Waste Management and Sustainable Development in a Circular Economy an Evidence of new Challenges in Europe

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Abstract

The European economy is largely linear by design, resulting in avoidable environmental and human health impacts, inefficient use of natural resources and over-dependency on resources from outside Europe.

Moving to a circular economy would alleviate these pressures and concerns, and deliver economic, social and environmental benefits (EEA, 2017). In the past, the creation of waste in connection with production and consumption was accepted as a necessary evil. Today, that apparent common sense is increasingly being challenged: circular economy, zero waste, closed-cycle, resource efficiency, waste avoidance, re-uses, recycling – all these terms can be attributed to the ideal of achieving a world largely without waste, and instead one with a responsible attitude to resources, materials, products and the environment.

However, it will require a comprehensive holistic concept to actually ensure that approaches like avoidance, re-use, and recycling are taken into account in every stage of the product life cycle and at the level of materials and energy – with environmental product design applied from the very outset to permit recycling at the end of the product life cycle (Wilts 2016). During the past decade, economists have become increasingly aware of the important implications of environmental issues for the success of development efforts. We now understand that the interaction between poverty and environmental degradation can lead to a self-perpetuating process in which, as a result of ignorance or economic necessity, communities may inadvertently destroy or exhaust the resources on which they depend for survival. Rising pressures on increasingly taxed environmental resources in developing countries can have severe consequences for Third World self-sufficiency, income distribution, and future growth potential.

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1. Historical Background

Currently, the side effect of an economy with a high GDP is large volumes of waste per capita. Thus the decoupling of waste production and related impacts from economic growth is critical to a transition to a circular economy UNEP (2011b). Environmentally sound waste management has been a cornerstone of European policies from the beginning and significant progress has been achieved regarding the reduction of impacts from waste generation to the environment and human health. Extensive technical regulations focused and massive investments in waste treatment infrastructures like sanitary landfills, waste incineration plants, as well as sorting and recovery facilities for specific waste streams have led to a situation where in many countries waste is now managed in a reliable and environmentally sound way. Of course, there is still a lot to be done e.g. with regard to the amount of waste that is still disposed of without any prior treatment (EEA, 2015).

Traditionally, with the exception of certain high value waste streams, the European waste management sector could be described as a ‘collect and dispose of’ operation; collecting mixed waste streams from municipal and commercial sources and disposing of the waste to landfill or through incineration.

Nevertheless, it is becoming more and more obvious that waste management in a circular economy will have to go beyond such an end-of-pipe approach that simply focuses on ‘cleaning up the mess’ after the production and use phase: waste management will have to become an integral part of a circular economy, closely linked to patterns of production and consumption. Circular product design will require feedback from the waste management sector how products or components could be remanufactured, dismantled and recycled. The waste management sector will have to become a crucial partner in new business models that focus on waste prevention and of course the waste management sector will have to ‘turn waste into resources’ (EC, 2015): Instead of predominantly seeing waste as a threat the waste management sector, in close cooperation with industry, will have to produce high quality secondary raw materials that can be fed back into production processes.

In this sense seeing waste as a resource – where benefits could come from high-quality recycling as well as from less waste – will require nothing less than a fundamental transformation of one of the key technical infrastructures that
predetermine a large share of our current industrial metabolism and has been optimised for centuries with the purpose of reducing direct threats to human health and the environment: e.g. the first waste incineration facility in Germany was built in 1896 in the city of Hamburg – not to produce, but following the last great outbreak of cholera. The idea was to get rid of waste in a more reliable way.

Today, waste management will have to expand the perspective and take into account resource requirements linked to our patterns of production and consumption alongside the whole value chain (SRU, 2016). The environmental benefits of avoiding waste clearly far outweigh the environmental impacts of any other waste management option lower down on the waste hierarchy. As an example, the following table highlights the greenhouse gas emissions avoided through waste prevention when compared with recycling.

Indirect but clearly increasingly important impacts of resource consumption will have to become a key driver of future waste management. It is clear that waste management policy or the waste management sector is not responsible for the waste generation – that is a decision for companies and households – but they could play a key role in an overall transformation towards a resource efficient circular economy.

2. The goals of sustainable development
The best way to provide a somewhat more complete picture of what sustainable development means is to categories its goals:

economic growth deals with the fact that an economy should attempt to keep growing at least at the same rate as the population growth and its capital depreciation, an idea developed by Robert Solow

![Figure 1](image)

On the vertical axis, we measure income per worker (y) and on the horizontal one, we measure capital per worker (capital stock). An economy must invest enough to at least offset the increase in population (n) and the worn out capital (5k) in order to stay at its steady state equilibrium, denoted by points E and k*.

b) social welfare includes such actions as increasing the percentage of green in urban areas, reducing the percentage of poor housing (houses judged unfit to live in), decreasing centralization and investing in education and health to reduce poverty. Political agendas also stress the importance of increasing community awareness concerning environmental issues.

c) environmental factors include a variety of issues. These include:

- Prudent use of non-renewable resources. This can be achieved by:
  
  i) research & development which results in technological progress in either the extraction or the commercial use of non-renewable resources
  
  ii) increased energy efficiency. The graph is an example of how technological progress can result in energy saving and reduced use of exhaustible resources. It is evident that automobiles in the US, within a span of twenty years, travel larger distances using much less fuel.

The European Directive 2008/98/EC on waste (Waste Framework Directive, WFD) stipulates in Article 4 that following waste hierarchy shall apply as a priority in waste prevention and management legislation and policy: (a) prevention; (b) preparing for re-use; (c) recycling; (d) other recovery, e.g. energy recovery; and (e) disposal. Deficiencies in implementation or the application of transposed national legislation of the hierarchy have been claimed in five cases from 2011 and in two analysed petitions of 2017 from Greece and Spain. In the latest European
Commission’s report on the implementation of waste legislation (EC 2015a), it is stated that both Countries have transposed the hierarchy in their national legislation (for Greece: Law 4042/2012 (OJG 24 A); and for Spain Law 22/2011 of 28 July). Article 13 of the WFD requires that the Member States shall take the necessary measures to ensure that waste management is carried out without endangering human health, without harming the environment and, in particular: (a) without risk to water, air, soil, plants or animals; (b) without causing a nuisance through noise or odours; and (c) without adversely affecting the countryside or places of special interest. Deficiencies in implementation of this Article or the application of transposed national legislation has been claimed in 25 cases from 2011 and in four analysed petitions of 2017 covering Greece, France, and Slovak. In the latest European Commission’s report on the implementation of waste legislation (EC 2015a) for Greece and Slovak information on the implementation of this Article is given by the Member States, for France no information is available. As this Article covers an important but very generic issue, checking the level of endangerment of the case in situ, as well as checking the compliance of the case with other Articles of the WFD and other pieces of the waste legislation, are crucial steps to assess possible deficiencies. This assessment can only be carried out by the Member States authorities in charge of the permitting, inspection and enforcement issues of the related cases. Requirements for the prevention of waste in general, specific qualitative or quantitative benchmarks for waste prevention measures and the requirements to prepare a waste prevention program are laid down in Article 9 and Article 29 of the WFD. Deficiencies in implementation or the application of transposed national legislation of this Article were not addressed in the cases analysed in 2011 and were addressed once in the 2017 study, namely from Greece. In 2014, Greece published a National Waste prevention strategic Plan covering the period 2014 -2020. It covers the sectors on sale, retail, transport, households, private service activities, health care sector and public services. The main focus was laid on the waste streams food/organic, household/municipal waste, paper, packaging, waste electrical and electronic equipment (WEEE)/batteries. It defines inter alia measures for the prevention of waste at the national level.

3.1 Waste Management in the Circular Economy

This transformation has to go beyond waste management and has to be embedded into a wider framework – the circular economy. The need to transition to a more circular economy is recognised as an essential element in developing a sustainable, low carbon, resource efficient and competitive economy. Using the concepts of circularity helps progression towards a sustainable future.

As outlined above, our current modes of production and consumption remain overwhelmingly based on the linear principle. Resources are extracted, processed, used, and ultimately, for the most part, discarded as waste. At the end of such a cycle, waste is typically disposed of by incineration (thermal utilisation) or landfill. In both cases, materials are withdrawn from circulation or destroyed (even if thermal utilisation does at least produce energy).

In 2012, the 28 Member States:

- consumed 5 billion tonnes of the material of which 80 percent (4 billion tonnes) came from virgin materials and only 20 percent (1 billion tonnes) came from secondary raw materials recovered from the waste stream (WRAP, 2015) – giving a recirculation rate of 20 percent.

- Disposed of 2.5 billion tonnes of waste, 42 percent (1.2 billion tonnes) went to landfill

However, such a linear economic model can only function if limitless resources are available to satisfy endless demand. Global demand is growing steadily, while the availability of both non-renewable and renewable raw materials is finite. A strictly linear economy will inevitably encounter limits.

Central to the circular economy concept is the notion that the value of materials and products is kept as high as possible for as long as possible. This helps to minimize the need for the input of new material and energy, thereby reducing environmental pressure linked to the life-cycle of products, from resource extraction, through production and use to end-of-life.

The concept covers all aspects of economic activity, from resource extraction through production, storage, and consumption, ending with disposal or ideally recycling. The reduce, re-use and recycle approach go a long way towards this concept, although waste avoidance is prioritized (European Commission, 2014). The idea is to close cycles to turn waste back into a resource (in this connection we also speak of ‘second-sourcing’). But if this idea is to be put into practice as effectively as possible, another earlier step is needed: to take account of later recycling already at the design stage.

The fundamental idea of the circular economy has given rise to various currents and variants featuring smaller or larger differences in concept, approach, and scope. These include the circular economy of the Ellen Mac Arthur Foundation, the blue economy concept, cradle-to-cradle, and zero waste (the differences lie principally in the roles of bio-based cycles and renewable energy).
STOA has an overarching vision: sufficient resources for a world with 10 billion people by 2050. Both minimising the production of waste, and then extracting maximum value from what might have traditionally been considered waste, are key pillars in ensuring there are sufficient resources. This becomes all the more significant against a backdrop of resource scarcity (or a lack of access to resources through geographical and political factors), price volatility and population growth.

4. The Current Policy Framework

Looking at the potential positive benefits of a circular economy, the key question is: what kind of policy framework would enable and support such a radical transformation from a linear towards a circular system. This question is especially high on the agenda of the European Commission. In 2015 the Commission published its Circular Economy Action Plan, which set the ambitious objective of treating waste as a resource by the year 2020 and turning the European economy into a circular economy (European Commission 2015). The objectives are in line with the strategic direction for EU environmental policy outlined by the 7th Environmental Action Programme (EAP, adopted in 2013). In setting the vision for 2050, it mentions a ‘circular economy where nothing is wasted and where natural resources are managed sustainably’.

4.1. The Policy Framework for a Circular Economy

The Circular Economy Action Plan comprises various legislative proposals and measures in the areas of production (product design and production processes), consumption and waste management, as well as concrete targets for creating an ambitious long-term roadmap for waste management and recycling in Europe. The action plan can be divided into two key elements: communication on how to integrate circular thinking into different stages of the life cycle and a much more specific proposal for changed regulations on waste treatments. Although the circular economy, of course, goes beyond waste management, the European Commission also acknowledges that waste infrastructures are a crucial element for reducing linear patterns of production and consumption.

The key objective of the legislative proposal to amend current waste regulations is to set incentives for the waste sector to no longer consider waste primarily as a threat but as a potential source of future secondary resources. Against this background, the review includes the following key aspects:

- Align definitions and reporting methods;
- Increase targets for municipal waste;
- Increase targets for packaging waste;
- Limit the landfilling of municipal waste;
- New measures to promote prevention, including for food waste, and re-use;
- Minimum conditions for Extended Producer Responsibility;
- Early Warning System for monitoring compliance with the targets;
- Simplify reporting obligations.

The Action Plan comprises a variety of measures to strengthen the implementation of the circular economy in the EU Member States that go beyond traditional waste management policies. As a policy innovation, the circular economy links waste management with production, consumption, and general policy frameworks, e.g. in the field of production-oriented policy instruments:

- Support for eco-design of products
- Addressing planned obsolescence
- Support for SMEs

The European Commission’s Action Plan not only addresses the production phase but also aims to influence consumer behaviour, especially by providing reliable information for households so that they can benefit from the cost saving potentials of a circular economy, e.g. by:

- Strengthening re-use and remanufacturing
- Green Public Procurement

In addition to policy approaches that directly target activities in the spheres of production or consumption; the overall policy framework will also be of crucial importance for the transition towards a circular economy. The European Commission specifically addresses financing opportunities as a key framework condition.

4.2 Waste Prevention
Waste prevention has been established as a priority through the Waste Framework Directive and its promotion of the waste hierarchy (with reduction as the top priority). The Waste Framework Directive required the Member States to establish waste prevention schemes by December 2013. Flexibility is provided within the Directive regarding the nature of the programmes; however, it does require that objectives are set and that qualitative or quantitative indicators are introduced.

In 2015, the European Environment Agency (EEA) undertook a review of the first 27 waste prevention programmes. The reviewed programmes cover a variety of sectors (see Table 4). General conclusions are that (EEA, 2015):

- All programmes cover the household sector;
- All programmes, except Northern Ireland, cover the public services sector and all programmes, except Bulgaria and Latvia, cover the construction/infrastructure sector;
- Most programmes cover private service activities/hospitality, manufacturing, and the sale, retail and transport sectors;
- Programmes in France, Germany, Hungary, Ireland, Italy, Lithuania, the Netherlands, Poland, Scotland, Spain, and Sweden include the agriculture sector. Agriculture is mainly mentioned in the context of preventing food waste;
- Ten programmes, those in the Czech Republic, Estonia, Finland, France, Germany, the Netherlands, Poland, Scotland, Slovakia, and Spain, include mining and raw material processing.

Only six countries and regions (France, Germany, the Netherlands, Poland, Scotland and Spain) cover all the listed sectors. Stating that the programme covers a sector does not necessarily mean that specific initiatives or measures on waste prevention are included. For example, the number of waste prevention measures for the agriculture, and mining and raw material processing sectors is very low. Where not covered, the agriculture, and mining and raw material sectors may be dealt with in other policies and by other ministries.

The review revealed that countries and regions use a wide variety of indicators with 17 settings quantified targets, but with limited use of monitoring systems (EEA, 2015). Based on their specific context, countries, and regions have chosen different key sectors, waste streams and policy approaches for the implementation of their programs. Around two-thirds of policy, instruments focus mainly on information and awareness-raising, with regulatory and economic instruments accounting for only around one-third.

The EEA reviews of progress in Europe in 2013 and 2014 highlighted a clear need to improve on the implementation of waste prevention measures. The European Court of Auditors (2012) reported similar findings, stating that the EU Waste Framework Directive’s targets do not adequately focus on waste prevention, even though prevention is the first management option according to the waste hierarchy.

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5.1 Policy Instruments in the Current Waste Management Sector

One of the key challenges for a circular economy policy framework will be its integration with the existing waste management approaches in the Member States and regions.

European Union directives and regulations have set the context for many of the other trans positional policy instruments to be implemented and could, therefore, be considered the most significant drivers in the changes seen in waste management across Europe. The general framework for waste management within the EU is provided by the Council Directive 2008/98/EC on waste (the Waste Framework Directive). Of relevance to all the waste streams covered by this report, the Waste Framework Directive:

- Established the waste hierarchy as key to making waste management decisions;
- Sets out the basic waste management definitions including for when a by-product is not waste and the end-of-waste status;
Requires the Member States to take necessary measures to recover, re-use and recycle waste, which includes the separation, where feasible, of waste streams;

Controls hazardous waste through a ban on the mixing of hazardous waste, with the exception of household waste;

Establishes principles such as polluter pays and extended producer responsibility (EPR).

Packaging and packaging waste

The objective of the European Parliament and Council Directive 94/62/EC on packaging and packaging waste (the Packaging Directive) aims to limit the production of packaging waste and promote the waste hierarchy for packaging waste. The Packaging Directive established targets, and therefore collection schemes, for the recovery of packaging materials. Incineration with energy recovery was permitted and was considered as contributing to the realisation of the targets. By 2009, 25 Member States had developed extended producer responsibility (EPR) schemes (IEEP, 2009).

The Packaging Directive (Annex ii of the directive) also had provisions on packaging prevention with measures aimed at limiting the production of packaging waste. However, these have been difficult to implement due to the absence of clear indicators (European Commission, 2014a). Waste prevention is at the very ‘top’ of the waste hierarchy but, in the case of packaging, the market share of reusable household packaging is decreasing. This is seen as a trend that may favour the smooth functioning of the EU’s internal market for packaging under the EU Treaty governing the free movement of goods and competition, rather than national re-use systems that in some instances pose a problem to the internal market regulations through limiting movement of packaging (the second of the Packaging Directive objectives) (EIMPACK, 2011).

The European Commission report (2014c) stated that the circular economy concept is not considered ‘fully developed’ within the Packaging Directive as there is no focus on re-use and minimisation, although the conclusion is that the directive has undoubtedly proved to be an effective instrument of European waste policy. The implementation of EPR schemes, coupled with the use of economic instruments (landfill taxes, bans, PAYT schemes) has been a particularly effective approach to meeting the packaging recycling and recovery targets (BIOIS, 2011). However, it is reported that to date legislation has only considered quantitative aspects of recycling and that a more qualitative approach may be required to ensure the increased recycling rates are not met through the downcycling of contaminated mixed household packaging waste (European Commission, 2014a ). It might be that close investigation is needed to be certain that the headline figures meet the aspirations of the circular economy. Clearly, this is highly relevant to the ‘value’ driven concept of the Circular Economy Package.

5.2 Wastewater Issues

Wastewater is managed through the Council Directive on Urban Waste Water Treatment (91/271/EEC), and through other directives that manage the quality of water in the natural environment such as the Bathing Water Directive, the EU Water Framework Directive, Ground Water Directive and through steps are taken to protect certain sites under the Habitats Directive.

Wastewater is not often considered within the context of the circular economy. Clearly, the implications in relation to negative impacts upon Europe’s flora and fauna from poor water quality following emissions from wastewater treatment plants to surface and underground water bodies must be considered. The treatment of sludge from wastewater treatment plants is captured within the Waste Framework Directive and the Fertiliser Directive. It is included in the bio-waste and residues sections as ‘common sludge’.

6. Concluding Remarks

Issues of sustainability are ultimately issues about limits. To begin with, if we assume that economic growth can be achieved indefinitely through technological progress, to what extent can future environmental problems be fixed technologically? Moreover, from all the above arguments it becomes apparent that in order to ensure long-term sustainability, in terms of an economy-environment balance, countries must be their "steady state". Thus, developing countries would be primarily concerned with economic growth, at any cost, in order to get closer to their steady state, and then start worrying about environmental issues and sustainability issues. Furthermore, it is impossible to account for every minor fluctuation in the natural environment; as it is impossible to control human behaviour at every level. Thus it is not at all easy to construct some kind of "sustainability index", as some have suggested, that would be complete and accurate enough. But even if some kind of index is constructed, it must be regularly monitored. That is where governments must take an active part in pursuing policies to achieve desired levels of sustainability, just like they do with GDP or interest rate levels. Markets have to be regulated accordingly and deviations from desirable levels must be somehow reflected on the consumer, as is a rise in interest rates or the price level. A correction mechanism has to be devised, along with institutions responsible for the implementation of such a mechanism. And, at the end of the day, individuals have to change attitudes towards the entire concept of sustainability, ranging from consumption patterns to increased awareness and sensitivity about the preservation of the environment or even better,
the entire natural capital stock. All these issues have to be taken into account. They form essential aspects of sustainable development. They are important for our well-being and, most importantly, for the well-being of future generations.

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