Policy Instruments and Incentives for Circular Economy - Final report

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1 Introduction

1.1 Definitions

The term *circular economy* (CE) is ambiguous, with numerous definitions being presented. For example, Rizos, Tuokko and Behrens (2017) have compared eleven definitions for the circular economy. The common factor to them all is that they include the aspect of resource management as a means to achieve environmental and economic benefits. We want to emphasize the aim of fundamental rather than incremental change in behaviour and a broad scope, thus highlighting the following two definitions:

- New way to design, make, and use things within planetary boundaries (Ellen MacArthur Foundation, 2019).
- A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible. These can be productively used again and again, thereby creating further value (European Parliament, 2018).

Figure 1 shows the main elements of the CE starting from raw materials extraction to collection, reuse, repair, remanufacturing and recycling of products and materials. The design phase is critical, contributing not only to the efficient use of raw materials (to minimize the waste streams) but to the entire life cycle, through defining structure, properties and performance of the solutions.

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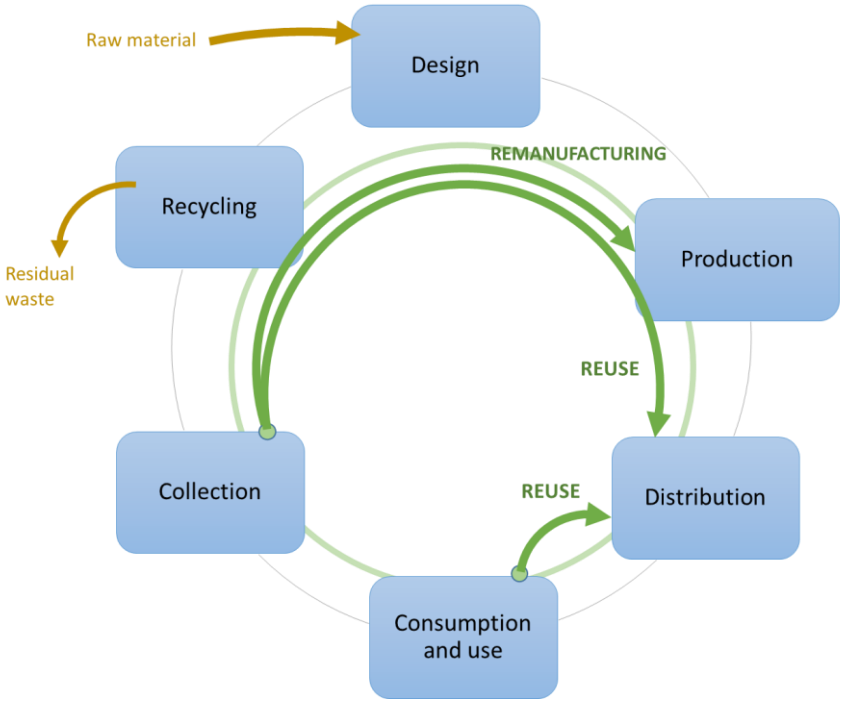

Figure 1. Elements of circular economy.

Besides the several phases along the life cycle, Figure 1 implies that numerous *stakeholders* are associated with the raw material loops through technologies and value chains. Often, both industrial stakeholders (large companies, small- and middle-size enterprises, SMEs) and research and technology organisations (RTOs) that develop and transfer the new technologies are needed to complete new types of raw material loops. Additionally, customers: either individual consumers or businesses, are involved. The entire operational environment is modified by public stakeholders at various levels, ranging from regional to national and further up to European Union (EU) level, through policy making and, e.g., public procurement, while they may also have a role as funding bodies (although funding bodies may also be completely separate from policy making, such as investors or banks). Non-governmental organisations (NGOs) and various interest groups may also be active stakeholders in CE, through advancing specific CE issues or participating in awareness raising. Universities are linked through technology development but also due to education of labour force to the market, while also other educational institutions have an educational form through either formal or less formal educational programs.

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Cambridge dictionary (2019) defines *incentive* as something that encourages a person to do something. Given that CE has such a wide variety of stakeholder groups involved, our interpretation is that *circular economy incentives* encourage all relevant stakeholders to implement circular economy into actions.

1.2 Motivation

Importance of the circular economy is growing due to unresolved global challenges, such as climate change and resource scarcity. As defined and shown above, the CE is an economic system that creates value by catching and reusing the limited raw material and energy resources by slowing, narrowing and closing their loops. The CE is expected to provide major benefits in terms of improved resource efficiency, reduced extraction, reduced processing, and the disposal of scarce natural resources. Additionally, the CE also relates to the new types of business opportunities for existing and new stakeholders. Despite these potential benefits, the process of transition towards a CE has been quite slow.

There are many reasons why the implementation of the CE principles is hindered. Among them, one identified factor is the lack of CE know-how of political decision-makers. Related to this are the recognised barriers for CE implementation: the lack of clear incentives, complex and overlapping regulation as well as the lack of governmental support.

Environmental policy instruments are structured activities aimed at changing other activities in society to achieve environmental goals in a particular time schedule. Therefore, they are particularly suitable in advancing CE in the society. Policy instruments are referred by Winans, Kendall and Deng (2017) as "regulatory and economic instruments implemented to achieve an effect that will not occur in the absence of governmental intervention". Policy instruments may be broadly divided into three categories: regulatory, market-based relying on financial incentives or fiscal penalties, or voluntary and information-oriented (non-formal, educational) or bound to social acceptance (cultural norms). However, there are also policy instruments, which are not directly intended for changing the environmental impacts of activities in the society, yet they do, such as waste, energy and transport policies. Consumers are individual members of the society, thus their behaviour is governed by policy actions. In turn, for organisations, like industrial companies in raw materials sector, other incentives than policy instruments to facilitate change in the prevailing mode of thinking and acting may be necessary in the transformation to CE, such as institutional or technological. Additionally, here the social instruments may be different than in consumer side, with standards and certified processes as examples. At all levels, policy instruments and incentives

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for advancing CE are actually a mix of various means, and some instruments may also have CE restricting dimensions, particularly in the case of such policies which do not have direct environmental aims (like waste, energy and transport policies mentioned above).

In order to overcome the barriers of CE, it is essential that knowledge of policy instruments and incentives are available and that their effects are described. Additionally, knowledge on how to implement such policy instruments and incentives that boost CE is needed. The importance of incentives for boosting CE has been emphasized in a recent report from the European Commission (2019a):

"In every aspect of the systemic transition, the default still is a linear business-as-usual approach. But in the end, the core driver for the transition can be reduced to incentives. These are the formal and informal rules that influence behaviour and decisions. Within each of the elements, we should look for incentives to make the circular business approach the preferred one."

For this, it is essential to survey what kind of incentives aiming to support CE already exists and analyse their positive and/or negative influences on promoting the CE. This would result in as a significant source of information for policy makers, to better understand the impacts of various types of incentives. At the same time, the results of the analysis would generate valuable input for the formulation of new kind of advanced incentives.

2 Objectives

2.1 The project behind the report

In spring 2019, EIT Raw Materials launched a KAVA6 call Knowledge Creation and Dissemination, which covered six eligible topics: 1) Transition to circular cities, 2) Incentives for circular economy, 3) The cost of mobility, 4) The mobility transition –a new chance for resource-rich developing countries, 5) Sourcing raw materials and social licence to operate (SLO) and 6) Deep intelligent exploration and mining. In topic #2, Policy instruments and Incentives for Circular Economy (POLICE) project proposal by VTT Technical Research Centre of Finland was funded.

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The aim of the project was to identify and describe different types of incentives to promote and boost the implementation of the circular economy concept, considering relevant policy instruments and incentives and their mixes. Another key objective of the project was to compare positive versus negative policy instruments and incentives. The third target of the project was to evaluate and analyse the effectiveness of incentives based on the information on CE barriers and drivers.

2.2 Structure of the report

This report presents the key findings of the POLICE project. The report is structured as follows. Chapter 1 provides the introduction to the topic, by defining the key terms and describing the motivation behind the work. Chapter 2 presents the objectives of the study. In Chapter 3, materials and methods are introduced. Chapter 4 forms the core of the work, i.e., covers the results. Chapter 5 is devoted to discussion and conclusions of the work. In the end, the list of references and the appendixes are shown.

3 Materials and methods

Various research methods were utilized to deliver the project. These included literature review, interviews and co-creation workshop together with stakeholders. The methods are described in the following sub-chapters.

3.1 Literature review

A bibliometric study was conducted in order to identify the current state of research in policy incentives for circular economy. A search was conducted in the data bases Scopus and Web of Science using the search terms: circular AND economy AND polic* AND incentiv*. Scopus and Web of Science searches resulted in 56 articles. The results included original research articles (41), proceeding papers (9), reviews (6). Considering the low number of research documents from the searches, a new search was conducted for strategic documents, such as European national strategies and roadmaps, accessible mainly through the Circular Economy Stakeholders Platform, and studies on incentives made by various organizations in the various areas of CE. The

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interviewees also suggested documents that referred to policy incentives for circular economy in their fields of work, which were subsequently included in the literature survey.

3.2 Interviews

Interviews were conducted in order to identify the incentives, barriers and drivers for circular economy that were considered crucial by various stakeholder groups. Additionally, the goal was to gain a rich insight into different aspects of circular economy in different types of organisations and to identify new documents and reports to complement the literature review. Purposeful sampling (Palinkas *et al.*, 2015) was used to select the interviewed organisations and informants. Seven semi-structured interviews were conducted in five organizations. All interviews were recorded and transcribed. Interview questions are presented in Appendix 1. Informants and interview data are introduced in Table 1.

Table 1. Interview data.

Interview number	Type of organisation	Focus area of the organisation in terms of CE	Position of interviewed	Length of interview
1	EU Commission	Raw materials	Policy Officer	48 min
2	Industry	Recycling	Public Affairs Director	49 min
3	Industry	Recycling	Head of Innovation	48 min
4	Industry	Raw materials	Global Manager	43 min
5	NGO	Reuse	Senior Policy Officer	62 min
6	University or research organisation	Teaching of circular economy management	Post doc Researcher	35 min
7	University or research organisation	Sustainability, including circular economy	Professor	15 min

The data analysis was conducted by textual coding using NVivo program. Example of the coding is given in Table 2. Emerging categories were identified iteratively from the data. These were then analysed in the context of the findings from the literature review and discussed with authors and external stakeholders.

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Table 2. Example of coding.

1st category coding	2nd category coding	Sample text
Barriers of CE	No concrete targets for reuse	"For us the main barrier is the fact that there is no target on reuse yet, there is no legal target for reuse. It gives clearly an advantage to premature recycling. This is why we push constantly for having these targets for reuse."
Drivers of CE	CE and climate neutrality go hand in hand (case critical raw materials)	"And then I would like to point out that, the actions and the policy area in the, in climate neutrality it goes hand in hand with the actions towards higher circularity and circular economy. I would say that the raw materials, that is something that run through both policy streams in a very strategic way. What I mean is that, in order to move towards a more climate-neutral, greenhouse gas-reduced economy activity, we see that the raw materials and especially the high-value, critical raw materials are, they can be found in so many developments. We see for example, I mentioned earlier rare-earth, we see them in magnets in windmills and windfarms and other renewable energy, we know that with the miniaturization of electronics and electrical equipment we have more and more use of, critical raw materials, we have the, whole e-mobility area and the, electric vehicles and the use of different battery, so in all these developments we see that, critical raw materials really play a crucial role. So, I would say that, the, and this is also that you can see in the proposals for the European Green Deal, that it is about more circular, activity, closing the loop it goes hand in hand with the climate neutrality endeavour."

3.3 Workshop

VTT organized a workshop 22.11.2019 as a part of EU Raw Materials Week (see Agenda, Appendix 2). All together 40 experts were registered to the workshop, of which 21 attended. The purpose of the workshop was to:

- Inform stakeholders about the project,
- Inform about existing incentives (incl. concrete examples),
- Review and discuss results of analysis of current incentives, and

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- Develop paths forward by co-creating ideas for incentives to boost circular economy in the future.

Workshop started with a section where project backgrounds were presented and current findings discussed. Most part of the workshop was allocated to collective working, where future paths were constructed by co-creating ideas for incentives and to boost circular economy in large. There, participants were divided in four different thematic groups of: “Education and awareness, “New technologies and solutions”, “Industrial arrangements”, and “Market incentives”. Experts were placed in these different sub-groups by heir background organization with an idea of supporting multi-dimensional discussion and data to emerge. The utilized framework for the group work consisted of three horizontal layers of action items, mechanisms and impacts. Vertically, contents were reflected in short (2019-2022), medium (2022-2025) and long term (2025-) scopes.

Outcomes of the workshop covered various larger- and more precise topics that approached futures of incentives and CE from different point of views. This covered observations concerning regulative integration of CE, organizational CE, and mapping CE in an ecosystem perspective - for example. Findings of the workshop is presented more in detail in chapter 4.3.

4 Results

4.1 Literature review

The literature review focused on identifying barriers and drives for implementation, institutional drivers and incentives for implementation of CE. The following chapters present the key findings of the literature review.

4.1.1 Barriers and drivers of CE

Many authors have analysed the barriers and drivers for moving towards CE. As an example, main categories of barriers for moving towards CE have been identified as financial, structural, operational, attitudinal and technological (Ritzén and Sandström, 2017) or cultural, regulatory, market and technological (Kirchherr *et al.*, 2018). For both barriers and drivers, examples include

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hard, i.e., technical and economic/financial/market, and soft, i.e., institutional/regulatory and social/cultural, factors (de Jesus and Mendonça, 2018). Tura et al. have divided the factors behind barriers and drivers as environmental, economic, social, institutional, technological and informational, supply chain-based and organizational (Tura *et al.*, 2019). Combination of drivers and barriers identified in four recent review studies (Ritzén and Sandström, 2017; de Jesus and Mendonça, 2018; Kirchherr *et al.*, 2018; Tura *et al.*, 2019) are presented in Table 3 and Table 4.

Table 3. Barriers of CE.

Barriers of CE	
Measuring financial benefits of CE	Lack of large-scale demonstration projects
Financial profitability	Lack of collaboration and resources
High upfront investment costs and lack of financial capability and support for circular business models	Incompatibility with existing (linear) operations and development targets
Low virgin material prices	Silo thinking
Lack of tools and methods to measure (long-term) benefits of CE projects	Conflicts with existing business culture and lack of internal cooperation
Lack of social awareness and uncertainty of consumer responsiveness and demand	Hesitant company culture i.e. risk aversion
Lack of market mechanisms for recovery	Heavy organizational hierarchy and lack of management support
Lack of clear incentives or policies in support of a CE transition	Missing exchange of information
Complex and overlapping regulation	Unclear responsibility distribution
Lacking global consensus	Infrastructure and supply chain management
Lack of governmental support	Perception of sustainability
Lack of CE know-how of political decision-makers	Integration into production processes
Lacking standardization	Lack of circular design in products
Lack of information and knowledge, e.g. on impacts	Lacking consumer awareness and interest
Lack of technologies and technical skills related to CE	Limited circular procurement
Lack of network support and partners and limited willingness to collaborate in the value chain	

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Table 4. Drivers of CE.

Drivers for CE	
Rising resource demand and resource depletion, and resource cost increase and volatility	Increased information sharing through enhanced information management technologies, e.g. platforms
Potential for preventing negative environmental impacts	Potential for reducing supply dependence and avoiding high and volatile prices
Potential for improving cost efficiency, finding new revenue streams and gaining profit	Open collaboration and communication practices
Potential for new business development, innovation and synergy opportunities	Multi-disciplinarity, increased availability of resources and capabilities
Increased internationalization and worldwide awareness of sustainability needs	Management of (reverse) networks
Potential to increase workplaces and vitality	Potential for differentiation and strengthening the company brand
increasing environmental legislation, environmental standards and waste management directives	Increased understanding of sustainability demands
Supportive funds, taxation and subsidy policies	Circularity integrated in company strategy and goals
Potential for improving existing operations	Development of skills and capabilities for CE
New technologies that facilitate resource optimisation, re-manufacturing and re-generation of by-products as input to other processes, development of sharing solutions with superior consumer experience and convenience	Social awareness, environmental literacy and shifting consumer preferences (e.g. from ownership of assets to services models)

Based on the extensive interview study, Kirchherr *et al.* (2018) have identified five main barriers for CE as lacking consumer interest and awareness, hesitant company culture, operating in a linear system, low virgin material prices and high upfront investment costs. Interestingly, technical and regulatory barriers do not emerge as core barriers in their work. In contrast, based on the extensive literature review of de Jesus and Mendonça (2018), technical barriers are the most frequently mentioned CE barriers in the literature (35%), followed by institutional/regulatory (23%), economic/financial/market (22%) and social/cultural factors (20%). In terms of drivers, institutional/regulatory (36%) and economic/financial/market (35%) were mentioned most regularly, whereas social/cultural (22%) and technical (8%) were mentioned less frequently (de Jesus and Mendonça, 2018).

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4.1.2 Institutional environment

Ranta *et al.* (2018) emphasize the need for the broad engagement of economic and societal stakeholders for the successful implementation of CE initiatives. For societal support, legislative and financial subsidies are needed, as well as taking into consideration broader institutional issues, such as norms and cultural aspects, to promote the transition towards more sustainable choices and the adoption of CE principles.

Referring to the institutional environment, laws and regulations affecting CE have focused mostly on the topics related to waste management (Winans, Kendall and Deng, 2017; Berg *et al.*, 2018; Nylén and Salminen, 2019) and have aimed mainly to enhance safe waste management through the sorting of waste, landfill diversion, charges and taxes and extended producer responsibility (EPR) (Berg *et al.*, 2018). The EU Circular Action Plan (European Commission, 2015) is an evolution of these policies as it proposes policy interventions across the life cycle of products that should be considered in the short/medium term of policy development (Milios, 2018). Table 5 shows policies proposed by the EU Action Plan for the Circular Economy. These policies address different levels of the implementation of CE affecting industry, society, and governments.

Table 5. Summary of the EU 2015 Action Plan for the Circular Economy, with examples of specific policies (McDowall *et al*, 2017).

Area	Examples of specific policies
Production	Eco-design: proposal do adapt the existing eco-design work plan to incorporate durability, reparability, and recyclability criteria Cleaner Manufacturing: R&D funding, knowledge centres
Consumption	Proposed introduction of product labelling for durability Pricing: member states are encouraged to use pricing instruments. Consumer protection rules: e.g., guarantee periods Various proposed measures to promote innovative consumption, including collaborative consumption models based on leasing, lending, and sharing Adapting existing public procurement rules
Waste Management	New legislative proposals on waste and landfills, including new binding targets Proposed changes to extend produce responsibility rules to reward products that are designed for easier repair, remanufacture, or recycling Direct funding support for specific regions by cohesion policy

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Boosting markets for secondary materials	Clarifying legal rules on definition of waste; proposed standards for various secondary materials to foster markets
Priority areas	Plastics, food waste, critical raw materials, construction/demolition waste, and biomass and bioproducts.
Innovation, investment and horizontal measures	Funding for research and innovation
Monitoring progress	Development of indicators for the circular economy.

European Commission has carried out a review of the implementation of the EU CE Action Plan. There has been progress in the pursue of CE in the European society and towards reaching of the sustainable development goals, although some open challenges remain. Table 6 summarizes the results of the evaluation according to its areas of implementation.

Table 6. Main results of the implementation of the EU Circular Economy Action Plan (European Commission, 2019b).

Area	Main Achievements
Circular Design and Production Processes	Implementation of the Ecodesign Working Plan 2016-2019 that further promoted the circular design of products, together with energy efficiency objectives: 1. Ecodesign and Energy Labelling measures for several products now include rules on material efficiency requirements such as availability of spare parts, ease of repair, and facilitating end-of-life treatment; 2. European Standardisation Organisations are developing horizontal criteria to measure durability, reusability, reparability, recyclability and the presence of critical raw materials. These criteria should be applied in existing and new standards.
Empowering Consumers	Introduction of product-related policies to increase the effectiveness of the EU Ecolabel to offer consumers accurate environmental information. Development of the Product Environmental Footprint (PEF) and Organisation Environmental Footprint (OEF) methods enable companies to make environmental claims that are reliable, reproducible and comparable.
Turning Waste into Resources	Revised waste legislative framework entered into force in July 2018, which includes: new ambitious and realistic recycling rates; simplification and harmonisation of definitions and calculation methods and clarified legal status for recycled materials and by-products; reinforced rules and new

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	obligations on separate collection; minimum requirements for EPR; strengthened waste prevention and waste management measures.
Closing Loops of Recovered Materials	Elaboration of the new Fertilising Products regulation, which introduces harmonised rules for organic fertilisers manufactured from secondary raw materials. This the new regulation: reduces of market entry barriers for more sustainable and circular products; includes new limits on hazardous substances for all fertilisers; and includes end-of-waste criteria.
EU Strategy for Plastics in a Circular Economy	Implementation of the EU Strategy for Plastics in a Circular Economy, a policy framework adopting a material-specific lifecycle approach to integrate circular design, use, reuse and recycling activities into plastics value chains. It rules on Single-Use Plastics items and fishing gear, offering opportunities for EU companies to innovate in products, materials, technologies and business models taking into account consumers' behaviour and available alternatives.
Innovation and Investments	More than €10 billion in public funding invested to the transition over the 2016-2020 period, covering: Horizon 2020, Cohesion Policy, smart specialisation for market-led innovation and deployment, European Fund for Strategic Investments and InnovFin.
Strong Stakeholder Engagement	Majority of Member States have adopted or are designing national strategies for the transition to a circular economy. European Circular Economy Stakeholder Platform has been established as a "meeting place" for networks and initiatives on the circular economy and multiplier for best practices from the public and the private sectors.

There are still open challenges for the transition to CE in Europe. According to the review of the CE Action Plan, there is a need to scale up actions at EU level and globally, fully close the loops and reap the competitive advantage it brings to EU businesses. For EU to maintain its leadership in CE, a set of actions is necessary. They include, according to the (European Commission, 2019b):

- To make CE a backbone of the EU industrial strategy, enabling circularity in new areas and sectors, life-cycle assessments of products to become a norm and the eco-design framework to be broadened as much as possible.
- To empower consumers to make informed choices and enhance efforts by the public sector through sustainable public procurement.
- Step up their efforts to implement the revised waste legislation and develop markets for secondary raw materials.
- Continue supporting research, innovation and investment in the priority sectors identified in the action plan. Building on the example of the European Strategy for Plastics in a

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Circular Economy, other sectors with high environmental impact and potential for circularity such as IT, electronics, mobility, the built environment, mining, furniture, food, drinks and textiles could benefit from a similar holistic approach to become circular.

- Implement the recently updated Bioeconomy Strategy and the revised renewable energy framework to move further towards using biological resources in a circular way, respecting the ecological boundaries and contributing to halting biodiversity loss.
- Pursue together the transition towards a circular and climate-neutral economy, based on a strong industrial ambition and achieving the EU businesses' first-mover advantage in these areas. These joint approach should be promoted in companies, including SMEs, and communities to reduce production costs and support new forms of business interaction such as industrial symbiosis.
- To adopt circularity and sustainability in the sourcing, use and treatment of raw materials (in particular critical ones) as a key to ensure the necessary security of supplies, a level playing field with industrial competitors and the EU's global leadership in the production of key enabling and low-carbon technologies.
- To realize the potential of artificial intelligence and digitalisation to optimise energy and resource use and make information available in support of circular business models and responsible consumption choices.

As stated earlier, the EU CE Action plan inspired the incorporation of CE into legislation and national strategies. Most European countries have established strategic documents orienting policy making in the field. Table 7 shows examples of strategies promoting CE in different EU countries. Table 7 discloses that many of the strategic documents are published recently, thus their implementation into concrete actions remains to be seen in the future.

Looking at the strategies and legislations listed in Table 7, it is possible to see them referring to various aspects of circular economy such as sustainability, waste management, green economy and packaging, amongst others. It is noted that strategies have been implemented both top-down (from national to regional and local, as in the case of Finland) to bottom-up (as in the case of Spain, which have regional strategies in Catalunã and Basque Country but does not have a national strategy yet). It has to do as well with the level of engagement of the local stakeholders with European policies and the coupling of those with local development strategies, such as smart specialization.

The strategies and other policy instruments, including those applied by most of the strategies in Table 7, are classified according to five types (regulatory, research and development, information, education and network formation and voluntary measures). Among the regulatory instruments applied there are regulations, legislations, plan and programs for waste management and

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utilization of residues and secondary raw materials, revealing alignment with EC components. These are present in the documents of the following countries: Germany, Italy and Portugal. Finland has introduced requirements related to the product design and end-of-life solutions.

Fiscal incentives and disincentives are highlighted among the economic instruments applied, since changes in the taxation system affect to changes in business models, production processes and consumer behaviour. Denmark and Spain (Extremadura) are among those countries utilizing these instruments to promote the transition.

Research and development are combined with economic incentives such as R&D funding (Spain/Extremadura and Portugal) with other activities promoted by incubators and innovation centres for the development and adoption of circular technologies, as in Spain and Denmark.

Among instruments for information, education and network formation are worth noting those promoting education and knowledge dissemination, such as in Spain, Finland and Portugal; access and systematization of data (France and The Netherlands), besides formation of networks and platforms for sharing of physical resources and information (Denmark, Spain and France).

Table 7. National strategies and legislations for promotion of circular economy in Europe. Source: Circular Economy Platform (https://circulareconomy.europa.eu/platform), Ecopreneur.eu (2019), countries websites.

Country	Year	Title, Type of Document and Reach
Germany	2012	Act to Promote Circular Economy and Safeguard the Environmentally Compatible Management of Waste (Legislative Act, National)
	2016	National Programme of sustainable consumption: From Sustainable Lifestyles towards Social Change (Framework program, National)
	2019	German Packaging Act (Legislative Act, National)
	2016	Resource Efficiency Program Phase II (Framework program)
Belgium	2016	Regional Program in Circular Economy 2016-2020 Mobilizing resources and minimizing lost wealth: for an innovative regional economy (Program)
	2017	Circular Flanders Kick-off Statement (Report, Flanders Region)
Denmark	2018	Strategy for Circular Economy: More value and better environment through design, consumption, and recycling (Strategy, National)
	2017	The Advisory Board for Circular Economy - Recommendations for the Danish Government (Guidelines, National)
	2017	Circular Economy - Denmark as Circular Economy Solution HUB (Guidelines, National)

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Spain	2018	Extremadura 2030 – Green and Circular Economy Strategy (Action plan)
	2015	Promoting the Green Economy and the Circular Economy – Competitiveness, Efficiency, Innovation (Act, Cataluña Region)
	2019	Circular Economy and Waste Management in the Basque Country (Action plan, Basque Country)
Finland	2016	Leading the cycle Finnish road map to a circular economy 2016–2025 (Roadmap, National)
	2019	Finland's Road Map to Circular Economy 2.0 (Roadmap, National)
	2017	Regional road map towards circular economy in Päijät-Häme (Roadmap, regional)
	2019	Riihimäki's circular economy roadmap (Roadmap, local)
France	2018	Circular Economy roadmap of France: 50 measures for a 100% circular economy (Guidelines, National)
	2017	Paris Circular Economy Plan (Roadmap, local)
The Netherlands	2016	A Circular Economy in the Netherlands by 2050 - Government-wide Programme for a Circular Economy (Roadmap, National)
Ireland	2017	Moving Towards a Circular Economy in Ireland (Report, National)
Italy	2017	Towards a Model of Circular Economy for Italy - Overview and strategic framework (Guidelines, National)
Portugal	2017	Leading the transition [Action plan for circular economy in Portugal: 2017-2020] (Roadmap, National)
Greece	2018	National Action Plan on Circular Economy (Roadmap, National)
Luxembourg	2018	National Waste and Resource Management Plan (Roadmap, National)
Slovenia	2018	Roadmap towards the Circular Economy in Slovenia (Roadmap, National)
	2018	Strategy for the Transition to Circular Economy in the Municipality of Maribor (Strategy, local)
Slovak Republic		Slovak Republic goes green economy (Roadmap, National)
Malta	2018	Malta's Sustainable Development Vision for 2050

According to Ecopreneur.eu (2019) the following countries do not have CE strategies: Austria, Bulgaria, Croatia, Cyprus, Hungary, Latvia, Lithuania, Poland, Romania, and Sweden. Estonia and Czech Republic are designing their own CE strategies. The latter is planning to launch its strategy in 2021. A national strategy for Spain is also under development (MITECO, 2018).

Milios (2018) has identified three policy areas that can contribute to circular economy. These are 1) policies for reuse, repair and remanufacturing; 2) green public procurement and innovation

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procurement; and 3) policies for improving secondary materials markets. Policy measures within these policy areas have the potential to influence the resource efficiency of products and services, reflecting the core principles of CE. Transition to circular economy would be enabled by developing policy mixes rather than individual measures. Policy mixes can better tackle the complexity of systemic challenges related to CE (Milios, 2018).

4.1.3 CE Incentives

According to results of the literature search, policy incentives are often presented as opportunities related to solving barriers for implementation of circular economy, either systemic in nature or sector-specific (e.g. ICT). Although no operationalization for the implementation of policies were presented, Whalen, Milios and Nussholz (2018) suggest examples of policy initiatives that can support circular economy. They are:

- Take-back incentives
- Monetary incentives
- Mechanisms to reduction of labour costs (lowering labour taxes)
- Legislative, legal and regulatory frameworks
- Extended Producer Responsibility
- Tax incentives
- Legal waste definitions affecting product end-of-life
- Skills development (training and educational activities) - e.g. training for refurbishers
- [Obligations to] provide spare parts
- [Obligations to] provide product information to repairers, refurbishers, remanufacturers
- Enforcement of longer warranty periods for consumers
- Support to innovative, circular economy-focused business models
- Development of infrastructure for consumers to hand in used products
- Introduction of material efficiency and durability in product design regulation
- Legal framework to facilitate trade of repaired and refurbished goods
- Reduction of value-added tax (VAT) for refurbished products
- Creation of subsidies for reuse that could help reduce operational costs and assist reuse operations.

In the analysis of different CE incentives, they were categorized in the following main categories: Technological, educational, social, regulatory, institutional, market conditions, fiscal, and industrial arrangements. The categories are described in Table 8. Incentives in each of these categories is presented in the following paragraphs. In the analysis also the nature of incentives has been considered. Positive incentives are for example pricing reduction for secondary products, tax reductions and negative incentives for example penalties for not adequate waste collection, and

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charges and restrictions for the landfilling and incineration of waste. Mostly the analysed incentives are positive, encouraging the target groups to transition towards circular economy. Some incentives include both positive and negative aspects, e.g. deposit schemes can be voluntary but opting out would lead to tax increase.

Table 8. Circular economy incentives.

CE Incentive category	Description
Technological incentives	Incentives aiming to speed up the development of different technological solutions and innovations for circular economy.
Educational incentives	Incentives aiming to increase knowledge and awareness on resource efficiency and circular economy. Education can raise awareness on the need for and benefits of a circular approach as opposed to a linear approach to production and consumption.
Social incentives	Incentives and activities aimed at engaging consumers and the society at large in circular economy. Awareness raising is an important area. Campaigns and other awareness raising tools can be used to engage consumers more in repair and reuse of products.
Regulatory incentives	Regulations related to implementation of circular economy. Examples include ecodesign, waste and extended producer responsibility.
Institutional incentives	Institutional incentives include policy measures, strategies, roadmaps that aim to promote circular economy implementation. Policy will have a central role in achieving improved handling of materials and implementation of circular economy principles.
Market conditions	Incentives to create markets for secondary raw materials, repaired, reused and remanufactured products.
Fiscal incentives	This category includes fiscal incentive such as taxation, subsidies, financing, and internalising the cost of externalities. Starting point should be identifying and eliminating subsidies that are harmful for the environment.
Industrial arrangements	Industrial arrangements incentives refer to activities aimed to facilitate collaboration and partnerships in circular business. Enabling and rewarding value chain collaboration is needed to align interests of partners.

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4.1.3.1 Technological incentives

This category refers to incentives that are aiming to speed up the development of different technological solutions and innovations for circular economy.

European Environment Agency (2019b) has emphasized that there is a need for much greater investment in sustainability-oriented research and experimentation. Policy support is needed to help innovations bridge the 'valley of death' between research funding and commercialization. Meeting the investment needs will depend on policies that correct market incentives, reduce risk and uncertainties, and incentivize private investment. Investment programs to support implementation of circular economy solutions have been suggested e.g. by (SITRA, 2019). In Sweden, a circular and bio-based economy innovation partnership programme has been established. The purpose of this programme is to identify innovative solutions for circular economy throughout all sectors and industries with the focus on actions and co-financing by companies (SB Insight, 2019).

European Commission has established Environmental Technology Verification (ETV) programme. ETV offers a verification procedure to new environmental technologies that may otherwise find it difficult to establish their environmental added value. The verification procedure provides an independent assessment and validation of the manufacturer's claims on the performance and environmental benefits of their technology. The information produced by the verification is public and can be used to compare performance parameters. This can be used to convince third-parties of the merits of a technology and enhance market value and acceptance of the technology. (European Commission, 2011)

Extending the life of products, making them repairable and using products more efficiently should be encouraged. Incentives aimed at fostering circular design and the development of new circular products, services, and business models have been suggested e.g. by the Dutch government (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016).

Platforms for sharing data in order to improve the circulation of materials are needed. Currently, there is no precise data on the quantity, quality and composition of the materials used in the built environment. To enhance the reuse of materials, there should be more information available on the composition, total amounts and geographical locations of materials in use or available for recycling (SITRA, 2019).

Industry and research collaboration initiatives have been initialised to develop CE solutions. One example of this type of arrangement is RE:source in Sweden. RE:Source is a meeting place for

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stakeholders from the Swedish industry, waste management and research sectors to cooperate and apply for funding for their innovation projects. The program focuses on the field of resource and waste management (SB Insight, 2019).

4.1.3.2 Educational incentives

This category refers to the incentives aiming to increase knowledge and awareness on resource efficiency and circular economy. Education can raise awareness on the need for and benefits of a circular approach as opposed to a linear approach to production and consumption. School and university curricula could provide early exposure to students about approaches to resource efficiency and circular economy (Ghose and Kapur, 2019).

EIT RawMaterials has been active in the development of education. The RawMaterials Academy is the overarching brand of their education activities. These activities cover the entire ecosystem of learners, i.e. PhD students, Masters' students, industrial partners, professionals within the raw materials sector, and wider society. The aims of the RawMaterials Academy are (EIT RawMaterials, 2019):

- To introduce society as a whole to the importance and relevance of raw materials and incite interest in topics related to raw materials
- To train current and future stakeholders to the technical standards required by the raw materials industry today – contextually across the entire raw materials value chain
- To foster the entrepreneurial and innovation skills, knowledge and attitudes needed for the entre- and intrapreneurs of tomorrow

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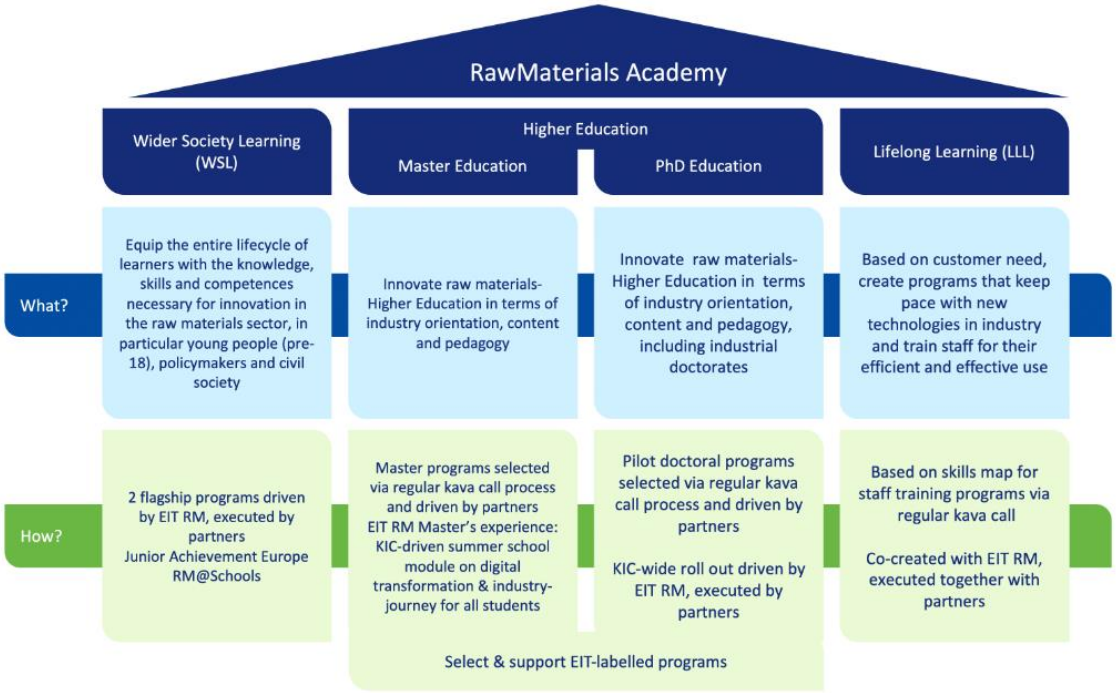

Figure 2. EITRawMaterials education areas and activities (EIT Raw Materials, 2018).

Schools and education play an important role in achieving targets related to carbon neutrality and circular economy. Currently, there is limited amount of teaching material on sustainable everyday life and the circular economy available for primary school pupils (SITRA, 2019). One example of teaching material is the Circular Classroom, which is an interactive educational toolkit for upper secondary high school educators and students to integrate circular thinking into the classroom. The toolkit includes workbooks and support materials for educators and videos and activity workbooks for students (Acaroglu, 2018; Circular Classroom, 2019).

In the Netherlands, the government aims to embed the circular economy firmly in education. For the higher education sector, a Circular Economy Platform will be set up for lecturers at Universities of Applied Sciences with the objective of developing and coordinating research programmes, and exchanging knowledge. For secondary schools, the Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs have set up the Duurzaam Door programme (Sustainably Forward).

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4.1.3.3 Social incentives

This category refers to incentives and activities aimed at engaging consumers and the society at large in circular economy. Awareness raising is an important area of social incentives. Campaigns and other awareness raising tools can be used to engage consumers more in repair and reuse of products. Information awareness tools, such as campaigns, development of a reparability label, providing information on the availability and price of spare parts and repair services can be used (Cambridge Econometrics, Trinomics and ICF, 2018).

Product durability labelling has been suggested as one incentive to provide information of the expected lifetime of a product at the time of purchase (RREUSE, 2015b). Key questions related durability labelling need to be solved before it can be implemented. These include the scope of the durability labelling, scheme for consumer information, how it should interact with other policies, whether it should be standalone information or provided through existing labelling schemes, and how the information may best be conveyed to consumers (Dalhammar and Richter, 2017).

Reuse of products can be incentivised using reuse targets. In Flanders, Belgium there is already a reuse rate of 5 kg reused material / capita being achieved by a network of approved reuse centres from the social economy, supported by a separate reuse target. The reuse centres collect around 64,000 tonnes of material annually, of which half is reused. This activity employs 5000 people as a result, and is equivalent to re-using around 1% of municipal solid waste generated in the Flemish region. (RREUSE, 2015a)

According to Circle Economy (Douma *et al.*, 2018), in circular economy jobs will shift from the extraction and the manufacturing industry towards repair, remanufacturing, bio-based and renewable energy sectors. The trend is towards increased demand from cross-cutting competences, such as problem solving and communications. Promotion of jobs and adequate skills can be done via CE policies as well as education and training policies, paying particular attention to impacts in affected sectors (raw materials, durable goods such as electronics, machinery, cars and accommodation, and construction).

Circular economy policies will contribute also to higher employment levels. By 2030, compared to baseline scenario, GDP will grow by almost 0,5% and there will be additional 700.000 jobs due to higher demand from recycling plants, repair and rebounds in consumer demand from savings through collaborative actions (Cambridge Econometrics, Trinomics and ICF, 2018). As an example, key elements for circular employment in the Amsterdam Metropolitan area are incorporating digital technology (representing more than half of the employment in the region), preserving and extending what is already made, design for the future, rethink the business models, use waste as a

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resource, and collaborate to create joint value (Douma *et al.*, 2018). Practical actions that municipal policymakers can deploy to develop circular skills within the workforce are:

1. Develop necessary skills in practical experience and training through public private partnerships (between education and business) and apprenticeships.
2. Ensure the necessary cross-sectoral collaboration and interdisciplinary thinking in the circular economy by focusing on early cooperation between different vocational training courses.
3. Integrate principles of the circular economy into University programmes and schools to enable graduates from all disciplines to contribute towards the circular economy.
4. Capitalise on the competitive advantage and defining character of a city to further maximise the potential of the circular economy.

4.1.3.4 Regulatory incentives

This category includes regulations related to implementation of circular economy. A supportive, well-functioning, policy and regulatory framework is needed for the transition to a circular economy. Such a framework should be designed to enable the intrinsic value of materials to be preserved or enhanced along production systems and value chains and to minimise at the same time the level of inputs of virgin materials. The current policy and regulatory framework is not sufficient for circular economy business models and value chains to succeed (European Commission, 2019a). According to the European Commission Expert Group on Circular Economy Financing, the following principles need to be taken into account when formulating policy interventions (European Commission, 2019a):

- Value preservation and creation
- Proportionality (to the level of externality)
- Progressive dematerialisation
- Sensitivity to innovation
- Additionality, which is the need to ensure that new policy interventions integrate with and support the effective and timely implementation of existing related policies or enhance their impact.

Existing regulation related to CE include for instance, Ecodesign Directive and Ecodesign Working Plan 2016-2019, Waste Framework Directive, Extended Producer Responsibility and EU Ecolabel. Extended Producer Responsibility (EPR) is one regulatory incentive that has been implemented in several areas during recent years. Rezero (Mitjans Sanz *et al.*, 2017) refers to EPR as a set of instruments to be implemented through administrative, economic, and informative policy

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instruments. In EPR, the producer's responsibility for a product is extended to after the use stage of a product's life cycle.

Enhanced EPR measures could help to improve EPR schemes in three main ways (Watkins *et al.*, 2017):

- They could help to improve the implementation of legislation (e.g. to attain existing and new, more ambitious, waste targets), and the integration of EPR into environmental and circular economy objectives (e.g. through wider application of EPR to other products). This would contribute to reducing the environmental externalities of packaging waste (e.g. natural resource depletion, GHG emissions and waste leakage to terrestrial and marine environments, with associated impacts).
- Changes to EPR could deepen its scope, and strengthen the financial incentives for eco-design. Economic incentives should be developed to favour circular products and business models (e.g. through harmonised criteria and the further application of modulated fees to support the waste hierarchy and incentivise more environmentally sustainable products).
- Improved EPR could enhance the market performance of existing schemes. This could be done by: developing clearer definitions at the EU level to support harmonised approaches; ensuring clear allocation of responsibilities between stakeholders; ensuring maximum cost coverage; facilitating fair competition; and ensuring transparency on schemes' performance and costs.

Modulated fees that vary based on product features that have environmental impacts (e.g. not recyclable, toxic additives disrupting recycling) could be one measure to develop EPR. Ecopreneur.eu (2019) recommendations for improving EPR include the following:

- France and Belgium provide good examples of EPR.
- More sectors can be covered by EPR, even by countries with good coverage already.
- EPR has the unique potential to foster innovation in circular design for all companies by applying eco-modulation of fees to give a positive economic incentive.

Ecodesign Working Plan 2016-2019 (European Commission, 2016) proposes that material efficiency, repairability, remanufacturing and recycling aspects should be considered already in the design phase of products. The goal is to include aspects such as durability, reparability, upgradeability, design for disassembly, information and ease of reuse and recycling, greenhouse gas and other emissions. It aims to extend the previous Ecodesign Directive (European Commission, 2009) that focuses on energy efficiency aspects.

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4.1.3.5 Institutional incentives

Institutional incentives include policy measures, strategies and roadmaps that are targeted to promote circular economy implementation. Policy will have a central role in achieving improved handling of materials and implementation of circular economy principles. Starting point could be to re-examine pre-existing policies. Material Economics (2018) report states that current targets for materials collection could be reformulated to take aim at secondary materials production and material value instead. The current 'producer responsibility' framework creates weak or non-existent incentives but could be steered towards a degree of individual rather than collective accountability, enabled by new technology for the marking and tracking of products. Without the introduction of these types of policies, secondary material will continue to face an uphill battle to reach markets. EU published the CE Action Plan in 2015 (see Table 5.). In December 2019, the EU Commission published the European Green Deal to *transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use.* The Commission will launch a new circular economy action plan to stimulate the development of lead markets for climate neutral and circular products. (European Commission, 2019c)

Several EU Member States have developed roadmaps for transition towards the circular economy. According to the Ecopreneur.eu (2019) currently 15 EU Member States have defined a CE roadmap. National roadmap is one powerful lever for change. The process of formulating it creates support within the government, fostering cooperation between the ministries involved, and from stakeholders. In addition, Ecopreneur.eu (2019) encourages to follow the example of the Netherlands to set a target to develop a circular economy by 2050 and the interim objective of a 50 per cent reduction in the use of primary raw materials (minerals, fossil and metals) by 2030.

One example of an institutional incentive is the European Circular Economy Stakeholder Platform (European Union, 2017). This is a joint initiative by the European Commission and the European Economic and Social Committee. The Platform brings together stakeholders active in the broad field of the circular economy in Europe. As a "network of networks", it goes beyond sectorial activities and highlights cross-sector opportunities. It also provides a meeting place for stakeholders to share and scale up effective solutions and address specific challenges. The Platform bridges existing initiatives at local, regional and national level, and supports the implementation of circular economy.

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4.1.3.6 Market conditions

Market conditions refer to the incentives to create markets for secondary raw materials, repaired, reused and remanufactured products. Level playing field incentives are needed to create similar market conditions (e.g. legislation, tax system). Stimulating a level playing field between different business models and raw versus secondary or recycled resources and materials may require further fiscal policy instruments, such as material or resource taxes (European Commission, 2019a; European Environment Agency, 2019a). Today's playing field is still far from level, and measures such as requirements for the use of recycled material in new products may be required. International cooperation will be crucial. Most products and materials are international commodities, and it is necessary to coordinate policies, at EU level and internationally (Material Economics, 2018).

Circular public procurement could be one instrument to promote circular economy. SITRA (2019) has proposed that the government should set up a risk funding instrument in support of innovative public procurement and provide resources for it. It would encourage towns to procure and companies to scale up circular economy solutions. European Commission (2012) has published a collection of good practices of green public procurement. The examples illustrate how European public authorities have successfully launched green tenders, and provide guidance for others who wish to do the same.

The Cabinet in the Netherlands aims to give more attention to integral life-cycle costs, environmental performance and the social costs during and after the first life cycle of a product. It will boost these goals by purchasing more circular and biobased goods, thus creating or enlarging the market for sustainable and circular products and services. In the memorandum on Socially Responsible Purchasing, this is extensively discussed, as is the endeavour to raise the proportion of circular procurement to 10% by 2020. (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016)

Deposit and refund schemes (DRS) are economic incentives where an amount of money is levied when the product is sold, and then refunded when the good or its container is returned after use. This provides a clear incentive for consumers to return end-of-life products. Most deposit and refund schemes are used effectively to ensure high rates of recovery of drinks containers or other packaging, e.g. transport packaging such as boxes or pallets. However, only a few examples exist where deposit is used to encourage the collection of other end-of-life products, including products that could be hazardous or toxic –such as tyres or batteries– when not separated of the general waste stream. Deposit-refund schemes need policy intervention only where there is an important and identified reason for separate recovery of items that would not otherwise happen on a

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commercial basis. DRS can be a straightforward way of achieving many of the aims of EPR and no incompatibility exist to implement DRS arrangements within EPR schemes (Mitjans Sanz *et al.*, 2017).

One example of deposit scheme is Palpa in Finland. Primarily, a beverage packaging tax of EUR 0.51 per litre must be paid for beverage packages in Finland. However, manufacturers and importers of beverage packages can be exempted from the beverage packaging tax by joining a deposit-based recycling system approved by authorities or by organising one themselves. A separate membership fee is paid for the membership of each recycling system. In year 2018 the return rates in Finland were: cans 95 %, PET bottles 90 % and glass bottles 88 %. (Simons *et al.*, 2018)

Standardisation is one tool to create level playing field in the market. Standardisation and modularisation of components is needed e.g. for enabling reuse and creating product designs which allow easy disassembly (Technopolis Group, 2016). Circular design that includes improvements in materials selection and product design lie at the heart of the circular economy. Standardisation or modularisation of components, purer materials flows, and design for easier disassembly are key aspects in circular design. (Ellen MacArthur Foundation, 2015)

Standardisation of requirements across the value chain would boost collaboration between partners. Product certifications and calculations such as Life Cycle Assessments (LCA) on the potential impact and environmental aspects of products allow to track sustainability across the value chain. Through specific standards, it is possible to assess how goods are produced, and subsequently disposed of at the end of their lives. This can facilitate the identification of socially responsible suppliers for a company's value chain, in favour of circularity. (Houston *et al.*, 2018)

4.1.3.7 Fiscal incentives

This category include fiscal incentive such as taxation, subsidies, financing, and internalising the cost of externalities. Starting point should be identifying and eliminating subsidies that are harmful for the environment (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016; European Environment Agency, 2019a).

European Commission (2019a) report on accelerating the transition to the circular economy have identified areas where incentives would be needed:

1. Level playing field incentives that enable circular business to have a better chance to compete and succeed in the market

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2. Value chain collaboration incentives to enable and reward collaboration to optimise circular economy solutions
3. Long-term value creation incentives to reward product longevity models
4. Market participation incentives to engage end-users in the value chain to ensure circularity of products and material
5. Integration of public good incentives to take into account the cost of negative externalities and the benefits of positive externalities
6. Finance knowledge build-up incentives to increase the understanding of financing circular business models
7. First mover's action incentives to create market demand and engage consumers in circular business models

Stimulating a level playing field between different business models and raw versus secondary/recycled resources and materials may require further fiscal policy instruments. These include material and resource taxes. Environmental tax can be implemented at different stages of the value chain: 1. at the extraction stage; 2. at the input of the material to its first industrial use; 3. at the final consumption of products including the material. All three approaches have advantages and disadvantages in terms of improving resource efficiency, requirements related to administration, uncertainties, and side effects and issues related to international trade. (European Environment Agency, 2019a)

Setting a minimum level of landfill tax to be applied by Member States to increase the recovery rate of materials has been suggested (Watkins *et al.*, 2012) . A common method for calculating a minimum tax level could be developed. Means of executing this policy option could include revision of relevant directives, a decision addressed to Member States or guidance issued to Member States.

Incentives for financing circular business models would be needed. There is need for a clear understanding of what circular business models are and e.g. what are the financial implications for producers of managing products as assets instead of selling them. Finance providers should be able to understand the financial and operational risks, as well as the residual value after a product's first life. In addition, there is need to work out clear contractual agreements between the circular service provider and the financing party. (European Environment Agency, 2019a)

Internalising externalities is an area where fiscal incentives can play a role. One example is related to greater transparency in the food value chain. The Dutch government is studying the opportunities that true pricing offers, ascertaining the real costs of food, including any external

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effects that can later lead to costs elsewhere (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2016).

4.1.3.8 Industrial arrangements

Industrial arrangements incentives refer to activities aimed to facilitate collaboration and partnerships in circular business. Enabling and rewarding value chain collaboration is needed to align interests of partners (European Commission, 2019a).

Platforms to facilitate business collaboration have been established in various countries. In Sweden Bio Innovation platform has been set up as a collaborative cooperation between government and industry to promote a bio-economy in Sweden by 2050 (SB Insight, 2019). The Strategic innovation program is financed by the Swedish Innovation Agency Vinnova, the Energy Agency and Formas, and by stakeholders.

Promoting and financing new CE business models is necessary. The circular economy offers growing global business opportunities. The funding of circular business aimed at strong international growth typically requires major risk-carrying capacity from the funding providers. Therefore, provision of funding in the form of venture capital investments plays an important role in the operation of circular economy-sector companies (SITRA, 2019).

Voluntary agreements between companies can promote circular economy implementation. As an example, In Finland, a voluntary corporate water responsibility has been established. There is room for improvement in using water in sustainable way, for example, in the management of impacts of individual production plants on water bodies and the prevention of scattered loading of water bodies (SITRA, 2019).

Industrial symbiosis has been defined as engaging "traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and by-products. The keys to industrial symbiosis are collaboration and the synergistic possibilities offered by geographic proximity" (Chertow, 2000). Waste streams of one sector can be used as resources for other sectors, thus providing opportunities to replicate the functioning of natural ecosystems. Industrial symbiosis allows to understand resource flows in the economy and to identify inefficiencies (Cambridge Econometrics, Trinomics and ICF, 2018). Policies to improve collaboration within and across sectoral value chains especially at local level can foster further applications of industrial symbiosis approaches (OECD, 2018; European Environment Agency, 2019b).

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4.2 Interviews

This chapter discusses the main results of the stakeholder interviews. The results are divided into barriers and drivers of CE, CE incentives, effectiveness of incentives and areas lacking incentives and future vision of CE.

4.2.1 Barriers and drivers of CE

Barriers for CE identified in the interviews are presented in Table 8.

Table 8. Barriers for CE incentives based on the interviews.

Barriers	Quote
Limited weight of CE businesses in lobbying	"Waste management is sector is a quiet, small player in Brussels. It's a big issue, but powerful associations or chemical companies have a lot of means so to speak." "My feeling is that, there is no industry or sector who is lobbying right now for circular economy actively. As a sector, you know, I don't see for example the car industry, saying we need a clearer legal framework for extending the life of battery for example, I don't see no one doing that. There were the, push for the opposite, to keep maximum freedom in operating, producing and managing the disposal of the product."
Plans for achieving recycling targets are missing	"They usually set very high targets for recycling in Europe, but they never really tell you how to achieve this target and the market views is usually not really, taken into account so, this is what should be done, but it's not. The only tool I've seen lately is the one I mentioned before, the minimum recycled content."
Reuse targets are largely missing	"For us the main, barrier is, the fact that, there is no legal target for reuse. It gives clearly an advantage to, premature recycling."
Technology	"We need the technology to develop because you know when they are doing this kind of circle with recycling, after a while especially for some metals, like copper or something, you get impurities to it, to some extent, that the recycling is not possible. So we need also technology to actually overcome that part."
Cost disadvantage of secondary materials	"The point is that most of the time the secondary product is, by definition more expensive than, fossil product." "But one area, where the recycling input rate is very low is for example rare-earth metals. And the situation there is that the, what do you have that push for the increased recycling, either you have a legal obligation, a legal target for recycling or that you have a market-driven, driver for the enhanced recycling. And as concerns rare-earth metals, you, will know that the market is such that there is no push for recycling because you can sort it in a much cheaper and easy way from primary extraction."
Cost disadvantage of reuse vs. recycling	"When you treat products which are, hazardous for the environment like for example we have members working with fridges, you need to respect very detailed standards and requirements to be able to do that, it can be quite costly. So it's important that,

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	reaching these requirements is financed by the producers, by any actor which is able to do that so local authorities, governments." "When producers and retailers have the control on the waste stream, they finance only recycling, because they don't necessarily want to finance preparing for reuse because it might be more expensive. Indeed it's, more labour-intensive which is interesting for social economy enterprises but not for, normal enterprises. And also because for producers and retailers, having second-hand products put back on the market is not really..."
Quality concerns	"Lack of acceptance for the users, so people using material and a lack of confidence. You know they go for the materials they know, and it's more complicated to go for secondary products so they don't do it." "Standards for products are an issue because some of them actually prohibit or restrict the use of recycled material. And we think some products could have a lot more recycled content. Let's say pipes for instance. And the reason why they prevent the use of, recycled plastics if because they take the origin into account and we think, what should be taken into account is the, specification. So if plastic which, which has a very specific specification, it should be taken into account regardless or whether it's waste or virgin" "When you listen to product manufacturers, sometimes they complain about the quality of recycled materials. I think one of the key area we have to work on is quality, how do we reach good quality"
Lack of alignment between regulation among countries	"Barrier to a more dynamic let's say market for secondary raw materials is that, there is a lack of alignment between end-of-waste criteria in different member states. You know the situation that one specific, material type, might be classified as waste in country A, and as product in country B, which of course lead to different legal requirements, different waste or product legislation and which makes a single market for these type of secondary raw materials quite heavy."
Availability and access to raw / reused material and products	"it's important to be able to have access to the waste stream. Because often this, the waste stream is not available for them" "in terms of, ecodesign, what is extremely important is to have access to repair information, to have access to, spare parts... having access to spare parts in the products so to basically to be able to dismantle a product without destroying it" "It's about 12 to 15 kilogram, very simple metal copper for the car. But if we want to go towards the electric vehicles, the consumption of the copper, is 80 kilogram per car. So it's almost four times or five times, of the consumption. Where it's coming from, it should come from the mine. So the people should understand it. If they want something, they have to actually accept, to be, to give the license to operate for the mining industry to, actually open it, to open mine for the future."
Challenges of CE are systemic	"I think in almost every sector, the challenges related to the circularity, they are very systemic and, there might be some systemic challenges that the companies can't really address. For example, if we think about the textile sector, there is a wide variety of challenges related to the unsustainable consumption of the clothes and how much they cause climate emissions and pesticide use and, water scarcity in the developing countries. So, the challenges to, that there are, it's not only about the business model. It's also about the, like the whole, for example, in the textile sector about the whole paradigm and whole consumption, the current consumption patterns of the most

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	customers and so on. So, those kind of systemic challenges might be that, prevent companies to take those steps towards circularity."
Finding markets	"Price gap is the main barrier to achieving something. Because, it should work as a market but it's not a usual market because we don't really have a, control over the demand side, the supply side because we get waste and we treat waste and then we, we have to find outputs, and this is where we have an issue. We would invest a lot more in recycling, in sorting, in collecting... if we had a clear view and visibility on the different outlets." "For plastics, we have markets that are for PT, PP. But then for specific other areas we hardly have markets. And the question of quality is very important for our clients, so maybe having standards would allow more confidence in those emerging markets."
Unrealistic expectations for CE (e.g. zero waste vs. minimising waste)	"But the thing that I don't like it normally will, or people often talk about that, o zero waste, and within the circular economy. Is it impossible to have a zero waste? And we have to say okay, with circular economy we are minimising actually the amount of the production of the waste, minimising that."

Altogether twelve barriers were identified. The barriers were related to regulation (Lack of alignment between regulation among countries and Reuse targets are largely missing) market aspects (Availability and access to raw / reused material and products and Finding markets), cost and quality concerns (Cost disadvantage of secondary materials, Cost disadvantage of reuse vs. recycling and Quality concerns), technology or implementation of incentives (Plans for achieving recycling targets are missing). More general barriers were systemic nature of CE challenges, unrealistic expectations for CE and Limited weight of CE businesses in lobbying.

Drivers for CE incentives identified in the interviews are presented in Table 9.

Table 9. Drivers for CE based on the interviews.

Drivers	Quote
Policy obligations and taxation systems	"It's a lack of legal obligation. As long as it's only a recommendation, then some of them will do it and others won't care." "Most of the time the secondary product is by definition more expensive than, fossil product. We need a strong willingness from the politics to change this so we need some, either tax incentives with a tax system for secondary products."
Ecodesign	"And also one of the main problem we have with recycling is the way products are actually designed. A good design is a priority. We should design new products properly, they should be recyclable. Which is not the case today, and it's not the case, not only, when dealing with dismantling but also when dealing with substances"
Waste and resource management is taken seriously	"But the good thing is that the topic of waste management and resource management also is, very seriously taken into account in Brussels."

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Job creation - Social integration support from local authorities and government	"10 tonnes of waste collected, if you landfill it, it creates 3 jobs and if you incinerate it, it creates 1 job. If you recycle it, it creates 36 jobs, and if you reuse it, it's 296 jobs. So, given that the objective of social economy enterprises is to create jobs, reusing before recycling just makes sense." "A lot of our members are not, do not receive subsidies because of their waste management work but because of, or thanks to their impact in terms of social integration. So, we receive some financial help from either the government, the local authority, to integrate people on the job market and provide training."
EPR schemes	"It's very important that, social economy enterprises working on reuse and repair activities are helped by their government, by EPR schemes, by local authorities, to reach a better level of quality"
CE and climate neutrality go hand in hand (case critical raw materials)	"in climate neutrality it goes hand in hand with the actions towards higher circularity and circular economy. I would say that the raw materials, that is something that run through both policy streams in a very strategic way. What I mean is that, in order to move towards a more climate-neutral, greenhouse gas-reduced economy activity, we see that the raw materials and especially the high-value, critical raw materials are, they can be found in so many developments. We see for example, I mentioned earlier rare-earth, we see them in magnets in windmills and windfarms and other renewable energy, we know that with the miniaturization of electronics and electrical equipment we have more and more use of, critical raw materials, we have the, whole e-mobility area and the, electric vehicles and the use of different battery, so in all these developments we see that, critical raw materials really play a crucial role."
Lifestyle changes i.e. environmental perspective	"I think the one coming in the first stage is the changing lifestyle, to my opinion.... And a good thing is actually, with the circular economy we have to bring also aim more and more to my opinion, the lifestyle and lifestyle of the people, how the people are.. the lifestyle of the people is nowadays comparing to, maybe, a few decades before. Looking at how the consumption of the material is, critical material, the metals or something like that... I think if you wanted to be more and more in the circular economy way, we have to also change our lifestyle."
Forerunner companies and organisations	"I think, in case of these forerunner companies. it starts from the fact that, they see some kind of changes or forecast these kind of changes in their operational environment, and they see that, they have to become climate-neutral and resource-efficient and, there is going to be increasing demand for these kind of services and products. So, I think those forerunner companies are starting to take those steps earlier and, when the business cases aren't maybe so obvious but, they see that this is where the world is going, and they want to be the forerunners. For example, Neste has been an interesting example how they have changed their, like the focus of their business to these renewable fuels and so on. So, that's how I would describe it." "You know they go for the materials they know, and it's more complicated to go for secondary products so they don't do it, unless, some companies have a strong marketing interest to do it so it would be part of the strategy so they will do it."

EU Commission and Member State policies were identified as one of the main drivers. These include policy obligations and tax incentives, taking waste and resource management seriously, various directives such as Ecodesign and Waste Framework Directive, job creation and EPR

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schemes. Megatrends such as the connection of CE and climate neutrality and lifestyle changes regarding consumption and environmental perspective were also considered important drivers. Lastly, companies and organisations were considered as a driving force for CE. Forerunner companies, ecodesign considerations and adoption of CE as part of strategy were emphasised. Technology was not mentioned as an important driver even though some examples are mentioned regarding a need for new recycling technologies.

4.2.2 CE Incentives

CE incentives identified in the interviews are presented in Table 10. The incentives are categorised into eight categories similarly to the incentives identified in the literature review.

Table 10. CE incentives identified in the interviews

Category	Incentive	Examples
Technological (R&D&I)	Platform for secondary raw materials	Raw materials information system (RMIS)
Educational	University courses on CE	Circular economy in the curriculum of education at Aalto University (FI)
Social	Awareness raising (e.g. NGOs and governmental organisations)	Green Friday (as opposed to Black Friday, awareness raising) Repair truck (teach people to maintain and repair)
	Supporting social economy enterprises	City of Pamplona - waste collection taken care by social economy enterprise
Regulatory	Reuse, preparing for reuse or renewable product targets	Renewable product quotas - e.g. phosphorus and E10 gasoline Reuse targets - Belgium (Flanders) - reuse target 7 kilos per habitant per year, Spain - electronics and municipal waste
	EPR and take back schemes	EPR in France (electronics)
	Recycling rate targets	Collection and recycling rate targets - EU directives and national legislation
	EU directives and actions	Waste Framework Directive Extractive Waste Directive Ecodesign Directive - Resource efficiency for certain products

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		EU CE Action Plan e.g. promoting circularity and best practices in the management of extractive waste European Green Deal
Institutional	Strategies (national, roadmaps)	Sitra's Circular economy roadmap in Finland France food leftover obligations for supermarkets
Market conditions	Standardisation	More resource efficient recycling
	Circular Public Procurement	Emphasizing role of ecodesign in public procurement City of Pamplona - waste collection taken care by social economy enterprise (public procurement)
Fiscal	VAT tax reduction and vouchers for repaired and second-hand products	Repair voucher in Austria Reduced VAT for repair and second-hand activities in Sweden
	Subsidies	Financial incentives - subsidies from social impact of work
	Feed-in tariffs for energy	Feed-in tariffs for energy from waste and refuse-derived fuels
Industrial arrangements	Voluntary pledges	Voluntary pledges for recycling of plastics

Incentives were identified in all the eight categories. Most of the incentives were related to regulatory targets set by EU Commission or the Member States. Other categories with several examples of incentives include social, institutional, fiscal and market conditions.

4.2.3 Effectiveness of incentives and areas lacking incentives

Interviewed stakeholders discussed the effectiveness of existing incentives for CE. Support for CE is indirect, and there is no direct support from policy for recycling or other CE activities. There is a lack of incentives for ecodesign. In addition, incentives related to collection and recycling rate are only for some waste streams and reducing waste is not supported. To increase the effectiveness of policies, transition from recycling targets to impact assessment was suggested. Suggested incentives that would foster CE include increased legal obligations for CE, waste standards, smoother process for license to operate for mining, plastics tax, education and cooperation with media regarding CE, stronger voluntary policies and goals or quota for use of secondary materials.

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Identified areas that are lacking incentives and would benefit from new incentives include temporary ownership of assets, tax incentives for secondary products, removing VAT from secondary materials, subsidies for using renewables and making processes more efficient, good design of products I.e. aspects such as recyclability and reusability, collaboration economy or sharing economy, consumer incentives to produce less waste and deal with waste, increasing recycling rate and more high-quality and material-efficient recycling of specific waste streams.

4.2.4 Future vision of CE

Interviewed stakeholders provided several narratives for the future vision of CE. In general, the current progression of CE was considered slow considering the challenges. The focus is currently on energy sector, even though products and food have also major impact on climate change. The stakeholders envisaged a shift from just recycling to more waste prevention and reuse. More emphasis is put on eco-design, which considers the whole life cycle including the end of life. Design should ensure that no product is put on market without being repairable or at least entirely recyclable. From the perspective of raw materials, future vision includes sustainable access to raw materials outside of the EU, sustainable access to primary extraction and secondary sources within the EU, and increased resource efficiency and recycling. Finally, the CE is seen in its hype moment now and it is not the only one to promote sustainability. In the future, it is hoped it will be part of the mainstream practices aimed at promoting sustainability by the whole society, in a systemic thinking, integrated in education, business models, production systems and government actions at all levels.

4.3 Results of the CE Incentives workshop

In a workshop, paths forward were constructed by co-creating ideas for incentives and to boost circular economy in large. In all together 21 participants attended in the workshop. These experts were divided in four different sub-groups: “Education and awareness, “New technologies and solutions”, “Industrial arrangements”, and “Market incentives”. A fifth category of “Institutional environment” was also planned to organize but was cancelled due to non-appearance of some registered experts.

The logic of knowledge creation is presented in the Figure 2. It follows the idea where different working groups created sub-roadmaps (Appendix 3) from their specific angles. These perspectives are interconnected and share interfaces between each other. In upper abstraction level they

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established a meta-roadmap that can be see taken as more generic view to circular economy, and consequently, summarizing the work of different sub-groups.

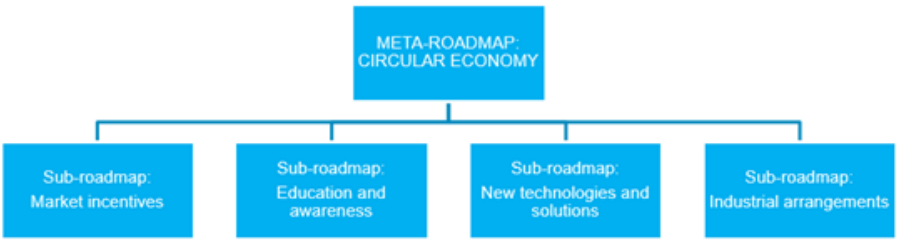

Figure 2. Hierarchy of roadmaps.

As a part of workshop, sub-groups created a specific vision for their roadmap. These visions were:

- Market incentives: "Harmonize, streamline, facilitate taxation public procurement"
- Education and awareness: "Changing the education system by educating teachers in circular economy to raise awareness among students from an early age. Younger generations have higher impact on older generations and on the future"
- New technologies and solutions: "Technologies must come with appropriate circular economy business case for industries"
- Industrial arrangements: "Network arrangements based on trust and common interest that are fair for people, planet and profits"

The vision of the meta-roadmap on its' behalf was constructed as a desk study. It was expressed as "Boosting circular economy incentives in society/Europe", following the aims of the EU CE Action Plan which is to give a new boost to jobs, growth and investment and to develop a carbon neutral, resource-efficient and competitive economy (European Commission, 2019b).

Utilized framework (see Figure 4) consisted of three horizontal layers - action items, mechanisms and impacts. There, action items represent potential activities that would be needed to contribute positive change in a society, mechanism layer identifies change factors that are required to take actions items in practice, and impacts condense expected, desired impacts that can and should be achieved in a transition process.

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Contents of meta-roadmap is presented in the Figure 3. These items are based on the findings of sub-groups work and they been processed as a desk study work after a workshop. Contents of the meta-roadmap are discussed more in detail below.

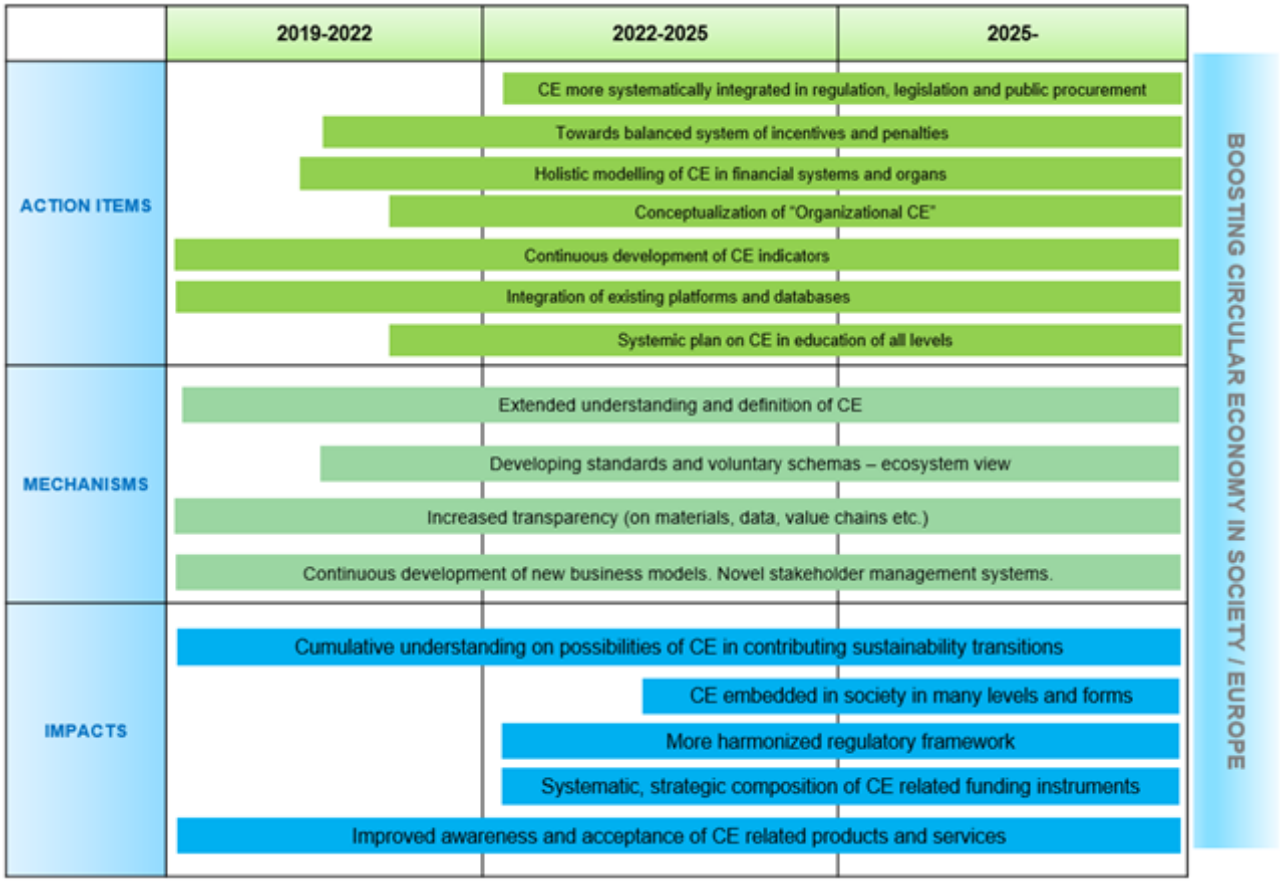

Figure 3. Roadmap summarising the CE Incentives Workshop discussion

4.3.1 Action items

CE more systematically integrated into regulation, legislation and public procurement. The item emphasizes the need to build up increasingly coherent regulative and administrative system to promote and to oversee the development and implementation of circular economy related schemas in the sphere of multi-level governance system (EU, national, regional).

Towards balanced system of incentives and penalties captures both positive and negative factors / mechanisms influencing the implementation of circular economy in various domains. Referring to

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expression of “balanced system” it requires up-keeping holistic modelling on different transformation factors composing commonly the change towards desired direction.

Holistic modelling of CE in financial systems and organs raises the significance of financing factors and mechanisms related to transformation towards society where CE embeds in societal fundamentals. There, creating systemic understanding and modelling on different financial organs and mechanism paves the way for the development of more coherent, transparent and achievable funding system for the use of both applicant and provider side.

Conceptualization of “Organizational CE“ refers to the need for building more structured picture on various ways to implement circular economy in a level of single organization. This covers composing toolbox of variety of existing and emerging tools in/for use. Corporate Social Responsibility & Responsible Business Conduct represent development acts compose existing contexts for implementation of organizational CE.

Continuous development of CE indicators. Due to many factors - but particularly to refer ambitious efforts to combat climate change in line with Paris agreement - circular economy itself goes through continuous transformation process. As the CE enters new domains and as more systemic data will be available, the change process requires continuous research and articulation on indicators of CE. This concern building common methodologies and answering reorganizing basic questions what to measure, how to measure and how to process increasingly multi-dimensional information in comparable ways.

Closely related to previous item, *Integration of existing platforms and databases* establishes apparent ground for data gathering, processing and utilization. As a particular technological domain, the possibilities of big data analyses poses vastly developing possibilities there.

Systemic plan on CE education of all levels refers to observed need to create more comprehensive understanding on existing programs and future possibilities of CE in education systems. Continuity between different levels of an education system is one essential issue to consider. However, education should not be considered only as a way for developing experts, but to consider circular economy as a part of environment awareness raising for all citizens. There, providing individuals with a better understanding of the unintended consequences of their consumption choices is seen one essential topic (OECD, 2018).

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4.3.2 Mechanisms

Extended understanding and definition of CE. Through establishing unified perspective, there is an aim for understanding CE better - and trough that, to boost CE implementation and make it a feasible way to attain genuine sustainable development (Prieto-Sandoval, Jaca and Ormazabal, 2018). In line with this kind of aim to achieve general, shared understanding on basic principles of CE, it seems evident, that circular economy will go on its metamorphosis as our knowledge of this multifilament approach increases, and as CE enters to new domains and contexts. In practical sense, this means that there is need for continuous reflection for crystallizations and re-structuring the concept both in theoretical and practical sense.

Developing standards and voluntary schemes - ecosystem perspective relates to industrial arrangements, wherein e.g. standards create spaces to reduce uncertainty, help creating new business opportunities, and contribute greater flows of materials (cf. Flynn and Hacking, 2019). Ecosystem approach composes conceptual platform to re-structure CE by widening partnering perspectives and stressing knowledge creation aspects. In contrast to developing standards, there may also be cases where downgrading standards can come in question.

Increased transparency creates natural continuum to previous item. Generally, increased transparency refers here to cover all different flows existing between different operators (data, knowledge, technologies etc.). Increased transparency relates closely to the idea of ecosystem way of operation, where trust and mutual learning are creating significant elements when building strategic partnerships. From the viewpoint of material flow, increased transparency is also a key concept in e.g. improving traceability of substances.

Here, *continuous development of new business models* attaches CE related innovation activities to business ecosystem point of view in particular. In this respect, network of different operators such as suppliers, distributors, customers, competitors and government actors establish a flexible and adaptable network of operators that affects and is affected by the others. This responds to needs for e.g. improving collaboration within and across sectoral value chains and fostering novel industrial symbiosis (see OECD, 2018).

4.3.3 Impacts

Sustainability transition can be understood as a long-term, multi-dimensional & fundamental transformation of large socio-technical systems towards more sustainable modes of production & consumption (Markard, Raven and Truffer, 2012). Ideally, proposed actions and mechanisms

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contribute to *creation of cumulative understanding on possibilities of CE in contributing sustainability transitions*. Consequently, this item places CE to respond to global and systemic, environmental challenges, and as such, contributing dramatic changes that our societies will have to face in various fundamental areas such as food, energy, mobility and construction (European Environment Agency, 2019a). In a longer run, CE could be seen as an approach that has been *imbedded in society in many levels and forms*. In a way, we may discuss change towards a state of affairs where different societal activities have adapted principles and methods guiding the development CE originally. *More harmonized regulatory framework* on captures on idea of coherent and fit for purpose -regulative support for the positive development to occur (cf. OECD, 2018), that in turn, function ideally in close loop with the *Systematic, strategic composition of CE related funding instruments*. Finally*, improved awareness and acceptance of CE related products and services* indicate cultural change that is needed to progress towards sustainable development goals in the first place.

5 Discussion and conclusions

In this chapter, the presented results are discussed, and the main conclusions drawn from them. Finally, a synthesis of all results is given.

5.1 Literature review

In the literature review part, barriers and drivers of circular economy are presented and discussed. Main barriers of CE were identified including financial aspects such as high upfront investment costs, low virgin material prices and measuring impacts and financial benefits of CE (Ritzén and Sandström, 2017; de Jesus and Mendonça, 2018; Kirchherr *et al.*, 2018; Tura *et al.*, 2019). Other identified barriers include institutional, regulatory, technological, social and cultural aspects such as hesitant company culture, operating in a linear system, complex and overlapping regulation, limited circular procurement, and lack of consumer awareness and interest, circular design in products, governmental support and large-scale demonstration projects (Ibid.). Main drivers identified in the literature review include financial aspects such as supportive funds, taxation and subsidy policies, finding new revenue streams and gaining profit, resource cost increase and volatility and potential for improving cost efficiency and innovation (de Jesus and Mendonça, 2018; Tura *et al.*, 2019). Other drivers include environmental, social, technological and strategic aspects such as preventing negative environmental impacts, rising resource demand and resource

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depletion, differentiation and strengthening the company brand, social awareness, environmental literacy and shifting consumer preferences and new technologies (ibid.). Following that, the institutional environment is described, followed by circular economy incentives. In approaching the barriers, drivers and incentives, one key challenge is the categorization. This concerns particularly the grouping of incentives: it is not simple to put an incentive into only one category.

The grouping of CE incentives into technological, educational, social, regulatory, institutional, market conditions, fiscal and industrial arrangement, formed the basis for selection of topics for the workshop. Consequently, workshop themes were Education and awareness, New technological solutions, Industrial arrangements and Market incentives. The literature review shows that there is limited amount of scientific literature on the topic of circular economy incentives. The examples presented in the literature cover only limitedly the implementation, impact and effectiveness of incentives. Examples focus on areas such as waste management, energy efficiency, remanufacturing and fiscal incentives such as VAT reduction, which is understandable as the EU directives and national regulation have been more focused on these aspects in comparison with for instance reuse.

Incentives for CE is, however, widely covered in different policy publications and reports i.e. grey literature. Related to CE and in comparison with the scientific literature, the grey literature is generally more focused on the economic benefits and costs, governmental agencies and enterprises (de Jesus and Mendonça, 2018). Various types of incentives have been suggested for boosting circular economy in both scientific and academic literature. Mix of different policy measures and incentives has been suggested to be the best way to enable the transition to CE (e.g. Milios, 2018).

5.2 Interviews

Based on the interviews, the main barriers of CE were related to regulatory aspects, market conditions and technological and social aspects. In general, the challenges of CE are systemic. Regulatory barriers included the lack of reuse and recycling targets and the lack of alignment between regulation among countries. Related to market conditions, aspects such as cost advantage of virgin materials and recycling in comparison to reuse, availability and access to raw or reused material and products and finding markets for secondary material and products were emphasised. Technological and social barriers, such as perceived quality concerns of secondary materials and reused products, and limited weight of CE businesses in lobbying were identified. Main drivers identified in the interviews are related to regulatory aspects such as directives, strategies and

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roadmaps at EU and national level, connecting CE to megatrends such as climate neutrality and environmentally aware lifestyle and the role of forerunner companies in adopting CE.

Incentives were identified in all the eight categories. Most of the incentives were related to regulatory targets set by EU Commission or the Member States. Examples of regulatory incentives included reuse and recycling targets, EPR and EU directives. Other categories with several examples of incentives included social, institutional, fiscal and market conditions. Examples of these include awareness raising campaigns, circular public procurement and VAT tax reduction. Other mentioned incentives were platform for secondary materials, university courses on CE, national strategies and roadmaps and voluntary pledges.

Opinions of interviewed stakeholders were divergent on whether the incentives should be negative or positive. Some considered that legal obligations are the best way for implementing CE, whereas others believed in education, standardisation and subsidies. Shifting focus of incentives from recycling activities to higher circular value activities such as waste prevention, maintenance, repair and reuse was suggested. However, value potential was identified also in recycling and recovering materials from the waste streams. Ecodesign was considered crucial in the transition towards CE. To increase the effectiveness of incentives, transition from recycling targets to impact assessment was suggested.

5.3 Workshop

Looking at future directions, arranged workshop approached CE from various, simultaneous angles to generate guidelines for sustainable transition to occur in a future. Based on the work conducted in working groups of “Education and awareness, “New technologies and solutions”, “Industrial arrangements”, and “Market incentives”, meta-level roadmap was established to crystallize workshop’s findings. In a context of incentives, we may view this data as a ground to create holistic frames for establishing novel incentives. As such, few key observations seem important to address.

First point is mostly a methodological note and concerns the systemic nature of incentives. It can be argued, that there is some tendency to position incentives more or less in mechanical or quite narrow way - despite of their multifilament nature. As a response, we bring out a need to capture incentives in frames of large societal, transformative change modelling, that pays attention not only to the immediate socio-technical environment, but to create integrative platform for understanding different incentives and other change factors to work as a whole. Practically, this may have an implication of more sophisticated system of incentives to emerge, that constructs and

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develops incentives in a more structured and holistic manner - and as such, to contribute positively in striving systemic change into a desired direction.

Another observation relates to transformation process of circular economy itself. As an approach, it is entering new domains and contexts continuously. To support this development comprehensively, the following items compose essential change factors now and in future:

- To integrate CE systematically into regulation, legislation and public procurement
- To create holistic modelling of CE related instruments in different systems and organs
- To conceptualize of "Organizational CE", where more structured picture is established on various ways to implement circular economy in a level of single organization
- To assure continuous research and articulation on indicators of CE
- To integrate existing platforms and databases to improve data gathering, processing and utilization
- To conduct systemic plan on CE education of all levels to create more comprehensive understanding on existing programs and future possibilities of CE in education systems
- To apply ecosystem approach to re-structure CE by widening partnering perspectives and stressing shared knowledge creation aspects
- To go on persistently multifold actions to increase transparency in all levels, domains and technical grounds
- To support emerge of CE related business modelling & To support capabilities and operational models that increase collaboration within and across sectoral value chains and enable novel industrial symbiosis to develop

5.4 Synthesis

Based on the analysis of the scientific literature, reports, roadmaps and strategies related to CE, stakeholder interviews and CE incentives workshop, several CE incentives were identified. These were categorised into technological, educational, social, regulatory, institutional, market conditions, fiscal, and industrial arrangement incentives. There is overlap between these categories and some incentives could be placed in two or more categories, as already discussed above. Figure 4 presents different incentives and how they relate to the main elements of the CE.

As shown in Error! Reference source not found., various types of incentives cover the entire lifecycle of the raw materials and products. As such, this is a valuable piece of information. However, it may also be noticed that incentives related to the initial steps of the loop: raw material and design, are

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much fewer in number compared to those related to steps towards the end of the loop and closing the loop. According to the present understanding, the majority of product's environmental impacts are fixed at the design table, i.e., during the concept and design stages, through various selections. This is a challenge to all current and future CE stakeholders: how to take CE into account as early as possible? Ecodesign directive and introduction of material efficiency and durability in product design regulation will provide the framework for the design activities, but the key issue is to focus on the most impactful aspects in the design. This raises the question: are there, e.g., suitable design and assessment tools that enable to bring the incentives into action?

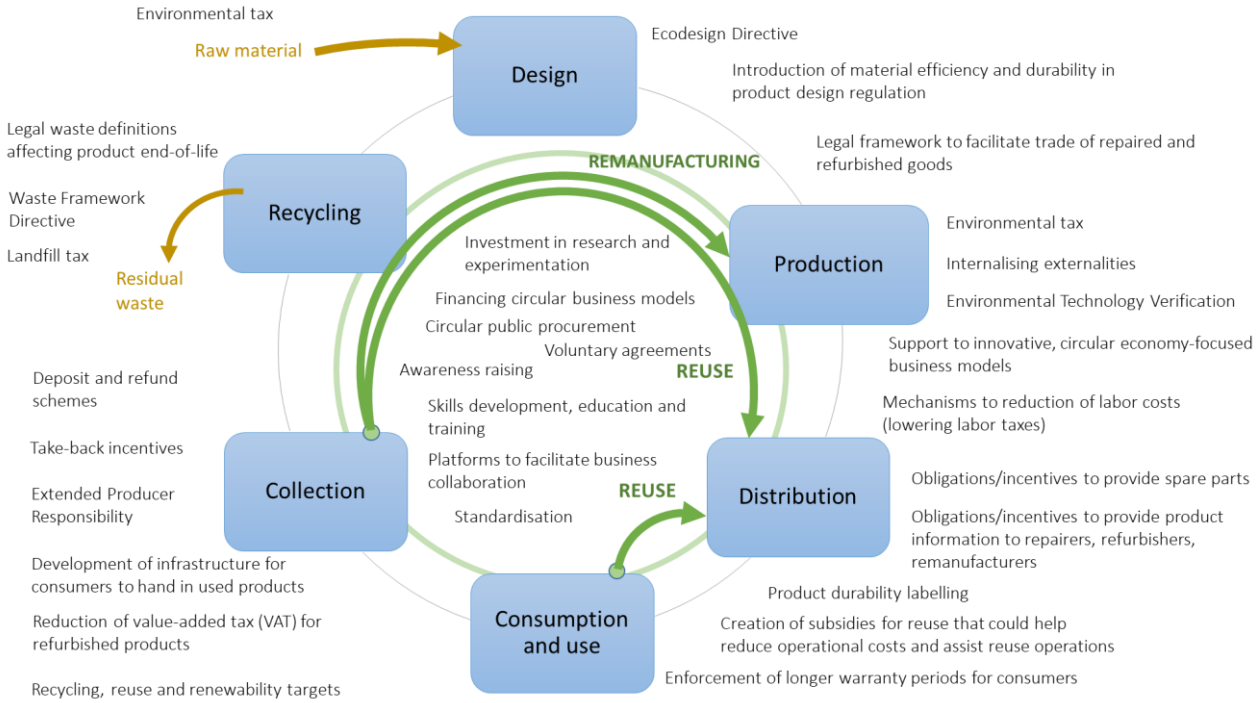

Figure 4. Various incentives that can boost the implementation of circular economy in society.

It appears that there is no straightforward way to compare positive and negative incentives and their effectiveness. This is due to several reasons, but to respond in a general way, incentives are part of complex entity effecting market dynamics among many other factors such as variety of consumption and demand related variables. To make it even more multifilament, the same incentive can have both negative and positive effects on markets - deposit schemes that can be voluntary but opting out would lead to tax increase, as an example. As a response to the research question and challenge of comparing positive and negative effects of incentives, we address the need to develop assessment methods of incentives into a direction where possibilities and

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restrictions of a specific incentive is assessed in more holistic sense. Practically, this does not contain only comparing assumed positive and negative (primary and secondary) impacts of an incentive but to create case specific analysis, where incentive in question should be placed in a profoundly understood, systemic context. In parallel with analysis of data from past and present, this approach should also share dynamic and future oriented dimension, capturing assessment of related drivers and barriers. There, ex ante impact assessment approach represent example of prospective method to assess future impacts of incentives.

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Appendix 1: interview guide

Semi-structured interview

Duration about one hour

- Request permission to record
- Request permission to quote the interviewee

Topics to be covered:

0. Introduction:

Briefly about the project, background of the interviewees

Please tell about your background & focus of the interviewed person

1. General view of CE incentives
    a. How do you define a CE incentive, examples?
    b. What kind of CE incentives you know? How would you categorize them? (economic, regulation, education, awareness raising, market conditions, fiscal)
    c. What are the most relevant barriers/drivers for CE incentives?
2. Benchmark cases
    a. Are you aware of good cases/examples of CE incentives that have been successfully implemented?
    b. Examples of cases where the results have not been what has been aimed at?
3. Effectiveness/impact of incentives
    a. General view on the effectiveness of incentives?
    b. View on effectiveness of particular incentives?
    c. Cases where impact of incentives is shown?
4. Where is there room for improvement
    a. Sectors
    b. Locations / Countries
    c. Types of incentives
    d. Planning
    e. Implementation
    f. Assessment & refinement
5. How different aspects of CE are covered/should be covered?
    a. Products, services design
    b. Reuse
    c. Remanufacturing
    d. Repair
    e. Sharing platforms/business models
    f. Climate neutrality (biobased instead of fossil)
6. Could you express a future view of circular economy regarding current and future approaches?
7. Other comments?

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Appendix 2: Workshop Agenda

Circular Economy Incentives Workshop

Friday 22.11.2019, 9:00–13:00

Time		
08:30-09:00	Registration & coffee	
09:00-09:15	Opening	Ignacio Calleja, EIT Raw Materials Facilitators: Maria Lima Toivanen, Senior scientist, Jouko Myllyoja, Senior scientist (VTT)
09:15-09:35	Key results of the analysis of Circular Economy Incentives & Future needs for incentive development	Teuvo Uusitalo, Senior scientist (VTT) Elina Huttunen-Saarivirta, Principal scientist (VTT)
09:35-09:50	Discussion	
09:50 – 09:55	Introduction to group work	Facilitators (VTT)
09:55 - 11:15	Group work: Identifying novel activities & incentives	All/Facilitators (VTT)
11:15-11:35	Coffee	
11:35-12:50	Presentations of group work (5 groups), ~ 15 min / group	Group rapporteurs / All
12:50-13:00	Concluding remarks	Facilitators (VTT) Ignacio Calleja, EIT Raw Materials
13:00 – 14:00	Lunch	

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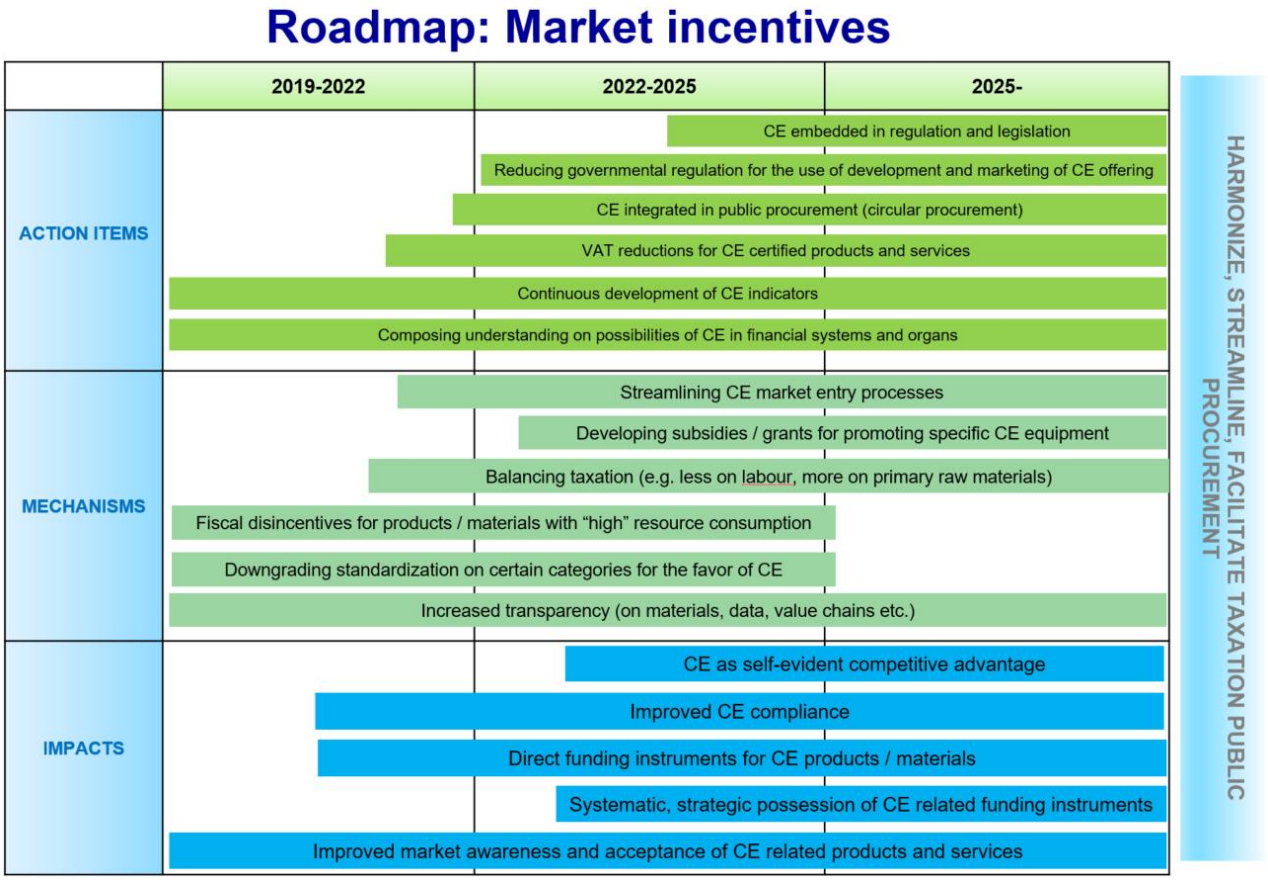
Appendix 3: Sub-roadmaps from workshop (1/4)



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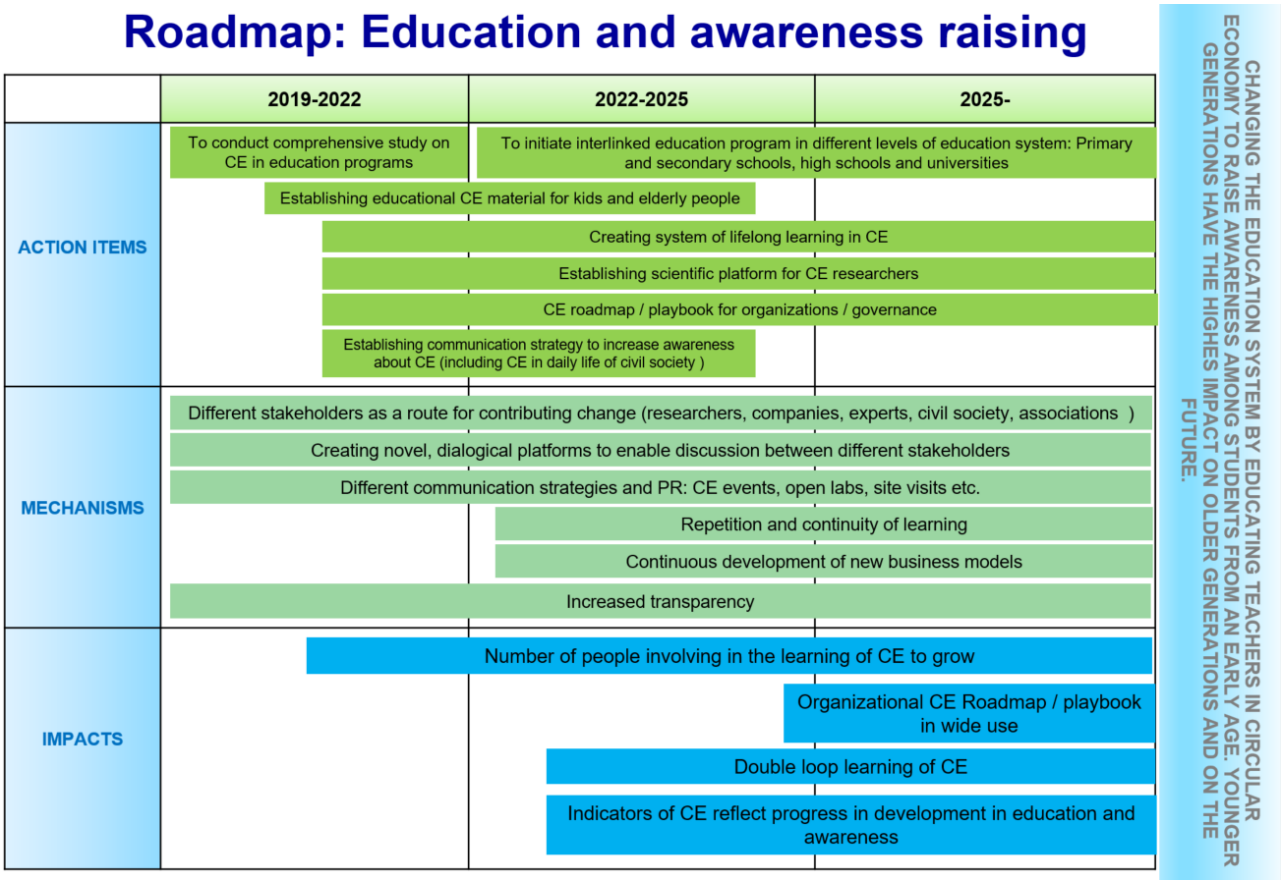
Appendix 3: Sub-roadmaps from workshop (2/4)



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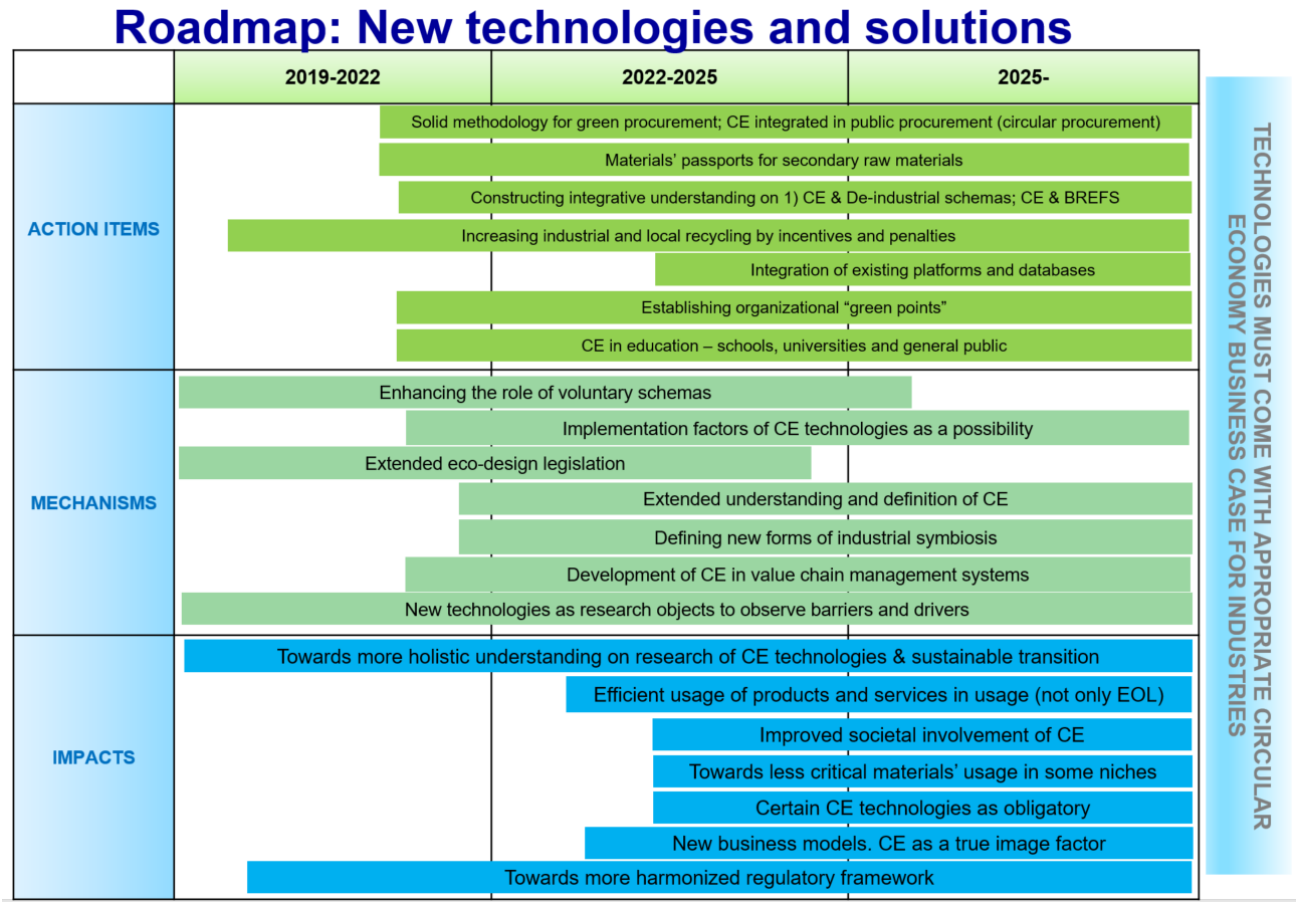
Appendix 3: Sub-roadmaps from workshop (3/4)



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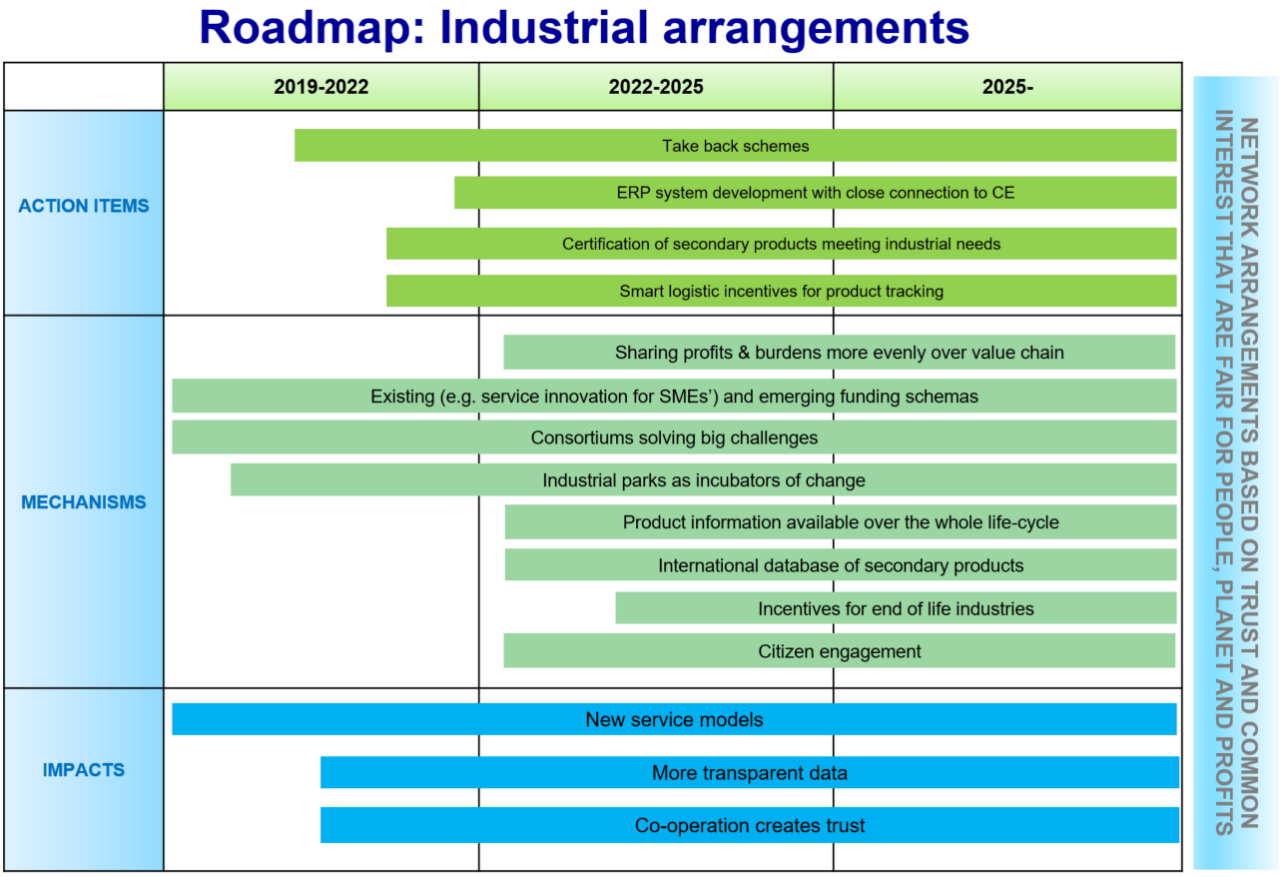
Appendix 3: Sub-roadmaps from workshop (4/4)



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