A Review of the European Union's Circular Economy Policy

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1 Introduction

The "Circular Economy" (CE) is one of the central policy platforms of the European Union *Horizon 2020 strategy*. Unfortunately, defining the CE has been a difficult task; recently, there have been two summary papers by Ghisellini, Cialani and Ulgiati, (2016) and Geisendorf (2017, submitted paper) which have attempted to do this. They show that the CE is derived from a variety of concepts in economics, ecology and design. At its core, the defining element of the CE is the "restorative use" of resources in which raw materials would no longer be transformed to discarded waste, as found in the traditional linear economy (Geisendorf, 2017, submitted paper). As one of the chief proponents of the CE, the Ellen MacArthur Foundation (2012, p. 14) argues: "While great strides have been made in improving resource efficiency, any system based on consumption rather than on the restorative use of resources entails significant losses along the value chain."

The question remains as to how it might be possible to implement this restorative system. At least one part of this answer emanates from (governmental) policy which provides some of the necessary conditions needed by producers and consumers to participate in the CE; thus in this paper, we review the EU's policy efforts to implement a CE.[1]

The format of this review is as follows: In the next section of this paper we review recent EU policy history with regards to the CE prior to its (most recent) 2015 action plan. Following this, we discuss the possible benefits the EU sees itself reaping from adopting a CE. This is followed by a review of the European Commission's (most recent) 2015 CE action plan, which concurrently draws upon other specialized policy initiatives; this section also integrates a report by the Ellen MacArthur Foundation, Systemiq and SUN Institute (2017) concerning future investment in the CE, and the policy measures needed to activate such investment. Most recently, the European Commission released a report on the implementation of the 2015 action plan; this is reviewed in the next section. Following that section, we provide a critique of the most recent action plan. The final section summarizes the policy review.

2 EU History with Regards to CE Policy

As noted, this report divides CE policy history before and after release of the EU's most current action plan in 2015. However, before discussing this earlier policy, we briefly note that the entire policy review is derived from three groups of sources:

[1] A full review of CE ontology is provided by Geisendorf as another part of R2Pi's deliverables.

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1. Primarily, from official documents of the European Commission. See: http://ec.europa.eu/environment/circular-economy/index_en.htm, which collects many of the recent initiatives.
2. From charities and NGOs, most prominently, the Ellen McArthur Foundation: https://www.ellenmacarthurfoundation.org/
3. From academic reviews of CE policy (including waste management policies).

Ghisellini, Cialani and Ulgiati, (2016) and Sakai et al., (2011) provide the most comprehensive (general) academic reviews of CE policies and implementation. Their papers show that there has been little academic research concerning CE policy, outside of studies focusing on China (See: Feng and Yan 2007; Geng et al. 2013; Jiao& Boons, 2014; Shi et al. 2012; Yap, 2005).[2] This is partly related to the fact that China was the first country to codify a CE policy (in the 2007 Circular Economy Promotion Law of the People's Republic of China) as part of its waste management system; in turn this has made it easier to analyze its implementation as the CE has existed longer in China than in the EU.

Another difference between China and the EU with regards to CE policy concerns their "national political strategy". CE in China is a direct outcome of a top down approach, with its implementation structured following both horizontal and vertical approaches[3] (Feng and Yan, 2007). Chinese national governmental policy aims to transform not only its industry but also the socioeconomic organization of its society (Naustdalslid, 2014).

The top down approach of China's strategy is also reflected in the instruments used, that are mainly of "command and control" rather than market-based (Friends of Europe, 2014) as in European policy (European Union, 2013). In contrast, the transition towards CE in Europe mainly seems to be occurring as a bottom-up approach (e.g. from the initiatives of environmental organizations, civil society, NGOs, etc.). All these economic actors call for greener products and adequate legislation and try to involve both companies and public authorities in a "virtuous cycle" (Naustdalslid, 2014).

The vertical approach in China implies the shift of CE from the low level of analysis (i.e. micro = company or single consumer level) to the higher hierarchical levels (i.e. meso = eco-industrial parks, and macro = cities, provinces and regions) while the horizontal dimension implies a link between "industries, urban infrastructures, cultural environment, and the social consumption system" (Feng and Yan, 2007).

In the EU, the Waste Framework Directive (2008)[4] was established as the basic waste management legislation, and EU Member States have implemented domestic laws on waste

[2] In contrast the only academic studies focusing on EU CE policy were by Costa et al. (2010) and Lehtoranta et al. (2011).
[3] Explained below.
[4] In terms of legislation, the EU influences member countries through *regulations* (laws applied in full throughout the EU), *directives* (binds members to achieve objectives; however, they are free to address their local distinctiveness while incorporating the objectives into their legal system) and *decisions* (binds particular individuals, firms or member states, to

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management under this directive. The most notable characteristic of the EU's waste management system is the promotion of 3R (reduce, reuse and recycle) policies in parallel with waste management regulations. However, as we will see, an analysis of these policies shows that there has been no implementation of a full CE in the EU, as the majority of efforts were connected with waste treatment and recycling, with the overall goal being to reduce the amount of landfill as obtaining final disposal sites has become increasingly more difficult.

Nonetheless, even though EU member states were considered to have developed integrated and advanced waste management systems, Asian countries (in general) have been importing recyclable resources in recent years, essentially playing the role of global recycling facilities (Sakai et al., 2011).

In a recent report, the EEA[5] (2016b) published an analysis of EU material resource efficiency, which is an update on an earlier report from 2011; it also both complements and completes the picture illustrated by Sakai et al.'s (2011) study. The scope of the EEA report is concerned with material flows entering or leaving an economy (biomass, non-metallic minerals, metal ores and fossil energy materials) as well as secondary (waste-derived) raw materials. Also within its scope are the transformations that materials undergo throughout their full life cycle, and initiatives to close material loops in the context of a CE.

The most important finding is that little has changed since 2011 with regards to how most EU countries relate to the CE; for most countries CE means better waste management. Furthermore, climate change and resource efficiency policies appear largely disconnected in practice, while integration with a bio-economy strategy also requires further efforts.

These findings are reinforced by the individual surveys of EU countries. Only ten EU respondents identified the concept of a circular economy and closing material loops as a driver of material resource efficiency, and even fewer — Flanders (Belgium), Germany and the Netherlands — reported having a dedicated strategy for closing material loops. Two further countries have dedicated strategies at a regional (subnational) level — in Flanders (Belgium), and Scotland (United Kingdom). Further, Belgium, France, Germany, the Netherlands, Switzerland and the United Kingdom mentioned preparatory initiatives to develop metrics and indicators for the circular economy.

There are many reasons for the lack of CE development, including lack of investment and insufficient use of economic instruments and incentives. So too, a lack of policy focusing on closing the loops in the CE is a source of problems. Indeed, it was found that a majority of reported policy

perform or refrain from an action, confer rights or impose obligations). Implementation of EU directives is approached differently by the member states to suit their contextual distinctiveness. This explains the reason for different policies and legislations across the EU members Costa et al. (2010).

[5] The EEA (European Environment Agency) published this report in conjunction with Eionet countries and the European Topic Centre on Waste and Materials in a Green Economy (ETC/WMGE).

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initiatives across Europe (up to 2015) related to the CE focus on waste management as a downstream policy option, rather than on prevention or reuse. This is emphasised by the fact that only two countries explicitly commented that a circular economy implies going beyond merely raising recycling rates and increasing the use of secondary raw materials. In fact, the CE is interpreted differently by different stakeholders and EU countries; this points to a need for an agreed upon definition of the CE and its necessary policies.

The EEA (2016b) report did make a number of recommendations. These include:

1. For the majority of countries, compliance with existing legislation is the main driver of any action taken at the national level. Targets seem particularly effective in energising policy development and guiding policy implementation.
2. Regional (subnational) initiatives can take advantage of physical proximity, reduced distances and a strong incentive on the part of local stakeholders. When expanding the knowledge base for the circular economy, it is worth keeping an eye on emerging regional and local initiatives.
3. It would be useful to disseminate information on successful initiatives in which the circular economy helps achieve other key policy objectives, such as those related to the climate, competitiveness or employment agendas.

2.1 Estimated Benefits of CE to the EU

Resource benefits. By conserving (primary) materials embodied in high-value products, or returning wastes to the economy as high-quality secondary raw materials, a CE would reduce demand for primary raw materials; this would reduce Europe's dependence on imports, making the procurement chains for many industrial sectors less subject to the price volatility of international commodity markets and supply uncertainty due to scarcity and/or geopolitical factors.

An estimated 6–12 % of all material consumption, including fossil fuels, is currently being avoided as a result of recycling, waste prevention and eco-design policies; the maximum potential using the existing technology is estimated to be 10–17 % (European Commission, 2011). Using innovative technologies, resource efficiency improvements along all value chains could reduce material inputs in the EU by up to 24 % by 2030 (Meyer, 2011).

A recent study of the impacts of a switch to a CE in the food, mobility and built environment sectors estimated annual savings of primary resource inputs of EUR 600 million in the EU-27[6] by 2030 (EEA, 2016a). Achieving this would require systemic changes in these sectors. For example, in the area of mobility, changes would entail more sharing of cars and better integration of different transport modes. For the food system, the study mentions more regenerative farming practices such as organic farming, closing nutrient loops and reducing food waste. Moreover, in the built environment changes

[6] The EU-28, not including Croatia.

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would include factory-based industrial processes in construction, smart urban planning, sharing of residential and office space, and energy-efficient buildings (EMF and McKinsey Center for Business and Environment, 2015).

Environmental benefits. The absolute decoupling of economic output and social well-being from resource and energy use, and from related environmental impacts, is the main objective of the EU's resource-efficiency policy (European Union, 2013). Indeed, although current waste policies already contribute to this, the European Commission estimates that different combinations of more ambitious targets for recycling of municipal and packaging waste and reducing landfill could lead to a reduction in greenhouse gas emissions of around 424–617 million tonnes of carbon dioxide equivalent over 2015–2035, on top of reductions through the full implementation of existing targets (EEA, 2016a).

Measures beyond waste recycling, however, could further reduce greenhouse gas emissions. It has been estimated, for example, that, in the fabricated metals and hospitality and food services sectors, resource efficiency measures could avoid around 100–200 million tonnes of carbon dioxide equivalent emissions annually (AMEC Environment & Infrastructure and Bio Intelligence Service, 2014). Keeping materials in the loop would also enhance ecosystem resilience and the environmental impacts of mining raw materials, often outside Europe. The study of the potential in the food, mobility and built environment systems mentioned above estimates a prospective reduction in greenhouse gas emissions of 48% by 2030 and 83% by 2050 compared with 2012 levels, and a reduction in externality costs of up to EUR 500 million by 2030 (EMF and McKinsey Center for Business and Environment, 2015).

Economic benefits. A circular economy could provide significant cost savings for various industries. For example, implementation of circular economy approaches in the manufacture of complex durable goods with medium lifespans is estimated to result in net material cost savings of USD 340–630 billion per year in the EU alone, roughly 12–23 % of current material input costs in these sectors (Ellen MacArthur, 2012). For certain consumer goods — food, beverages, textiles and packaging — a global potential of USD 700 billion per year in material savings is estimated, that is, about 20 % of the material input costs in these sectors (Ellen MacArthur Foundation, 2013).

Another study estimates the annual net benefits for EU-27 businesses of implementing resource-efficiency/CE measures such as waste prevention, the recovery of materials, changing procurement practices and the re-design of products. These range from EUR 245 billion to EUR 604 billion, representing an average of 3–8 % of annual turnover (AMEC Environment & Infrastructure and Bio Intelligence Service, 2014).

Social benefits. Social innovation associated with sharing, eco-design, reuse and recycling can be expected to result in more sustainable consumer behaviour, while contributing to human health.

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A CE is also expected to create job opportunities. Indeed, according to the European Commission's impact assessment on a legislative proposal on waste, increased recycling targets, the simplification of legislation, improved monitoring and the diffusion of best practice to achieve increased recycling/preparing for reuse targets for municipal and packaging waste, in combination with reduced landfill of waste, could result in the creation of up to 178,000 new jobs by 2030 (EEA, 2016a).

The development of fully circular value chains might have significantly greater potential. Estimates for the United Kingdom suggest that around 500,000 jobs could be created in a circular economy. While some sectors may diminish, a net creation of jobs by 2030 is projected (Morgan & Mitchell, 2015). This study also demonstrates how differing circular strategies could generate different types of jobs. For example, labour-intensive strategies, such as the preparation of products for reuse or recycling, would yield low-skilled jobs; medium-skilled jobs are expected to be created in closed-loop recycling and high-skilled jobs in bio-refining.

Moreover, a meta-study reviewing 65 studies on employment and the CE found generally positive employment effects as a result of moving towards a circular economy. The studies mainly addressed energy and material savings; studies on employment effects of sharing, recycling and further approaches are scarce (Horbach et al., 2015; cited by EEA, 2016a).

3 Reviewing the European Commission's CE Package[7] (2.12.2015)

Closing the loop - An EU action plan for the Circular Economy (COM (2015) 614 final) (European Commission, 2015) is the European Commission's most current CE policy. Its purpose is to guide the EU and its states to transform the economy so as to "generate new and sustainable competitive advantages for Europe."

In December 2014, the European Commission decided to withdraw a pending legislative proposal on waste, as part of the political discontinuity exercise carried out for the first Work Programme of the Juncker Commission.[8] The Commission committed at that time to use its new horizontal working methods to present a new package by the end of 2015 which would cover the full economic cycle, not just waste reduction targets, drawing on the expertise of all the Commission's services.

The legislative proposals adopted within the action plan focus on changes in consumption and production behaviors via reuse and recycling, as well as waste management to reduce landfilling, in

[7] The CE Package consists of an action plan as well as an Annex and four legislative proposals on waste.

[8] The European Commission's Investment Plan for Europe is an ambitious infrastructure investment programme first announced by European Commission President Jean-Claude Juncker in November 2014; its goal was to unlock public and private investments in the "real economy" of at least € 315 billion over a three-year fiscal period (Jan. 2015 – Dec. 2017).

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order to close the loop of product lifecycles while supporting the CE in each step of the value chain (European Commission, 2015). Further measures are proposed to make implementation clear, promote economic incentives and improve extended producer responsibility schemes. The following **six** sections briefly summarize its goals of this plan and the activities that fulfill these goals.

3.1 Production

An important European Commission goal is to improve the durability, reparability and recyclability of products. This is to be achieved via the *Ecodesign directive*[9] as well as incentives which differentiate the financial contribution paid by producers under extended producer responsibility schemes on the basis of the end-of-life costs of their products. Moreover, the Commission will examine actions for a more coherent policy framework for the different strands of work on EU product policy in their contribution to the CE.

Concurrently, the European Commission emphasizes more efficient production processes to reduce waste and capitalize on business opportunities. Thus, the Commission promotes the sustainable sourcing of raw material globally via dialogues, partnerships and its trade[10] and development policy. Moreover, the Commission will include guidance on best waste management and resource efficiency practices in industrial sectors in *Best Available Techniques reference* documents (BREFs). To help SMEs (small and medium-sized enterprises) benefit from the business opportunities connected to increased resource efficiency the Commission is creating the *European Resource Efficiency Excellence Centre*.[11] Finally, the Commission is proposing (in its revised legislative proposals on waste) to clarify rules on by-products to facilitate industrial symbiosis and help create a common understanding of the rules on by-products.

3.2 Consumption

The Commission is working with stakeholders to make green claims more trustworthy, and will ensure better enforcement of the rules in place, including through updated guidance on unfair commercial practices. To do this it is testing the *Product Environmental Footprint* (COM/2013/0196 final) (European Commission, 2013), a methodology for measuring environmental performance, while creating the (voluntary) *EU Ecolabel*[12], which identifies products with a reduced environmental impact. At the same time, the Commission proposed an improved labelling system of energy-related products to help consumers choose the most efficient, durable products.

[9] The Ecodesign Directive (Directive 2009/125/EC) provides EU-wide rules for improving products' environmental performance, while preventing the creation of trade barriers and improving product quality. However, the future goal is to expand this directive to issues of durability, reparability and recyclability. See: http://ec.europa.eu/growth/industry/sustainability/ecodesign_en

[10] See "Trade and investment for all" strategy adopted 10.2015.

[11] See: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014DC0440

[12] See: http://ec.europa.eu/environment/ecolabel/

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Price is a key factor affecting purchasing both in the value chain and for final consumers. Member States are therefore encouraged to provide incentives to ensure that product prices better reflect environmental costs. Aspects relating to guarantees (such as the legal guarantee period) are also an important part of the consumption puzzle, as they protect consumers against defective products and contribute to products' durability and reparability, preventing waste. A two-year legal guarantee exists in the EU for physical goods, but problems exist with its implementation.

Product lifetime can be extended through reuse and repair, hence avoiding wastage. The reuse and repairs sectors are labour-intensive and therefore contribute to the EU's jobs and social agenda. Currently, certain products cannot be repaired because of their design, or lack of parts or repair information. Future work on *Ecodesign* will remedy these problems.

Planned obsolescence practices can also limit useful lifetime. Through an independent testing programme, the Commission will initiate work to detect such practices and ways to address them. Additionally, the revised legislative proposals on waste includes new provisions to boost preparation for reuse activities.

Reduction of household waste is often more effective at the national and local levels, where it is targeted via awareness campaigns and incentives.[13] The Commission promotes waste prevention and reuse through the exchange of information and best practices and by providing Cohesion Policy funding for projects at local and regional level.

Innovative forms of consumption can also support the development of the CE via the “sharing” economy, consuming services rather than products, or using IT or digital platforms (See also: Ellen MacArthur (2015)); these new forms of consumption are often developed by businesses or citizens, and promoted at national, regional and local level. The Commission supports these new business and consumption models through Horizon 2020 and through Cohesion Policy funding.

Public procurement accounts for a large proportion of EU consumption (nearly 20% of EU GDP). The Commission will encourage this role through its actions on Green Public Procurement, where criteria are developed at EU level and then used voluntarily by public authorities.

3.3 Waste management

Waste management policy is crucial for the CE as it determines how the EU waste hierarchy (from prevention to reuse to landfill) is actualized, so that the best overall environmental outcome is obtained. To achieve high levels of material recovery (a primary CE goal) for all waste, it is essential to send long-term signals to the public and private sectors, while establishing the right enabling conditions within the EU, including consistent enforcement of existing legislation.

[13] Such as incentive systems for municipalities or "pay-as-you-throw" schemes, where households (for example) pay according to the amount of non-recyclable waste that they throw away.

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Today, only 40% of EU household waste is recycled. The Commission is putting forward new waste legislation to provide guidance for increased recycling and reduced landfilling, which also account for differences between Member States.

To increase the level of high-quality recycling, improvements are needed in waste collection and sorting systems. These systems are often financed, in part, by extended producer responsibility schemes, in which manufacturers partially pay for collection and treatment. To improve these schemes, the Commission is proposing minimum conditions on transparency and cost-efficiency. The waste proposals will also address issues related to calculating recycling rates to ensure high-quality statistics across the EU, while encouraging higher and more effective recycling rates.

The new proposals also address barriers to higher recycling rates such as limited administrative capacity, lack of investment and insufficient use of economic instruments; these barriers can be overcome via time extensions for Member States, as well as providing technical assistance and disseminating best practices to ensure progress.

EU Cohesion Policy is essential for closing the investment gap for improved waste treatment. For the current (2014-2020) financing programme, ex-ante conditions must be met to ensure that new investments in the waste sector are in line with waste management plans designed by Member States to meet recycling targets. This means that funding for new landfill and new facilities for the treatment of waste (such as incineration) will be granted only in limited cases. The Commission has forecasted that €5.5 billion will be needed for waste management in the current financing programme.

Another barrier to higher recycling rates is the illegal transport of waste, both within the EU and to non-EU countries. A revised regulation on waste shipment was adopted in 2014 facilitating the detection of illegal shipments.

When waste cannot be prevented or recycled, recovering its energy content is in most cases preferable to landfilling it; 'waste to energy' plays an essential role with EU energy and climate policy. The Commission will examine how to optimize this role, without compromising the desire for higher reuse and recycling rates. To that end, the Commission will adopt a 'waste to energy' initiative in the framework of the Energy Union.

3.4 Boosting the market for secondary raw materials

In a CE, recycled materials are looped back as "secondary raw materials" (SRMs) which increases the security of supply and can also be traded like primary materials. Currently, such materials make up a small proportion of the raw materials used in the EU. Several barriers impede the (growing) use of these materials; one such barrier is quality. In the absence of EU standards, it can be difficult to ascertain impurity levels or suitability for high-grade recycling. The Commission will therefore launch work on EU-wide quality standards for SRMs in consultation with different industries. Moreover, it will

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establish rules clarifying when an SRM should no longer be legally considered 'waste', providing operators with a level playing field.

So too, it is important to establish quality standards for recycled nutrients, as they can be returned to soils as fertilizers (reducing the need for limited mineral-based alternatives). However, their use is also hindered by differing standards across the EU. Therefore, the Commission will propose a revision of EU regulations to stimulate the sustainable development of the market.

Water scarcity has worsened in the EU in recent decades. This calls for not only water-efficiency measures, but the reuse of treated wastewater, which is still an under-used means for increasing supply. Water reuse in agriculture also contributes to nutrients recycling by substitution of solid fertilisers. The Commission will take legislative actions to promote reusing treated wastewater.

A further issue for expanding the SRM market concerns chemicals. An increasing number of chemicals have become environmental concerns and are subject to restrictions. However, some chemicals are present in products sold before the restrictions applied, and these are sometimes found in recycling streams. They are also sometimes hard to remove, creating barriers for small recyclers. The promotion of non-toxic materials and the better tracking of chemicals will aid the uptake of SRMs.

It is also important to facilitate the cross-border circulation of SRMs to ensure that they can be traded across the EU. Action in this area will include simplifying cross-border formalities. Moreover, to improve the availability of data on SRMs the Commission will improve the recently initiated *Raw Materials Information System* and support EU-wide research on raw materials flows, as well as improve data reporting on waste shipments.

A key factor in creating a dynamic market for secondary raw materials is sufficient demand, driven by the use of recycled materials in products and infrastructure. The private sector is essential in creating demand, as well as shaping supply chains; a number of economic actors have already committed themselves to ensuring a certain level of recycled content in their products. This should be encouraged, given that market-driven initiatives are a fast way to deliver tangible results. Public authorities can also contribute to the demand for recycled materials through procurement policies.

3.5 Innovation, investment, and other horizontal measures

Innovation and investment are the key parameters under which the CE can flourish as they directly contribute to the competitiveness and modernization of EU industry. The *Horizon 2020* work program 2016-2017 includes: *Industry 2020 in the circular economy*, a program granting over €650 million for innovative demonstrative projects supporting CE projects and new business models. It also explores a pilot approach to help innovators facing regulatory barriers by setting up agreements with private and public stakeholders. This expands upon the existing budget for *Horizon 2020* implemented in 2014-

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2015.[14] In turn these efforts will be supplemented by the *Eco-innovation action plan* which has earmarked nearly €80 billion over the period 2014-2020 for a series of environmental initiatives including innovation and research[15].

Developing the CE will also require public and private sources of financing to scale-up improved technologies, develop infrastructure and increase cooperation between actors in the value chain. The EU has a series of funding programs earmarked for these efforts.

Concomitantly, the CE requires a qualified workforce with new skills; consequently, the Commission, based on its Green *Employment Initiative* (COM(2014)446) is analyzing needs, which will lead to the development of such skills, as well as to support job-creation. It is also acting through its forthcoming *New Skills Agenda* for Europe.

SMEs face challenges, such as access to funding, and the difficulty participating in the CE economy (if it is not their core). The Commission supports these companies by analyzing the barriers they encounter while encouraging innovation across sectors and regions.

Finally, on the global plane, the Commission will be cooperating closely with international organizations and other partners to reach the *2030 Sustainable Development Goals*.

As an addendum to the 2015 EU Action plan on investment in the circular economy, the most recent report of Ellen MacArthur Foundation, Systemiq and SUN Institute (2017) discusses ten next-wave CE investment "themes" divided into three value chains, *mobility* (transportation systems), *food* and the *built environment*, that could be fulfilled through 2025 with investments of €320 billion. As the previous report "Growth Within" (Ellen MacArthur, 2015) pointed out these value chains - representing 60 percent of the average EU household budget and 80 percent of resource consumption - could contribute significantly to Europe's overall economic performance and welfare by adapting them to a CE system. Although their research shows that the main barriers for initial scaling of Circular Economy Business Models (CEBM) do not emanate from the policy side, there are still many complex policies that increase (real or perceived) complexity and cost, and therefore hold back the progress of circular models. Ellen MacArthur Foundation, Systemiq and SUN Institute (2017) have identified four (out of the ten investment) themes distributed among the three value chains that would benefit from changing policy / regulation:

1. Mobility
    a. *Remanufacturing car parts*: Policies preventing use of remanufactured parts; for example, the EC Directives related to end-of-life vehicles, electronic equipment, and

[14] See: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-climate_en.pdf
[15] See: https://ec.europa.eu/environment/ecoap/about-action-plan/union-funding-programmes

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the disposal of hazardous waste focus primarily on recycling and have mixed effects on remanufacturing activities

2. Food:
    a. *Farming through indoor urban farms*: Urban permits and zoning laws preventing construction of new indoor farms
    b. *Developing next wave protein sources*: Restrictions currently imposed by human food chain legislation
3. Built Environment:
    a. *Closing Building loops*: Legislation preventing construction players from certifying non-virgin inputs and using some associated machinery.

Moreover, Ellen MacArthur Foundation, Systemiq and SUN Institute (2017) have identified **four** overarching policy issues that can catalyze action in all of the ten investment themes:

1. Setting direction and showing commitment. One of the success factors of the clean energy revolution is its clarity of direction; few company executives, researchers or policymakers doubt that the EU and the world are heading towards a clean energy system. Therefore, they invest business development based on this belief, further reducing cost and increasing attractiveness, and ensuring the drive toward a clean energy system. However, there is no such clarity for most of the ten themes. As a result, too many investors are waiting for a trend to develop (such as lower production costs); so, providing direction is an essential policy task, such as providing strategies, public investments, or trade agreements.

One crucial case is to endeavor to level the playing field for CEBM. Repeatedly when analyzing circular business cases, the historic bias for linear models becomes obvious: for example, primary materials can be easily traded internationally, while substantial hurdles exist to trade secondary ones. Moreover, labour taxes are ten times higher than resource taxes even though labour should be maximized while resource use minimized. Finally, externalities, such as congestion and environmental damages are not priced.

2. Removing policy barriers. Many of the identified themes require legislative changes to become investable at scale; most often, these consist of removing policy barriers. Further, these barriers currently exist to manage consumer health but in the context of adoption of CE business innovation, these risks are controllable. For example, quality and safety standards could be set for remanufactured parts or food proteins. Depending on the specific legislation, the change may be required at EU or Member State level.[16]

[16] The EU *Innovation Deals* are an example of how the European Commission approaches the legislative changes required towards a circular economy; see: https://ec.europa.eu/research/innovation-deals/index.cfm

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3. Creating platforms for dialogue, cooperation, and awareness creation. Successful examples of circular business models demonstrate the need for multiple stakeholders along the value chain to change (part of) the way they execute their business model. For example, in the case of looping waste streams, new suppliers would have to be contracted to provide required waste streams, while the stakeholders creating the waste would need to be incentivised to separate and collect the waste in the required volumes and quality. Moreover, customers would have to become aware of the benefits in order to shift from only accepting new products to adding products made from the end-of-life streams. All of this requires awareness creation and negotiations between different economic actors.

The public sector could play an active role by setting up platforms with the right set of players to facilitate discussions. A successful example of this was the European Resource Efficiency Platform (established 2012–14) which was vital for creating the European Commission's first CE package in June 2014. It served as an effective mechanism to gather information from relevant stakeholders, as well as develop solutions. Consequently, similar platforms might be set up for mobility, food, and the built environment. This should be done for themes where the public sector plays a large if not leading role as well as those where the private sector is more likely to lead.[17]

4. Focus public procurement, public circular economy investments, and financial support towards the ten themes. Some of the investment themes require technology innovations. As private capital is not always set up to invest in the perceived risk level of these innovations, focused public sector support would be needed to de-risk such innovations for the private sector to provide the needed funding. Although the CE budget within Horizon 2020 is currently already being deployed in this area, it does not yet cover the identified themes and underlying innovations fully.

In addition to innovation funding, the public sector has been supporting lower risk investments at larger scale with a central focus on infrastructure. For example, European Investment Bank (EIB) has been investing €14.5 billion over the last two years through the European Fund for Strategic Investments mostly in infrastructure projects, however less than 10% of this is going to circular economy-related investments. As the circular investment themes identified in this report have large infrastructure components, allocating a budget within existing funds for them would shift investments towards circular opportunities while providing new growth opportunities to those funds, but also, at the same time, shift investments towards circular opportunities. Investment funds at the Member State level could well provide an additional supply of public capital towards the investments themes. Lastly, reforms to existing subsidy frameworks should be considered, mainly in the area of shifting linear agricultural practices towards more circular ones, while fiscal incentives should also be geared towards circular business models.

[17] An example of a private sector-led initiative is the New Plastics Economy: http://newplasticseconomy.org/

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3.6 Monitoring

In order to monitor the effectiveness of CE action at the EU and national levels, it is important to have a set of reliable indicators. Thus, the Commission will work closely with the *European Environment Agency* and member states to propose an effective monitoring framework for the CE. This framework will complement data already collected by Eurostat, as well as indicators found in the *Resource Efficiency Scoreboard* and the *+Raw Materials Scoreboard*. This framework will be published in connection with the Commission's reporting on the Sustainable Development Goals. The Commission will report on progress in implementing its action plan five years after its adoption.

Implementation of the 2015 EU action plan: A report by the European Commission

The Commission put forward a set of key initiatives in 2016 to support the CE. These initiatives cover the full value chain and are presented below in chronological order of their completion (European Commission, 2017).

Legislative proposal on online sales of goods (9.12.2015).[18] This proposal aims to strengthen guarantees for consumers to better protect them against defective products and contributes to the durability and reparability of products so as to reduce waste. Under the proposal, in case of a defective product sold online, during the first two years from the time of delivery, the seller must prove that no fault existed at that time (current rules, provide for only a 6-month period). Moreover, the proposal provides a two-year legal guarantee for second hand goods and promotes a hierarchy of remedies where repair is more strongly promoted.

Legislative proposal on fertilisers (17.3.2016).[19] This proposal (which was not detailed in the 2015 action plan) creates a single market for fertilisers made from secondary raw materials, thereby transforming a waste management problem into economic opportunities. The draft regulation provides rules for free movement of all CE-marked fertilising products across the EU. Based on an impact assessment accompanying this proposal[20] an estimated 120, 000 jobs could be created thanks to recycling of bio-waste in organic-based fertilisers.

Launch of the Innovation Deals (26.5.2016). The Commission issued a call for expression of interest for *Innovation deals for a circular economy*[21]; the call constitutes a pilot approach to help innovators facing regulatory obstacles. If the existence of an EU legislative barrier is confirmed, the Commission will consider launching a further assessment of the impact of this regulation.[22]

Ecodesign (30.11.2016)**.** The Commission has decided to focus its *Ecodesign* efforts on product groups with the highest potential in terms of energy and resource savings while reinforcing the

[18] See http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A20 15 %3A63 5 %3AFIN
[19] See: https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-157-EN-F1- 1.PDF
[20] See: http://ec.europa.eu/DocsRoom/documents/15949
[21] https://ec.europa.eu/research/innovation-deals/index.cfm?pg=home
[22] 32 expressions of interest from 14 different Member States were submitted.

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evidence base for regulatory action. This resulted in the adoption of the *Ecodesign Working Plan 2016-2019* as part of the *Clean Energy for All Europeans* package.[23]

Ecodesign can also have an important contribution in creating a greater CE. While ecodesign measures have so far mainly focused on energy efficiency, in this working plan, the Commission undertook to also explore the possibility to establish requirements relevant for the CE such as durability, reparability, upgradeability, ease of reuse and recycling.

Immediately after adopting the CE Action Plan, the Commission also asked the European standardisation organisations to develop generic standards on durability, reusability and recyclability of specific products. Many consumer and industrial products could be made more durable, reusable and recyclable if appropriate metrics and standards were in place. The three European standardisation organisations have accepted the Commission's request and have submitted a joint working plan that will develop around 20 generic standards.

Food waste (throughout 2016). Food waste is a key area in the CE that should be addressed along the entire value chain. The Commission launched a stakeholder's platform on food waste prevention, made progress in developing an EU methodology to measure food waste, and prepared guidelines to facilitate food donations and the use of former foodstuff as feed.

On 1.8.2016, the Commission established the *EU Platform on Food Losses and Food Waste*. The platform will be the key forum in taking actions needed to achieve the Sustainable Development Goals commitment to halve food waste per capita by 2030.

In 2016, the Commission worked on preparing guidelines (to be published in 2017) to facilitate food donation. The guidelines are intended to provide a more consistent interpretation by Member States regulatory authorities of EU rules applying to food redistribution. It aims to address barriers, for both donors and receivers, for the redistribution of safe, surplus food.

The Commission is also creating guidelines for use of former foodstuff as feed, with the aim to valorise the nutrients in former foodstuffs through their safe-use in animal nutrition. This substitutes cereals and oil seed in the animals' diets while freeing land for the production of food and reducing the need for imported feed.

Waste-To-Energy (1.2017). The Commission is adopting a Communication on waste-to-energy processes and their role in the CE (COM(2017)34). Its goal is to ensure that the recovery of energy from waste in the EU supports the objectives of the CE action plan while being guided by the EU waste hierarchy. The communication also examines how the role of waste-to-energy processes can be optimised to meet the objectives set out in the *Energy Union Strategy* and in the *Paris Agreement*.

[23] COM(2016) 773 final.

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Proposal to amend the Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (1.2017). Along with this report, the Commission is adopting a proposal to make a targeted amendment to the Directive restricting the use of hazardous substances in electrical equipment (*RoHS Directive*). The directive, by triggering the substitution of certain hazardous substances in electrical equipment, enhances the possibility and profitability of recycling waste of that equipment.

Enabling operators to prolong the use of electrical equipment will postpone their end-of-life thus avoiding additional generation of hazardous waste. It is estimated that the measure will prevent the creation of more than 3,000 tonnes of hazardous waste per year in the EU.

The proposal to amend the RoHS Directive will:

- enable secondary market operations for certain electrical equipment
- enable repair with spare parts of certain electrical equipment placed on the market before 22.7.2019.

Fully enabling secondary market operations and increasing spare part availability will have a positive economic impact by bringing market opportunities to the repair industries. It will reduce costs and administrative burden for SMEs and public authorities.

To facilitate preparation for the environmentally sound treatment of waste electrical equipment, the Commission also initiated dialogues between manufacturers and recyclers of electronic products to improve the exchange of information about preparation for reuse and treatment of new equipment.

The platform to support the financing of circular economy (1.2017). Together with this report, a platform is launched, bringing together the Commission, the European Investment Bank (EIB), financial market participants and businesses to increase awareness of the CE business logic and improve the uptake of CE projects by investors. While the business case for the CE is clear, this message still has to reach a good part of businesses and financial sector in the EU. The platform has a three-pillar structure:

- The *coordination and awareness raising pillar* will share best practices amongst project promoters and stakeholders. It will analyse the characteristics of CE projects and their particular financing needs, advice on improving bankability, as well as coordinate activities regarding financing. A dedicated expert group will be created in this context.
- The *advisory pillar* will be used to develop CE projects and to improve bankability prospects.
- The *financing pillar* will explore whether a dedicated financing instrument for circular economy projects is needed.

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In addition to the key initiatives listed above, a number of other important actions by the Commission, listed below, have helped to mainstream the CE into the full lifecycle of products, with tools such as best practices, procurement, information to consumers and funding schemes. These tools are essential for ensuring that the CE is taken up by all relevant actors in the economy to become standard practice.

Guidance on circular economy into BREFs for several industrial sectors. The Commission has integrated CE aspects into the Best Available Techniques Reference Documents[24] (BREFs) which Member States have to reflect when issuing permits for industrial installations. This will help to reduce waste generation, boost recycling and reduce resource use, thus bringing further sustainability and competitiveness. In addition, novel techniques that integrate aspects relevant to CE are identified through BREFs, thus promoting innovation.

Green Public Procurement (GPP). In 2016, the Commission published new GPP criteria for a host of sectors. These can be used by public authorities on a voluntary basis, and include requirements relevant to the CE. As public procurement accounts for a large proportion of European consumption, the inclusion of requirements related to circularity in public authorities' purchasing will play a key role in the transition towards a CE.

Updated Guidance on Unfair Commercial Practices Directive - Action on environmental claims (25.5.2016). The Commission has adopted a revised guidance for the *Unfair Commercial Practices Directive*, which includes specific elements to make green claims more trustworthy. The guidance addresses false, unintelligible, or ambiguous information, including claims related to the CE. It will aid consumers so that they are protected from misleading commercial information which result in consumers losing confidence in labels and in companies being discouraged from making truthful and relevant claims. The revised guidance integrates the input from national authorities, European business organisations, consumer associations and environmental NGOs.

Stepping up enforcement of the revised Waste Shipment Regulation (28.7.2016). The Commission adopted an act setting out a preliminary correlation table between customs and waste codes. This new tool will help customs officials identify waste crossing EU borders illegally, for instance labelled as second-hand goods. It will strengthen the enforcement of the Waste Shipment Regulation and will help to prevent the leakage of valuable raw materials out of the EU.

Good practices in waste collection systems (Throughout 2016). The Commission has been promoting good practices for separate waste collection across EU Member States. The Commission has reviewed the state of implementation of separate collection in the EU Member States. The review led to a set of recommendations addressing different levels of decision-making. The recommendations

[24] http://eippcb.jrc.ec.europa.eu/reference/

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have been discussed with stakeholders and EU Member States in a conference (29.1.2016). Additionally, *Horizon 2020* is supporting this work stream by financing a number of concrete projects in this area.

Water reuse (6.2016). Guidelines were issued under the *Common Implementation Strategy for the Water Framework Directive* with the aim to better integrate water reuse in water planning.[25] As water scarcity has worsened in some parts of the EU, the reuse of treated wastewater in safe and cost-effective conditions is a valuable and under-used means of increasing supply. Facilitating water reuse in agriculture will also contribute to recycling of nutrients by substitution of solid fertilisers.

Construction and demolition (9.11.2016). The Commission proposed an industry-wide voluntary protocol for managing construction waste. The protocol will increase trust in the quality of recycled materials and encourage their use in construction. (Construction waste is the largest waste stream in the EU so the *Waste Framework Directive* (2008/98/EC) establishes a target of 70 % of construction waste to be recovered by 2020).

Biomass and bio-based products (30.11.2016). In its recast of the *Renewable Energy Directive* as part of the package on *Clean Energy for all Europeans* the Commission adopted sustainability criteria for all bioenergy uses. In order to limit pressure on biomass resources, the Commission proposed that only efficient conversion of biomass to electricity should receive public support.

Support for circular economy through Cohesion policy funds and smart specialisation strategies (Throughout, 2016). The Commission undertook targeted outreach activities to assist EU Member States in the uptake of cohesion policy funds for the CE. Many regions have identified priorities related to the CE in their *Smart Specialisation Strategies*, which guide their investments in innovation through cohesion policy. In 2016, new thematic smart specialisation platforms have been launched aiding cooperation with others along various value chains.

For two decades, EU cohesion policy has provided policy implementation support relevant to the CE.[26] In the current funding period (2014-2020), ex-ante conditions for funding are in place to ensure that new investments in the waste sector are consistent with the waste management plans of EU Member States to meet recycling targets. The EU support for the 2014-2020 period for innovation, SMEs, low carbon-economy and environmental protection amounts to EUR 150 billion.

The Circular Ocean INTERREG project[27] deals with the problem of marine litter in the Northern Periphery and Arctic region by finding solutions to re-use plastic waste, such as old fishing nets and ropes, and to drive eco-innovation.

[25] See: http://ec.europa.eu/environment/water/pdf/Guidelines_on_water_reuse.pdf
[26] e.g. EUR 6bn for waste management in 2007-13
[27] See: http://www.circularocean.eu/

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Other important funding measures for the CE include the EU's research and innovation *Framework Programme Horizon 2020.* As an example, this program is contributing €8.8 million to the RESYNTEX project that will develop CE business models for recycling within the chemical and textile industry. Additionally, the LIFE programme has been supporting CE projects since 1992 with over 670 waste reduction, recycling, reuse projects totalling to EUR 1 billion of EU funding. This continues under the new LIFE programme 2014-2020 with EUR 100 million invested into 80 CE projects during its first two years.

Research and Innovation: Industry 2020 in the circular economy. The Horizon 2020 Work Programme 2016-17 invests € 650 million in "Industry 2020 in the circular economy" which grants funds to demonstrate the economic and environmental feasibility of the CE, and concurrently a strong impetus to EU re-industrialisation.

Additional calls have also been launched in 2016, within the framework of the *Public Private Partnerships* on "Factories of the Future", "Sustainable Process Industries" and "Bio-based Industries" to help develop the necessary key enabling technologies to support EU manufacturing across a broad range of sectors.

Technology services to accelerate the uptake of advanced manufacturing for clean production by manufacturing SMEs (8.11.2016). Under Horizon 2020, the Commission published a call to establish a one-stop shop access for SMEs to access technology services and/or facilities in the field of advanced clean-production manufacturing. (Many SMEs lack the resources or competence to integrate innovative advanced manufacturing technologies related to clean production).

The Commission has supported SMEs in their transition to the CE through the continued implementation of the *Green Action Plan for SMEs*. EU funds have also supported thousands of SMEs in the past decades for boosting resource and energy efficiency and innovation in manufacturing and production. This SME support continues from the cohesion policy funds in the 2014-2020 period. A *European Resource Efficiency Excellence Centre* for SMEs started operating in 1.2017; it provides self-assessment tools as well as networking opportunities to SMEs. A pilot project executed by the Commission will provide practical capacity building to SMEs in the area of CE and eco-innovation starting from 2.2017.

Key initiatives for 2017. The 2017 *Commission Work Programme* confirms the full commitment to ensure the timely implementation of the *CE Action Plan*. In 2017, the Commission will propose a *Plastic Strategy* to improve plastic recycling and reuse, to reduce plastic leakage in the environment and to decouple plastics production from fossil fuels.

The Commission will also put forward a detailed analysis of the legal, technical and practical problems at the interface of chemical, product and waste legislation that may hinder the transition of

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recycled materials into the productive economy. The objective is not only to promote non-toxic material cycles, but also to enhance the uptake of secondary raw materials.

The Commission will also come forward with a legislative proposal on minimum quality requirements to promote the safe reuse of treated waste water, while ensuring the health and environmental safety of water reuse practices and free trade of food products in the EU.

The monitoring framework assessing the progress of the circular economy in the EU and its Member States will also be presented in 2017.

In 2017, the implementation of the Ecodesign working plan will have an increased focus on CE and resource efficiency beyond energy efficiency.

The Commission will also publish the Fitness Check on *EU Ecolabel* and *EMAS*[28]in the first quarter of 2017.

2017 will be a crucial year to develop a policy dialogue with stakeholders. To this aim, the Commission and the European Economic and Social Committee launched a CE stakeholders' platform, at the occasion of an inter-institutional stakeholders' conference on the circular economy on 9-10 March 2017 in Brussels.

4 A critique of the EU's CE action plan

The EU's CE policy (European Commission, 2015) is a broad program that is taking definite steps to create the conditions for implementing the CE in European member states. Nonetheless, both de Man and Friege (2016) and Wilts et al. (2016) raise a series of critiques concerning its policy emphases.

De Man and Friege's (2016) **first critique** starts with the suggestion that the CE, as presently conceived, may be scientifically flawed. The CE's basic principles argue that (ultimately) all industrial processes should be designed so that their material flows are fully consistent with natural cycles.[29] In that case, they are either fully closed or designed such that all material flows into the environment consist of naturally occurring 'nutrients'. If that is the case, there would be no reason to minimize throughput and no reason to reduce waste. The most radical version of this CE approach is found in the "cradle-to-cradle" (c2c) philosophy (Braungart & McDonough, 2009), which is summarized by two design principles: (1) "waste equals food", and (2) "use current solar income". In this version of the CE, material flows should be designed such that all materials will either be used in the economic

[28] The EU Eco-Management and Audit Scheme (EMAS) is a premium management instrument developed by the European Commission for companies and other organisations to evaluate, report, and improve their environmental performance. See: http://ec.europa.eu/environment/emas/index_en.htm

[29] This is close to the CE definition found in the reports compiled by the Ellen MacArthur Foundation.

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process or dispersed as natural nutrients into the environment. There is no waste, only "food" for the next industrial process. Moreover, all energy used in the economy should come from the sun.

de Mann and Friege (2016) raise three scientific problems with this CE approach:

i. In reality, waste is almost never 'food'. All production processes lead to downgrading materials; so to create value from such materials, energy is always needed. To create a waste-free economy would cost huge sums of energy. Creating endless material cycles without continuously adding energy would oppose the Second Law of Thermodynamics; thus, complete recycling is a thermodynamic impossibility as it would require infinite quantities of energy and infinite time.[30]

ii. The assumption that natural nutrients can be fed into the ecosphere without any problems, regardless of their quantity is problematic; this cannot be guaranteed. There are scale problems even with natural nutrients (Reijnders, 2008).

iii. Our knowledge concerning harmful effects of substance flows is growing. In the past (and likely into the future) the production of beneficial products almost always resulted (and will result) in the creation of wastes, used products and /or hazardous materials, necessitating treatment and disposal.

De Man and Friege's (2016) **second critique** emanates from the practical problem of optimizing production systems to completely close material loops, as it requires a firm coupling of diverse processes of material conversion, not only within one company, but also between processes in different companies and countries. This tends to create dependencies that could be difficult to establish and manage in a market economy, where not only quantities processed and products produced continuously vary with market demand, but also companies appear and disappear regularly. Moreover, optimization of material flows creates dependencies between decisions now and in the (far) future, when products will reach their end of life. Dealing with such complexities and dependencies limits the availability of practical options for optimizing material cycles.

Experiences with implementing CE strategies – especially in the context of c2c projects – are still limited. They do show that implementation is difficult and that their outcomes are modest in comparison with original expectations. Examples of relatively successful implementations all refer to simple products close to original materials and biological cycles; however, successful examples for the design of complex high-tech products are difficult to find.

[30] According to Eurostat, the EU seeks to have a 20 % share of its gross final energy consumption from renewable sources by 2020. This makes it even more difficult to adopt a c2c. closed loop definition of the CE (at least in the near future) as to do so may mean adding to the green-house emissions. See: http://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics.

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According to de Man and Friege (2016) experience shows that products designed on the basis of CE principles are not necessarily leading to minimum environmental impact. They base this on Bjorn and Strandesen's (2011) study which suggests that when material cycles were closed, Life-Cycle Assessments show that their overall environmental impact was often higher than the non-circular design. Moreover, studies on electronic consumer products have shown that recovering all materials present in a certain product in their original grade is not possible without creating substantial additional environmental impacts.

De Man and and Friege (2016) argue that it is necessary to include multiple strategies beyond "consistency" wherein materials are fed back in a way that is optimally consistent with natural substance flows. Instead, they argue that it will be necessary to increase energy and material via an "efficiency" strategy in order to further decouple growth in waste generation, energy use, and pollution from growth in economic activities. Concurrently, it may be necessary to question the need for certain products and services in order to keep the ecological footprint of the economy within acceptable limits, in line with a "sufficiency" strategy.

A European policy based on CE economic ideas may create expectations that will never be realized. It sometimes conveys a misconception that there exists an "easy path" to creating a growing economy with an ever decreasing ecological footprint. It may also create the expectation that this can be done on the basis of market forces and voluntary actions only. It neglects the unsolved energy and waste issues that result from its implementation. It could weaken the necessary attention to regulatory issues.

In fact, De Man and Friege (2016) support (some of) their contentions with worrisome evidence. The new 10% landfill target for 2030 or 2035 (depending on the member states) goes beyond the targets of the 1999 directive (European Commission, 1999); however, many member states have never and still do not meet either the 50%, or the 35% target of that directive without consequences drawn by the Commission. New instruments for enforcement besides better reporting by member states are not proposed in the latest (2015) package; thus, it is likely that they will not achieve the defined targets and it is doubtful, if a more stringent target will be achieved ten years later.

This argument complements the earlier observation concerning the EU's CE policy as being generated from a bottom-up philosophy. Costa et al. (2010) add that local government can act as a bridge between national government and local companies, but its influence is limited. Higher levels of influence (e.g. supra-national, national) can set the objectives and targets to which sub-national level agents (e.g. local government, companies etc.) are left to respond with solutions. Citing Gertler, Costa et al. (2010) notes: "Economics alone will bring you a certain amount of symbiosis. To go further, you

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need political impetus to require pollution control technologies and/or to adjust prices to make symbiotic arrangements economically viable".[31]

It is certainly a step forward that the Commission accepts that recycling strategies have to be linked to product design, but the amendments for the *Waste Electric and Electronic Equipment* directive (WEEE) and the *Battery Directive* do not explicitly include such regulations. Uniform definitions for "municipal waste" and for recycling targets, as have been proposed by the Commission, are an important contribution to European waste management, but dedicated targets for valuable or scarce resources are still lacking. It might also be added that at least within the most recent policies discussed in this review, little to no mention is made of the link between (renewable) energy and its connection to the CE.

Sustainable resource management will start from an integrated concept covering waste policy, resource management, energy efficiency, and climate protection. In every single case, an optimal solution has to be selected on the basis of economic and ecological priorities. European policy should focus on instruments that can effectively influence the market so as to reduce consumption of scarce materials while increasing the level of material and energy recovery. De Man and Friege (2016) also suggest the following specific measures:

- The most successful tool against wasting resources – as has been shown in some member states – is a deadline for landfilling organic waste fractions in the relatively short term. This would be a strong contribution to climate protection, because recovery of material and energy are the only alternatives. The Commission might also encourage the transport of residual waste from countries still relying on landfills for waste disposal to countries with the best available disposal technology like waste to energy (Newman, 2015).
- Economic incentives such as instituting extended warranty periods would contribute to enhance the longevity of products ('design for repair'). In fact, as we have seen the European Commission has targeted this issue via its *Ecodesign* directive.
- Rules for the design of specific products, especially those including priority materials, would foster recovery operations ("design for recycling"). More transparency about the materials used, especially in the case of complex long-living goods (buildings, electric devices etc.), is necessary to facilitate methodical deconstruction of products to enhance material recycling opportunities. Again, the European Commission has targeted some of these issues through its *Ecodesign* directive.

[31] Apparently there is no consensus concerning regulation and enforcement within the EU. As Zbigniew Kamieński, former deputy director of Department of Innovation and Industry in Ministry of Economy of Poland stated: "an introduction of such [a circular] economy should be adapted to specific condition in a given country. It should rely on voluntary schemes, rather than additional regulation". See: https://www.euractiv.com/section/sustainable-dev/news/circular-economy-the-future-of-europe/.

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Only if it includes a mix of strategies and instruments that are optimally geared to provide specific solutions in specific situations, will a policy on materials, product design, and waste be effective. A clear decision to stop landfilling organic waste in Europe would be a good foundation for further actions. Basing policy one-sidedly on one selected strategy – such as (a rigidly defined) "circular economy" or "zero waste" – may sound attractive but may not be enough to create sustainability.

Indeed, some of this criticism is replicated by Wilts et al. (2016) who note that despite ambitious targets, policies and instruments that would enable a transition from a conventional waste management to an integrated and comprehensive resource management are still missing. Moreover, this will require innovative policy mixes which do not only address different end-of-pipe approaches but integrate various resource efficiency aspects from product design to patterns of production and consumption.

The policy mixes that Wilts et al. (2016) envisions include:

i. *Waste targets for resource efficiency* which echoes de Man and Friege's (2016) suggestion
ii. *Mandatory Ecodesign standards* for reuse and reparability. As of now EU *Ecodesign* standards focus on energy efficiency and there appears to be no plans to make reuse and reparability mandatory.
iii. *Individual producer responsibility* which goes beyond (the EU's) extended producer responsibility by creating a direct feedback loop between the design of brand-specific products and their end-of-life management and provide incentives for producers to adapt the product design to easy repair and reuse.

5 Summary

The EU's CE policy, under the rubric of its *Horizon 2020* plan has the ambitious goal of transforming Europe's economy in order to lessen the impact of a host of environmental problems. As we have seen, prior to the 2015 action plan, much of European environmental policy in fact had no connection to the "restorative" aspects of the CE. Instead, it focused on reducing solid waste, most notably via recycling, as well as lessening the impact of green-house gas emissions. Indeed, this claim is supported by a large-scale EEA (2016b) study, which showed that prior to the EU's 2015 action plan, for most EU member states, CE simply meant better waste management. Furthermore, climate change and resource efficiency policies appeared to be largely disconnected in practice, while integration with a bio-economy strategy needed further efforts.

Along with waste management, EU's 2015 action plan, "Closing the loop" adds five key action areas addressing the implementation of a full CE: production, consumption, secondary raw materials,

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innovation and investment, and monitoring. This action plan was followed a year later (in 2016) by a specific set of policy initiatives that cover the full value chain. These policy statements (as well as their various annexes) and the budgets that have been allocated to implementing them indicate that the EU sees the CE as the focus of its near future economic and environmental strategy. And indeed if the CE is implemented fully it could have a transformative effect on EU member states' economies.

However, recent critiques of the CE indicate that there are formidable barriers to CE implementation in the EU. De Man and Friege's (2016) recent work indicates that there are considerable scientific and practical problems to overcome towards CE implementation. Granted that De Man and Friege's (2016) work is based on a c2c interpretation of the CE, which is the most extreme definition of the CE; still their critique should be considered carefully.[32] Concurrently, Wilts et al. (2016) critique echoes De Man and Friege's (2016) concerns while adding in the observation that the EU's action needs a more innovative policy mix that pushes the European economy to a more "restorative" level. Moreover, both studies seem to imply that EU (and its member states') policy may have to embrace greater regulation via mandatory measures. Such measures are not without controversy, as Naustdalslid (2014) argues that the transition towards the CE in Europe mainly seems to be occurring as a bottom-up approach (e.g. from the initiatives of environmental organizations, civil society, NGOs, etc.). The question therefore remains how far will the EU (and its member states) proceed in legislating economic, as well as environmental behavior? These issues will influence both the implementation and further policy formulation within the EU in the years to come.

[32] This is especially the case when one of the leading CE proponents, the Ellen MacArthur Foundation advocates this CE definition.

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