven 'flagship initiatives' that give the framework conditions for action to be taken at both the member state and EU level in support of the Europe 2020 objectives. The seven initiatives are the following: "Resource-efficient Europe", "An industrial policy for the globalisation era", "An agenda for new skills and jobs", "European platform against poverty", "Innovation Union", "Youth on the move" and "A digital agenda for Europe".
	Policy	Thematic Strategy on the sustainable use of natural resources, 2005	Thematic strategy on the sustainable use of natural resources {SEC(2005) 1683} {SEC(2005) 1684}/COM(2005) 0670 final, communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions.
	Policy	Monitoring framework on progress towards a circular economy at EU and national level	This is composed of a set of 10 key indicators that cover each phase – i.e. production, consumption, waste management and secondary raw materials – as well as economic aspects. The 10 indicators are grouped according to the 4 stages of the circular economy: production and consumption, waste management, secondary raw materials and competitiveness and innovation. It shows progress towards a circular economy in the EU and its member states.
	Regulation	General Data Protection Regulation (EU) 2016/679	Provisions on the processing of personal data for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.
	Directive	Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives	This directive establishes the legislative framework for the handling of waste. It defines important concepts such as waste, recovery and disposal, and puts in place the essential requirements for the management of waste, notably an obligation for an establishment or undertaking carrying out waste management. It also establishes major principles like an obligation to handle waste in a way that does not have a negative impact on the environment or human health. The directive encourages application of the waste hierarchy (prevention, preparing for reuse, recycling, other recovery, disposal) and, in accordance with the polluter-pays principle, a requirement that the costs of disposing of waste must be borne by the holder of waste, by previous holders or by the producers of the product from which the waste came.
	Policy	EU strategy for plastics in a circular economy, 2018	In the EU action plan for the circular economy, plastics are considered one of the five priority areas to be addressed. In January 2018, the European Commission published a strategy for plastics, including a series of actions aimed at, inter alia, improving the economies and quality of plastics recycling. The actions are listed in annex I of the strategy.
	Policy	Communication on options to address the interface between chemical, product and waste legislation, 2018	This communication assesses how the rules on waste, products and chemicals relate to each other.

	Policy	The Eco-innovation Action Plan (Eco-AP), 2011	This strategic policy document aims to catalyse progress towards the transformation of innovative ideas into products and services that help generate growth and tackle the EU's critical societal challenges. It includes a set of targeted actions and measures. The actions are the following: "[u]se environmental policy and regulation for promoting eco-innovation"; "[s]upport demonstration projects and partnerships for eco innovation"; "[d]evelop new standards boosting eco-innovation"; "[m]obilise financial instruments and support services for SMEs"; "[p]romote international cooperation"; "[s]upport the development of emerging skills and jobs"; and "[p]romote eco-innovation though European Innovation Partnerships". Most of these actions have been completed by now.
	Policy	"A resource-efficient Europe – Flagship initiative", 2011	The flagship initiative for a "resource-efficient Europe" supports the shift towards a resource-efficient, low carbon economy and provides a long-term framework for actions in policy areas such as climate change, energy, transport, industry, raw materials, agriculture, fisheries, biodiversity and regional development. One of the main proposals under this initiative is the "Roadmap to a Resource Efficient Europe", which aims to transform the EU economy into a sustainable one by 2050. The roadmap identifies the economic sectors that consume the most resources, and suggests tools and indicators to improve resource efficiency.
	Policy	Strategy for corporate social responsibility, 2011	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – a renewed EU strategy 2011-14 for corporate social responsibility.
	Policy	Thematic Strategy on the prevention and recycling of waste, 2005	Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Taking sustainable use of resources forward – a thematic strategy on the prevention and recycling of waste {SEC(2005) 1681} {SEC(2005) 1682}/COM(2005) 666 final.
	Policy	Integrated product policy, 2003	Communication from the Commission to the Council and the European Parliament, Integrated product policy: Building on environmental life-cycle thinking, COM(2003) 302 final, Brussels, 18.6.2003.
	Policy	Innovation Union initiative	This is one of the seven initiatives of the Europe 2020 strategy. The major objective of the Innovation Union flagship initiative is to facilitate the transformation of innovative ideas into products and services that help generate growth and tackle the EU's critical societal challenges. There is a link with the EU Eco-innovation Action Plan, which aims to ensure that efforts to improve the market penetration of environmental industries extend beyond exploring the possibilities of technology and address all aspects of eco-innovation.
Agri-food	Directive	Proposal for a Directive of the European Parliament and of the Council on unfair trading practices in business-to-business relationships in the food supply chain	The Commission proposal aims to improve the role of farmers in the wider food supply chain by banning some of the most common unfair trading practices that they face. These include late payments for perishable food products, last-minute order cancellations and unilateral or retroactive changes to contracts. In addition, the European Commission proposes that each EU member state designate a competent authority to enforce the new rules, and sets out the minimum enforcement powers of such authorities.
	Directive	Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste (Text with EEA relevance)	This directive prioritises human use over animal feed and reprocessing into non-food products. Plant-based substances from the agri-food industry and food of non-animal origin no longer intended for human consumption which are destined for oral animal feeding should, in order to avoid duplication of rules, be excluded from the scope of Directive 2008/98/EC if in full compliance with Union feed legislation. Directive 2008/98/EC should therefore not apply to those products and substances when used for feed, and the scope of that Directive needs to be clarified accordingly. Without prejudice to other Union provisions applicable in the field of animal nutrition, animal by-products destined to be used as feed materials in accordance with Regulation (EC) No 767/2009 of the European Parliament and of the Council are already excluded from the scope of Directive 2008/98/EC to the extent that they are covered by other Union legislation.

	Directive	Nitrates Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)	The directive aims to protect water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices. The Nitrates Directive forms an integral part of the Water Framework Directive and is one of the key instruments in the protection of waters against agricultural pressures.
	Directive	Council Directive 64/432/EEC of 26 June 1964 on animal health problems affecting intra-Community trade in bovine animals and swine	This directive sets out rules for trade within the EU of bovine animals or swine for breeding, milk or meat production, slaughter or exhibition. Repealed by Regulation (EU) 2016/429 as of 21 April 2021.
	Other	Commission Notice – Guidelines for the feed use of food no longer intended for human consumption C/2018/2035	The objective of these guidelines is to facilitate the feed use of certain food no longer intended for human consumption, with and without products of animal origin.
	Other	2001/25/EC: Commission Decision of 27 December 2000 prohibiting the use of certain animal by-products in animal feed (Text with EEA relevance) (notified under document number C(2000) 4143)	This decision prohibits animal waste from all bovine animals, pigs, goats, sheep, solipeds, poultry, farmed fish and all other animals kept for agricultural production which have died on the farm but have not been slaughtered for human consumption, including stillborn and unborn animals to be used for the production of feed for farmed animals.
	Policy	Common agricultural policy (CAP)	The CAP is the overall policy for the EU. It shifted from market support to producer support in 1992, and was reformed in 2013 to strengthen the competitiveness of the sector, promote sustainable farming and innovation, support jobs and growth in rural areas and move financial assistance towards the productive use of land. The majority of the CAP budget is oriented towards the support of conventional (non-organic) farming. With the proposed revisions, a new system of so-called eco-schemes, funded from national direct payment allocations, will be mandatory for member states, although farmers will not be obliged to join them. This could provide an opportunity.
	Regulation	Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007	This regulation establishes the principles of organic production and lays down the rules concerning organic production, related certification and the use of indications referring to organic production in labelling and advertising, as well as rules on controls additional to those laid down in Regulation (EU) 2017/625.
	Regulation	Commission Regulation (EU) 2017/172 of 1 February 2017 amending Regulation (EU) No 142/2011 as regards parameters for the transformation of animal by-products into biogas or compost, conditions for imports of petfood and for the export of processed manure	Amendments made to Regulation (EU) No 142/2011 regarding biogas and pet foods.
	Regulation	Regulation (EU) 2016/429 'Animal Health Law'	Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 deals with transmissible animal diseases and amends and repeals certain acts in the area of animal health.
	Regulation	Commission Regulation (EU) 2015/1905 of 22 October 2015 amending Annex II to Regulation (EC) No 183/2005 of the European Parliament and of the Council as regards the dioxin testing of oils, fats and products derived thereof	This regulation concerns the feeding of animals.
	Regulation	Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005	This regulation sets out how the European Agricultural Fund for Rural Development (EAFRD) aims to develop the agricultural sector over the 2014-20 period to be more geographically and environmentally balanced and climate-friendly, resilient, competitive and innovative. It lays down the rules governing the EU's support for rural development funded by the EAFRD, and explains the EAFRD's objectives and how it works.

	Regulation	Regulation (EU) No 1308/2013 of the European Parliament and of the Council of 17 December 2013 establishing a common organisation of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007	Aiming to provide a safety net to agricultural markets, this regulation concerns the use of market support tools (for example public intervention and private storage), exceptional measures and aid to specific sectors (particularly fruit and vegetables, and wine). It seeks to encourage cooperation through producer organisations and inter-branch organisations (organisations that represent activities involving the production, trade in and/or processing of products in a number of sectors). It also lays down minimum quality requirements (marketing standards) for a number of products, as well as rules on trade in agricultural products and specific rules on competition.
	Regulation	Regulation (EU) No 1307/2013 of the European Parliament and of the Council of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009	The rules for direct payments made to support farmers under the EU's CAP are set out in this regulation. These payments are made on the condition that farmers meet strict rules on the health and welfare of people and animals, plant health and the environment — known as cross-compliance.
	Regulation	Regulation (EU) No 1306/2013 of the European Parliament and of the Council of 17 December 2013 on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008	This regulation includes rules for cross-compliance, a system which requires farmers to meet standards on things like the environment, public health and animal welfare in return for support payments. It requires EU countries to set up a farm advisory system to help farmers understand, in particular, the CAP's cross-compliance and greening obligations. It allows the Commission to suspend payments to EU countries if serious deficiencies in their national inspection systems are detected. Where farmers do not comply with eligibility conditions or other obligations, their aid can be withdrawn (if unduly paid) and penalties imposed. It permits the names of CAP fund recipients to be published, to discourage irregular behaviour, sets up a monitoring and evaluation framework to measure the CAP's performance and sets up a reserve to support the farming sector in the event of major crises affecting production or distribution.
	Regulation	Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers	For health protection, this regulation ensures that consumers have appropriate information to make informed choices on the food they buy and eat. It sets out requirements for expiration-date labelling, with exceptions for unprocessed fruit and vegetables. It also sets out limits for information provided to the consumer.
	Regulation	Commission Regulation (EU) No 142/2011 of February 2011 implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption and implementing Council Directive 97/78/EC as regards certain samples and items exempt from veterinary checks at the border under that Directive	This regulation lays down implementing measures: (a) for the public and animal health rules for animal by-products and derived products laid down in Regulation (EC) No 1069/2009; and (b) concerning certain samples and items exempt from veterinary checks at border inspection posts as provided for in Article 16(1)(e) and (f) of Directive 97/78/EC.

	Regulation	Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal By-products Regulation)	The regulation specifies the operating conditions required for rendering animal by-products not intended for human consumption. It lays down the health and oversight rules applicable to (among others) the collection, transport, storage, handling, processing and use or disposal of animal by-products. It incorporates a classification of animal by-products: categories (1, 2 and 3). The regulation determines the circumstances under which animal by-products are to be disposed of, in order to prevent the spreading of risks for public and animal health. In addition, the regulation specifies under which conditions animal by-products may be used for applications in animal feed and for various purposes, such as in cosmetics, medicinal products and technical applications. It also lays down obligations for operators to handle animal by-products within establishments and plants which are subject to official controls.
	Regulation	Regulation (EC) No 767/2009 of the European Parliament and of the Council of 13 July 2009 on the placing on the market and use of feed, amending European Parliament and Council Regulation (EC) No 1831/2003 and repealing Council Directive 79/373/EEC, Commission Directive 80/511/EEC, Council Directives 82/471/EEC, 83/228/EEC, 93/74/EEC, 93/113/EC and 96/25/EC and Commission Decision 2004/217/EC (Text with EEA relevance)	This regulation lays down rules for placing on the market and use of feed for both food-producing and non-food producing animals within the Community, including requirements for labelling, packaging and presentation.
	Regulation	Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control	Foods may be labelled 'organic' only if at least 95% of their agricultural ingredients meet the necessary standards. In non-organic foods, any ingredients which meet organic standards can be listed as organic. To ensure credibility, the code number of the certifying organisation must be provided. Since 1 July 2010, producers of packaged organic food have been required under EU law to use the EU organic logo.
	Regulation	Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092	This regulation pertains to organic farms/ecological agriculture.
	Regulation	Commission Regulation (EC) No 1141/2007 of 1 October 2007 concerning the authorisation of 3-phytase (ROVABIO PHY AP and ROVABIO PHY LC) as feed additive	This regulation concerns the feeding of animals; it authorises the mentioned substance as an additive.
	Regulation	Regulation (EC) No 2073/2005 of the European Commission of 15 November 2005 on microbiological criteria for foodstuffs	This regulation lays down the microbiological criteria for certain micro-organisms and the rules to be complied with by food business operators when implementing the general and specific hygiene measures referred to in Article 4 of Regulation (EC) No 852/2004.
	Regulation	Regulation (EC) No 183/2005 of the European Parliament and of the Council of 12 January 2005 laying down requirements for feed hygiene (Text with EEA relevance)	Laying down general rules on feed hygiene, this regulation sets out requirements and arrangements to ensure that processing conditions to minimise and control potential hazards are respected. It also provides that feed business establishments are to be registered with or approved by the competent authority. In addition, feed business operators lower down the feed chain are required to source feed only from registered or approved establishments.

	Regulation	Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC (Text with EEA relevance)	This regulation establishes, in accordance with the general principles laid down in Regulation (EC) No 178/2002, in particular the need to ensure a high level of consumer protection and harmonised Community provisions relating to maximum levels of pesticide residues in or on food and feed of plant and animal origin.
	Regulation	Regulation (EC) No 852/2004 Of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs – common basis for the hygienic production of all food including products of animal origin	This regulation lays down specific rules on the hygiene of food of animal origin for food business operators. These rules supplement those laid down by Regulation (EC) No 852/2004. They apply to unprocessed and processed products of animal origin, the activities of feed business operators at all stages, from and including primary production of feed, up to and including, the placing of feed on the market.
	Regulation	Regulation (EC) No 853/2004 of the European Parliament and of the Council	This regulation lays down specific rules on the hygiene of food of animal origin for food business operators. These rules supplement those laid down by Regulation (EC) No /2004. They apply to unprocessed and processed products of animal origin.
	Regulation	Regulation (EC) No 854/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption	This regulation lays down specific rules for the organisation of official controls on products of animal origin.
	Regulation	Regulation (EC) No 1831/2003 of the European Parliament and of the Council of September 2003 on additives for use in animal nutrition	Establishing a Community procedure for authorising the placing on the market and use of feed additives, this regulation lays down rules for the supervision and labelling of feed additives and premixtures in order to provide the basis for the assurance of a high level of protection of human health, animal health and welfare, environment and users' and consumers' interests in relation to feed additives, while ensuring the effective functioning of the internal market.
	Regulation	Regulation (EC) No 2160/2003 of the European Parliament and of the Council of 17 November 2003 on the control of salmonella and other specified food-borne zoonotic agents	The purpose of this regulation is to ensure that proper and effective measures are taken to detect and to control salmonella and other zoonotic agents at all relevant stages of production, processing and distribution, particularly at the level of primary production, including in feed, in order to reduce their prevalence and the risk they pose to public health.
	Regulation	Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilisers	The 2003 Fertilisers Regulation has harmonised the EU mineral fertilisers market. However, it mainly addresses mineral fertilisers and deters the introduction of new types of fertilisers. In March 2016, the Commission put forward a legislative proposal on fertilising products. This proposal has two objectives: (1) to incentivise large-scale fertiliser production from domestic sources, transforming waste into nutrients for crops; and (2) to introduce harmonised cadmium limits for phosphate fertilisers. Although the proposal repeals the 2003 Regulation, its main overall principles remain unchanged.
	Regulation	Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety	This regulation establishes common principles and responsibilities, the means to provide a strong science base, efficient organisational arrangements and procedures to underpin decision-making in matters of food and feed safety. It lays down the general principles governing food and feed in general, and food and feed safety in particular, at Community and national level. Article 18 sets general principles for traceability in the food sector.

	Regulation	Directive 2002/32/EC on undesirable substances in animal feed	This directive applies to all products intended for animal feed, including raw materials for feed, additives and complementary feeding stuffs. It lays down a list of undesirable substances and specifies the limit values for which the presence of these substances in animal feeds is forbidden (Annex I). The list includes substances such as certain heavy metals (like lead and cadmium), dioxin and some pesticides. It is regularly updated in the light of scientific and technical knowledge.
	Regulation	Regulation (EC) No 999/2001 of the European Parliament and of the Council of 22 May 2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies	Rules to prevent, control and eradicate transmissible spongiform encephalopathies are specified in this regulation. It covers the production, placing on the market and, in some cases, the export of animals and animal products. Regulation does not apply to cosmetic products or medical devices, or products which are not intended for use in human food, animal feed or fertilisers, or to their starting materials or intermediate products;
	Standard	Optional quality term 'product of island farming'	The Commission presented a report to the European Parliament and to the Council, in 2014, on the case for a new term 'product of island farming'. No further developments have taken place.
	Voluntary agreement	4 per 1000	Voluntary targets are set out to increase soils by 0.04% per year, resulting in vast global carbon sequestration and improvements in soil health, structure and productivity. They are potentially a highly important climate change tool and are being widely supported across EU at grass roots and national levels.
Electrical and electronic equipment	Directive	Directive 2013/56/EU of the European Parliament and Council, of 20th of November 2013, amending Directive 2006/66/EC of the European Parliament and Council on batteries and accumulators and their waste management	This directive amends Directive 2006/66 on batteries and accumulators and their waste management and repeals Commission Decision 2009/603/EC.
	Directive	WEEE Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (Text with EEA relevance)	The objective of the directive is to promote reuse, recycling and other forms of recovery of waste electrical and electronic equipment (WEEE) in order to reduce the quantity of such waste to be disposed and to improve the environmental performance of the economic operators involved in the treatment of WEEE. The WEEE Directive sets criteria for the collection, treatment and recovery of waste electrical and electronic equipment.
	Directive	RoHS Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (Text with EEA relevance)	EU legislation restricting the use of hazardous substances in electrical and electronic equipment (EEE) and promoting the collection and recycling of such equipment. The legislation provides for the creation of collection schemes where consumers return their used waste EEE free of charge. The objective of these schemes is to increase the recycling and/or reuse of such products. The legislation also requires certain hazardous substances (heavy metals such as lead, mercury, cadmium, and hexavalent chromium and flame retardants such as polybrominated biphenyls or polybrominated diphenyl ethers) to be substituted by safer alternatives.
	Directive	Ecodesign Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products (general, voluntary)	The Ecodesign Directive was created to provide coherent rules for ecodesign across the EU. The directive itself is a 'framework directive', so its actual purpose is to lay down the general principles of ecodesign and to define conditions and criteria for setting further, specific, requirements.
	Regulation	REACH (EC) No 1907/2006	REACH seeks to protect human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances. This is done by the four processes of REACH, namely the registration, evaluation, authorisation and restriction of chemicals. REACH also aims to enhance innovation and competitiveness of the EU chemicals industry.

	Other	Commission Decision (EU) 2016/1371 establishing the ecological criteria for the award of the EU Ecolabel for personal, notebook and tablet computers (notified under document C(2016) 5010)	This decision establishes EU Ecolabel criteria for the product group personal, notebook and tablet computers.
	Regulation	Draft regulation – Ares(2018)5145935: Ecodesign requirements for light sources	This draft lays down ecodesign requirements for light sources and separate control gears pursuant to Directive 2009/125/EC of the European Parliament and of the Council and repealing Commission Regulations (EC) No 244/2009, (EC) No 245/2009 and (EU) No 1194/2012. The draft regulation aims to reduce the energy consumption of lighting products by establishing minimum efficiency requirements and other performance criteria. This will result in a decrease of CO_2 emissions and deliver financial savings for European consumers.
	Regulation	Energy efficiency – ecodesign rules for electronic displays (TVs, monitors, signage)	Laying down ecodesign requirements for electronic displays pursuant to Directive 2009/125/EC of the European Parliament and of the Council, amending Commission Regulation (EC) No 1275/2008 and repealing Commission Regulation (EC) 642/2009.
	Regulation	Ecodesign requirements for electronic displays	Commission Regulation (EU) …/… of XXX implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for electronic displays, repealing Regulation (EC) No 642/2009 with regard to ecodesign requirements for televisions and amending Regulation (EC) No 1275/2008 with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment and Regulation (EU) No 617/2013 with regard to ecodesign requirements for computers and computer servers.
	Regulation	Energy efficiency – energy labelling for electronic displays (TVs, monitors, signage)	Commission Delegated Regulation (EU) …/... supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council as regards energy labelling of electronic displays and repealing Commission Delegated Regulation (EU) No 1062/2010.
	Regulation	Regulation (EU) 2017/1369 setting a framework for energy labelling and repealing Directive 2010/30/	NA
	Regulation	Regulation (EU) No 617/2013 implementing Directive 2009/125/EC with regard to ecodesign requirements for computers and computer servers	This regulation establishes ecodesign requirements for the placing on the market of computers and computer servers.
	Regulation	Regulation (EU) No 333/2011 establishing criteria determining when certain types of scrap metal cease to be waste under Directive 2008/98/EC	This regulation establishes criteria determining when iron, steel and aluminium scrap, including aluminium alloy scrap, cease to be waste.
	Regulation	Regulation (EC) No 66/2010 on the EU Ecolabel	This voluntary method of environmental performance certification and labelling is managed by the European Commission and the national competent bodies. Under the scheme, the environmental criteria are developed for specific product groups. The scheme is intended to promote products with a reduced environmental impact during their entire lifecycle and to provide consumers with accurate, non-deceptive, science-based information on the environmental impact of products. It covers personal computers, notebooks and tablets, cosmetics, detergents, paints, shoes, furniture, paper products, toilets and tourist accommodation services.

	Regulation	Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006	The regulation lays down uniform requirements for the classification, labelling and packaging of chemical substances and mixtures according to the United Nations' Globally Harmonized System. It requires companies to classify, label and package appropriately their hazardous chemicals before placing them on the market. It does not apply to food or feeding stuffs as defined in Regulation (EC) No 178/2002 including when they are used or cosmetic products as defined in Directive 76/768/EEC.

Table 42: National level in Spain – policies and legislation

Sector	Type	Name	Description
Agri-food	Policy	Plan Nacional de Control Oficial de la Cadena Alimentaria (PNCOCA)	These multi-annual plans (presently 2021-23) describe the official control systems throughout the food chain in Spain, from primary production to points of sale to the final consumer. The multi-annual plans are made in compliance with Regulation (EU) 2017/625 on official controls performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products.
	Regulation	Orden APM/189/2018, de 20 de febrero, por la que se determina cuando los residuos de producción procedentes de la industria agroalimentaria destinados a alimentación animal, son subproductos con arreglo a la Ley 22/2011, de 28 de julio, de residuos y suelos contaminados	Linked to Law 22/2011 on waste and contaminated land, the regulation addresses the treatment of waste from the agri-food sector.
	Regulation	Real Decreto 1338/2011, de 3 de octubre, por el que se establecen distintas medidas singulares de aplicación de las disposiciones comunitarias en material de higiene de la producción y comercialización de los productos alimenticios	Linked to RD 1084/2020.
	Regulation	Real Decreto 1086/2020, de 9 de diciembre, por el que se regulan y flexibilizan determinadas condiciones de aplicación de las disposiciones de la Unión Europea en materia de higiene de la producción y comercialización de los productos alimenticios y se regulan actividades excluidas de su ámbito de aplicación	Partially transposing Directive 2004/41/EC, which establishes food hygiene and the health conditions for the production and placing on the market of certain products of animal origin intended for human consumption, this regulation include measures for oversight of these products. The directive gives leeway to member states to adapt its measures to local requirements, insofar as norms of hygiene are properly observed.

	Regulation	Real Decreto-ley 4/2001, de 16 de febrero, sobre el régimen de intervención administrativa aplicable a la valorización energética de harinas de origen animal procedentes de la transformación de despojos y cadáveres de animales	Aimed at the prevention of spongiform encephalopathies, this regulation addresses the use of flours of animal origin in the feed of livestock, as well as the separation of risk materials for destruction under appropriate conditions of health and hygiene.
	Regulation	Real Decreto 324/2000, de 3 de marzo, por el que se establecen normas básicas de ordenación de las explotaciones porcinas	This regulation establishes measures for sanitary and zootechnical management of pig farms, in accordance with current legislation on hygiene, animal health, animal welfare and the environment.
All	Policy	Plan Estatal Marco de Gestión de Residuos (PEMAR) 2021-2023	The State Waste Management Framework Plan (PEMAR) transposes EU legislation and is the instrument guiding waste policy in Spain. The PEMAR supports the circular economy in Spain through the improvement of waste management and the application of the hierarchy principle in waste management. The plan contains (a) the general strategy of waste policy; (b) the structure to which the autonomic plans must conform; and (c) the minimum objectives to be met for prevention, preparation for reuse, recycling, recovery and elimination. The CCAAs must comply at least with those objectives with the waste generated in its territory, although the specific rules of each waste stream may establish other specific criteria.
	Policy	España Circular 2030 – Estratégia Española de Economía Circular (EEEC)	The circular economy strategy implements the EU December 2015 EU circular economy action plan "Closing the loop" and incorporates the Green Deal. The strategy covers several lines of action: production, consumption, waste management, secondary raw materials and reuse of water, implemented through action plans. The action plan 2021-23 focuses mostly on the construction sector and buildings, industry, consumer goods, food and agriculture, tourism and the textiles.
	Policy	Estratégia Estatal de Innovación (e2i)	This framework for actions in the field of innovation is applied to the change of the productive models in Spain. In its Axis 2, it addresses the promotion of innovative public purchasing, as a driving force for innovation from the point of view of demand.
	Policy	Estratégia de economía circular de la región de Murcia 2030	The Region of Murcia is in the process of drafting a circular economy strategy. The draft has not yet been released, but a public consultation has been carried out.

	Policy	Estratégia Española de Bioeconomía (Spanish strategy for bioeconomy)	This policy consists if a framework for less dependency on non-renewable resources. This strategy constitutes a key element of the subsequent circular economy strategy, which then broadens to include other production sectors and essential aspects such as ecodesign, the treatment and reuse of waste and other non-biological materials, etc., and promotes the design of actions and alignment of policies with a systemic and integrated vision.
	Regulation	Ley Orgánica de Protección de Datos Personales y Garantía de los Derechos Digitales	A law transposing the General Data Protection Regulation is in the process of approval.
	Regulation	Ley 2/2011, de 4 de marzo, de Economía Sostenible	This transversal legislation on the sustainable economy includes public procurement rules focusing, among others, on the savings and efficient use of materials; the environmental lifecycle costs; processes and methods of ecological production; the generation and management of waste; and the use of recycled, reused or ecological materials.
	Regulation	Ley 22/2011, de 28 de julio, de residuos y suelos contaminados	This regulation transposes Directive 2008/98/CE, the Waste Framework Directive.
	Regulation	Real Decreto 782/1998, də 30 de abril por el que se aprueba al Reglamento para el desarrollo y ejecución de la Ley 11/ 1997, də 24 de abril, de Envases y Residuos de Envases	This regulation applies Ley 11/1997, as well as Decisions 97/138/EC and 97/129/EC. It puts particular emphasis on industry business plans for packaging waste prevention and waste management. It provides requirements for production, composition and traceability.
	Regulation	Ley 11/1997, de 24 de abril, de Envases y Residuos de Envases	Transposing Directive 94/62/EC and repealing Real Decreto 319/1991, this regulation focuses on packaging and packaging waste management. Its requirements include minimising the environmental impact, and design that allows reuse and recycling. It also addresses avoiding toxic substances that may be released during waste disposal.
	Regulation	Real Decreto 293/2018, de 18 de mayo, sobre reducción del consumo de bolsas de plástico y por el que se crea el Registro de Productores	This regulation implements Directive (EU) 2015/720 as regards reducing the consumption of lightweight plastic carrier bags.
	Voluntary agreement	Pacto por una Economía Circular	A joint initiative of several Spanish ministries, the Pact seeks to involve the main economic and social agents in Spain in the transition towards new economic models. This initiative was launched in the context of the forthcoming Spanish circular economy

			strategy, and its objectives are in line with the 2015 EU action plan for a circular economy in Europe. There are 327 signatories to date.
	Voluntary agreement	Declaración de Sevilla	Cities commit to a circular economy, including around 200 municipalities.
Electrical and electronic equipment	Regulation	Real Decreto 1364/2018, de 2 de noviembre, por el que se modifica el Real Decreto 219/2013, de 22 de marzo, sobre restricciones a la utilización de determinadas sustancias peligrosas en aparatos eléctricos y electrónicos	This royal decree modifies RD 219/2013, to promote the transition to a circular economy. Its purpose is to facilitate secondary market operations that involve the replacement of spare parts, the updating of functionalities or the improvement of capacity, thus allowing the reuse of electrical and electronic devices. It includes provisions for certain equipment to remain in the production and consumption cycle for longer, thus limiting the waste that comes from electrical and electronic equipment.
	Regulation	Real Decreto 27/2021, de 19 de enero, por el que se modifican el Real Decreto 106/2008, de 1 de febrero, sobre pilas y acumuladores y la gestión ambiental de sus residuos, y el Real Decreto 110/2015, de 20 de febrero, sobre residuos de aparatos eléctricos y electrónicos	This royal decree is key to the topic of circular economy as it is the main instrument for the treatment of electrical and electronic products. It transposes Directive 2012/19/EU. It takes better into account the whole value chain and details the obligations of the different stakeholder categories. It sets concrete objectives and targets not only for the recycling but also for the reuse of EE products (the only EU member state to set targets for reuse) and establishes 'centres for reuse'. It creates harmonised data management at both the national and CCAA levels to guarantee traceability. It also systematises the obligation of information on the part of the producers.
	Regulation	Real Decreto 219/2013, de 22 de marzo, sobre restricciones a la utilización de determinadas sustancias peligrosas en aparatos eléctricos y electrónicos	Transposing Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment, this royal decree has just been modified by RD 1364/2018, to introduce measures promoting circularity.
	Regulation	Real Decreto 283/2001, de 16 de marzo, por el que se modifican determinados artículos del Reglamento del Impuesto sobre Sociedades en materia de deducción por inversiones destinadas a la protección del medio ambiente	This royal decree creates fiscal incentives for companies to make investments contributing to environmental protection, and can therefore promote eco-innovation. Article 40 addresses environmental protection, among others to promote the reduction, recovery or treatment of industrial waste.

	Regulation	Ley 43/1995, de 27 de diciembre, del Impuesto sobre Sociedades	Linked to the related royal decree.

Table 43: Regional level in Spain – policies and legislation

Sector	Region	Name	Description
Agri-food	Basque Country	Estratégia para la Protección del Suelo 2030	The Basque strategy for the protection of land 2030 updates the previous strategy until 2020 and strengthens its measures. It aims at a more efficient use of land as a resource and has the objective of reaching "zero net land degradation" as proposed by UNCCD (United Nations Convention to Combat Desertification) within the Rio + 20 goals.
All	Basque Country	Plan de prevención y gestión de residuos de la CAPV 2020	The key objective of the plan for waste prevention and management of the Basque Country 2020 is to meet the objectives set by Europe with a particular focus on the construction and demolition sector, so that 70% of the waste generated is directed to reuse and recycling in a circular economy framework. The concept of circular economy is central to the plan, and targets include reintegrating 3.5 million tons of waste into the production process, producing half a million tons of waste less by 2020, and significantly reducing landfill disposal. A new strategy for 2030 is in preparation.
	Basque Country	Programa marco ambiental de la CAPV 2020	The Basque framework environmental programme establishes six strategic objectives on topics such as a low carbon economy, efficient use of resources, nature conservation and the sustainability of municipalities. The present programme focuses on prevention as opposed to the traditional reactive policy. Key objectives include ecological taxation, green manufacturing (reduced use of resources and reuse of waste) and the circular food value chain. A new programme 2030 is in preparation.
	Basque Country	Ley 3/1998, de 27 de febrero, general de protección del medio ambiente del País Vasco	Transposing Directive 96/61/EC, this integrates aspects of the Rio Convention on Biodiversity and the UNFCCC. According to an interviewed expert, legislation related to the circular economy in the Basque Country, as well as other CCAAs (except for Galicia), is limited to transposition of international, EU and national law. The Basque Country is very active in the field of the circular economy and has set its own targets. A strategy is presently being drafted and will be published in January.
	Region of Murcia	Plan de residuos de la región de Murcia 2016-2020	The Waste Plan of the Region of Murcia 2016-20 transposes Directive 2008/98/EC and the Spanish national Law 22/2011. This plan provides an analysis of the situation on the prevention and management of waste, as well as measures to facilitate the reuse, recycling and other types of recovery, including energy recovery and the elimination of waste. No new plan has been released to date.
	Valencian Community	Plan Integral de residuos de la Comunidad Valenciana	One of the central objectives of the waste plan of the Valencian Community consists of contributing to the prevention of waste generation, to implementing zero waste as a strategic horizon and, in this order, to the reuse, recycling, recovery and disposal thereof.
	Valencian Community	Ley 10/2000, de 12 de diciembre, de Residuos de la Comunitat Valenciana	The Law of Residues of the Valencian Community transposes EU legislation, namely: Directive 91/156/EC of March 2018, which provides the legal framework for the definition, prevention in the production and management of waste; Directive 91/689/EC on hazardous waste, which establishes greater control and oversight; Regulation 259/93/EC concerning the monitoring and control of shipments of waste; and Directive 1999/31/EC regulating the dumping of waste. Without having been transposed at the national level, these directives are already incorporated into the Valencian legal text. It is soon to be replaced by a new law to bring the legislation up to date with the latest

			EU and Spanish strategies, directives and laws: "Ley para la prevención de residuos, transición ecológica y fomento de la economía circular en la Comunitat Valenciana".

Table 44: UK national level – policies and legislation

Sector	Type	Name	Description
Agri-food	Regulation	UK Agriculture Bill 2017-19	This will replace the current subsidy system of direct payments, which is ineffective and pays farmers based on the total amount of land farmed. The agricultural bill – Environmental Land Management Scheme – will underpin payment structure and laws around farming and food production post-Brexit. The government will work together with farmers to design, develop and trial the new approach. Under the new system, farmers and land managers who provide the greatest environmental benefits will secure the largest rewards, laying the foundations for a Green Brexit. The introduction of the Agriculture Bill now means that all the necessary measures will be in place for the start of the agricultural transition in 2021.
	Regulation	Organic Products Regulations 2009	These regulations implement the provisions of European regulations. Accordingly, the Defra Organic Farming Branch plays the legal role of the competent authority for the whole of the UK. All supervisory bodies holding their own standards in the UK need to adapt these in the light of the changes to the European regulation.
	Standard	Soil Association Certification (SAC) (UK)	The Soil Association develops national ecological standards, including standards for organic farming and growing. The Soil Association is a leading organic certifier. The SAC uses the EU organic regulation as their baseline, but in many cases they are more robust.
	Standard	Organic Fairtrade	The Fairtrade Foundation license the use of the Fairtrade mark in the UK.
	Regulations	General Food Regulations 2004	The regulations provide for the enforcement of certain provisions of Regulation (EC) No 178/2002 of the European Parliament and of the Council (OJ L 31, 1.2.2002, p. 1) laying down the general principles and requirements of food law.
	Policy	New industrial strategy	The aim of the new industrial strategy is to boost productivity by backing businesses to create good jobs and increase the earning power of people throughout the UK with investment in skills, industries and infrastructure. One of challenges will be clean growth: maximising the advantages for UK industry from the global shift to clean growth.
	Policy	"A Green Future – Our 25 Year Plan to Improve the Environment", HM Government,	The plan outlines ways to reduce the use of plastics that contribute to pollution and broader steps to encourage recycling and the more thoughtful use of resources.
	Policy	Clean growth strategy	This is the sister document to the 25-year environment plan. The plan sets out how the UK will deliver the clean, green growth needed to combat global warming.

	Policy	"Resource Revolution: Creating the Future, WRAP's plan 2015-2020"	In this document the 2020 goals for its key areas were set. For electric and electronic goods these are to reduce the carbon, water and waste footprint of electricals and electronic products; work with industry to develop smarter, more resource-efficient products and services; and increase value through more reuse and recycling. For resource management they are to meet the UK household waste and packaging waste recycling targets; increase the recycling of food waste by anaerobic digestion and increase access to household food waste collection services; and increase the number of people who recycle all they can on every occasion.
	Policy	"Resource Security Action Plan: Making the most of valuable materials"	This was a joint initiative of Defra and the former Department for Business Innovation and Skills (nowadays the Department of Business, Energy & Industrial Strategy) to examine strategies for addressing resource security in the UK. The resource security action plan put more emphasis on recovery (i.e. circular approaches) than on opening up new sources of materials as a means to provide greater resource security. It also encouraged the environmental think tank Green Alliance to establish the Circular Economy Task Force as a means of engaging businesses in the solutions.
	Policy	"Public procurement policy: Transforming Governmental Procurement", HM Treasury	Public sector procurement is subject to a legal framework which encourages free and open competition and value for money, in line with internationally and nationally agreed obligations and regulations. As part of its strategy, the government aligns procurement policies with this legal framework, as well as with its wider policy objectives.
	Policy	HM Government, "Industrial strategy: Building a Britain for the Future"	This policy is a commitment to moving towards a more circular economy – to raising productivity by using resources more efficiently, to increasing resilience by contributing to a healthier environment, and to supporting long-term growth by regenerating our natural capital. Among the measures to achieve this are raising the resource productivity of businesses, including through the promotion of recycling and strong secondary materials markets where products are designed with efficiency and recyclability. It also supports innovative and highly-efficient precision agriculture through the industrial strategy programme, "Transforming food production, from farm to fork".
	Policy	National Industrial Symbiosis Programme UK (NISP)	The NISP provides a platform to inspire businesses to implement resource optimisation and efficiency practices, keeping materials and other resources in productive use for longer through industrial symbiosis.
	Regulation	Controlled Waste Regulations	This regulation defines household, industrial and commercial waste for waste management licencing purposes. It prescribes a number of cases where a charge may be made for the collection of household waste. Charging for household waste could incentivise waste prevention, reuse and recycling as part of a circular economy.
	Regulation	Government buying standards (GBS) ('Buy Sustainable – Quick Wins') as a part of public procurement policy	All government departments and their related organisations must make sure that they meet the minimum mandatory GBS when buying goods and services. With GBS this can mean developing criteria that aim to reduce demand for new products in the first place (e.g. the standards require a 5% reuse target for furniture before purchasing new), or through buying products that are easily separable and upgradeable. Specifications are developed for (among others) office ICT equipment (2012) and food and catering services (2015). In the contract award process these could be further revised to better support circularity – for example, through revised criteria to include 'recyclability requirements' for public procurement practices and tenders and a systematic implementation of whole lifecycle costing criteria, which could also be a useful means to encourage product and investment choices that take lifecycle impacts into account .
	Regulation	Climate Change Act	This was the first regulation in the world to introduce legally-binding emissions targets. It is aimed to reduce emissions and identify and adapt to the pressures we face as our climate changes. It sets out greenhouse gas emissions reduction targets and places specific climate change duties on public bodies. This should encourage use of more efficient processes to minimise wastes and emissions.

	Regulation	Environmental Protection Act	This regulation covers a wide range of environmental protection aspects. In relation to the circular economy it outlines requirements around waste management licencing, duty of care, integrated waste management plans, controlled waste collection responsibilities, waste receptacles and payments for recycling. It also regulates industrial processes and places limits on emissions.
	Voluntary agreement	The Courtauld Commitment	The Courtauld Commitment is a voluntary agreement for the grocery sector, which has improved resource efficiency and prevented food and packaging waste in the home and supply chain. The second phase of this agreement helped prevent 1.7 million tonnes (Mt) of food and packaging waste, saving more than 4.8 Mt of CO_2e and £3.1 billion for consumers, industry and local authorities. A similar agreement in hospitality and food service is also helping to reduce waste and increase recycling. The next agreement, Courtauld 2025, focuses on improving the sustainability of key food and drink products from harvest to consumption.
	Programme	Waste and Resources Action Programme (WRAP)/Zero waste Scotland	WRAP helps businesses, local authorities, government departments, civil society organisations and consumers to become more resource efficient. It delivers a number of programmes and activities to improve resource efficiency. Between 2015 and 2020, WRAP concentrated on three key areas where collectively it could make the biggest difference: food and drink, clothing and textiles, electricals and electronics, with resource management underpinning them all.
	Regulation	Consumer Protection from Unfair Trading Regulations 2008 (UK)	Optional: These regulations could be applicable in cases where a manufacturer of lighting deals with refurbishment or remanufacturing of used elements or products. It prohibits misdescriptions of goods or services. It has an impact on how suppliers of reused/refurbished/remanufactured goods describe those goods.
Electrical and electronic equipment	Regulation	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012	The regulations implemented the provisions of the EU RoHS2 Directive into UK law. The regulations came into force on 2 January 2013, replacing the original regulations that came into force on 1 February 2008. The regulations apply to all EEE put on the market in the UK, which falls into broad categories including lighting. The regulations require manufacturers to self-declare the conformity of products with the requirements of the RoHS Regulations. Manufacturers are required to complete an internal production control procedure and must also draw up technical documentation. The key restriction concerns products containing of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers in the WEE in amounts exceeding the established maximum concentration values.
	Regulation	Energy conservation: Energy Information Regulations 2011	These regulations implemented Community legislation (Directive 2010/30/EU) on energy labelling and market oversight regarding energy-related products which have a significant direct or indirect impact on the consumption of energy and other resources. The regulations, among other aspects, set out the requirements which must be met by a supplier when supplying a product and the responsibilities of dealers when selling a product.
	Regulation	Ecodesign for Energy-Related Products Regulations, and the amendment from 2013	These regulations implemented Community legislation on the (oversight of) the marketing of ecodesign products. They require that an energy-related product must not be placed on the market or put into service unless it complies with an applicable implementing measure. The regulations require manufacturers to assess whether a product complies with an applicable implementing measure and to provide, in case it does, required declarations and ecolabelling.

	Regulation	General Product Safety Regulations (UK)	Optional: These regulations could be applicable in cases where a manufacturer of lighting deals with refurbishment or remanufacturing of used elements or products. It imposes requirements concerning the safety of products (including second-hand products) intended for consumers or which are likely to be used by consumers.
	Regulation	Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)	The main aims of REACH are to ensure a high level of protection of human health and the environment from the risks that can be posed by chemicals, the promotion of alternative test methods and the free circulation of substances on the internal market. It focuses more on an environmental and human health perspective. REACH does not ban chemicals – it provides the framework within which industry can assess and manage the risks posed by chemicals and ensure safety information is provided to the users of their chemicals. After Brexit, there are two main scenarios: the UK could choose as its new status 'still-in-REACH', to be a non-EU country and the scenario in which the UK will be 'out-of-REACH'.
	Standard	PAS 141:2011 Reuse of used and waste electrical and electronic equipment (UEEE and WEEE), process management, specification	Optional: This standard could be applicable in cases where a manufacturer of lighting deals with refurbishment or remanufacturing of used elements or products. PAS 141 sets out the requirements to successfully manage the process of preparing used and waste electrical and electronic equipment for reuse. It gives practical advice, helps to reduce costs and ensure that recycled parts and products are of the highest quality. The standard covers the preparation process for the reuse of electronic equipment and components. It applies to all organisations that deal with the preparation of equipment for reuse. PAS 141 also helps organisations to put the right quality assurance systems in place, while complying with environmental health and safety regulations. It looks at the handling, tracking, segregation, storage and protection of electronic equipment and components. It also explains how to prepare for reuse in detail and covers visual inspection, electrical safety and the classification systems of prepared equipment.
	Voluntary agreement	Electrical and Electronic Equipment Sustainability Action Plan 2025 (esap 2025)	Defra produced the esap 2025 to establish a voluntary commitment in the lightning and electronics sector. This specific sector consists of mostly global companies, and they were reluctant to sign up to any voluntary agreements within the UK. The programme was closed in 2018 because it was difficult to get commitments from enough companies to make it viable and self-funding.
	Voluntary agreement	EPEAT	EPEAT is the leading global ecolabel for the IT sector. The EPEAT programme provides independent verification of manufacturers' claims and the EPEAT online registry lists sustainable products from a broader range of manufacturers than any comparable ecolabel. The EPEAT ecolabel criteria are developed through a balanced voluntary consensus process. Standards that the EPEAT programme has historically adopted were created by standards development organisations employing balanced voluntary consensus processes. National governments, including the United States, and thousands of private and public institutional purchasers around the world use EPEAT as part of their sustainable procurement decisions.
	Regulation	Waste Electrical and Electronic Equipment Regulations 2013, Statutory Instruments, 2013 No. 3113 Environmental Protection	These regulations transpose the main provisions of Directive 2012/19/EU on WEEE, which recasts the previous Directive 2002/96/EC. These regulations also provide for a wider range of products to be covered by the directive with effect from 1 January 2019. With that comes the associated requirements for the recovery, reuse, recycling and treatment of WEEE. The regulations require producers to finance the collection, treatment and recycling or reuse of this fastest growing waste stream.

Table 45: UK, England – policies and legislation

Sector	Type	Name	Description
All	Policy	Resource and waste strategy for England	The resource and waste strategy was published by the government towards the end of 2018. The document sets out the government's approach to reducing waste, promoting markets for secondary (recycled) materials and incentivising changes to product design and end-of-life disposal. It is aimed, among other purposes, at making it easier for people to recycle. At the end of life/waste management stage, the strategy will improve the rate of recycling. The strategy will have five 'pillars': 1) how to become a zero avoidable waste economy by 2050; 2) phase out avoidable plastic waste by 2042; 3) new targets for waste and recycling, which after Brexit will be the same as the EU's circular economy package; 4) stopping food waste going to landfill by 2030; and 5) reforming the Packaging Recovery Scheme.
	Regulation	Controlled Waste (England and Wales) Regulations 2012	These rules came into force on 6 April 2012. They revoke and replace the Controlled Waste Regulations 1992.The existing framework does not necessarily conflict with the ambitions of a circular economy. The regulations classify waste as household, industrial or commercial waste. They enable local authorities in Wales to charge for the collection and disposal of waste from non-domestic properties. The regulations consolidate previous amendments, and include some amended and updated definitions and classifications.
	Regulation	Environmental Permitting (England and Wales) Regulations, Landfill Allowance Trading Scheme (England) and Landfill Allowance Scheme (Wales), Landfill Scotland, similar regulation in Northern Ireland	Within these regulations the Landfill Directive (an EU law) is applied in UK. Under these regulations, landfills no longer accept untreated waste or liquid wastes. Businesses and industries must now arrange for alternative ways for disposing of liquid waste and ensure that non-liquid waste is properly treated before disposal. The regulations also ban the disposal of hazardous and non-hazardous waste in the same landfill. All hazardous waste must be disposed of in specially designated landfills. They set out targets for local authorities to reduce the amount of biodegradable household waste sent to landfills.
	Regulation	Waste Management Licencing Regulations (England and Wales) (amendment and Related Provisions) No. 2) Regulations 2005	These regulations provide a framework for the development of a 'waste management licencing system' under part II of the Environmental Protection Act 1990. They also implement various EU Council directives regarding the management of waste. Waste is defined in five categories: controlled, household, industrial, commercial and special. These regulations also deal with sources of waste where doubt exists regarding its appropriate category.
	Policy	"Prevention is better than cure: the role of waste prevention in moving to a more resource efficiency economy", HM Government (but only covers England)	This document sets out the waste prevention programme for England. It articulates the actions for government and others that together will move England towards reducing waste. The aim of the action plan is to improve the environment and protect human health by supporting a resource-efficient economy, reducing the quantity and impact of waste produced. The programme's actions are taken within the Waste and Resources Action Programme (WRAP) and the Technology Strategy Board activities. The action plan has the following elements: building waste reduction into design, offering alternative business models and delivering new and improved products and services.

Appendix 3: List of experts consulted for the inventory of policies

Type of organisation	Position of interviewee
EEE industry association	Director
Food and agriculture association	Policy Officer
Food industry association	Director and Policy Officer
Sustainability NGO	Researcher
WEEE Recycling Association	Head of Communication and Development
Policy research & consultancy	Public sector consultant
Academia	Lecturer on Sustainability and Circular Economy
Regional authority	Project Manager Eco-innovation and Circular Economy