Chapter 30
Reconciling Waste Management and Ecological Economics

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30.1 Introduction

Many times, I have heard Prof. Joan Martínez Alier saying: "The economy is entropic, not circular!". Thus, it has not always been easy to reconcile ecological economics, with the more conventional views coming from waste management, where the so-called "circular economy" is the new mantra.

Although waste management is not the core discipline of Prof. Martínez Alier, he has emphasised the importance of the analysis of material flows to understand how societies operate, and here the analysis of inputs (resources) and outputs (waste) are equally relevant.

He has also been involved in several conflicts related to waste management, mostly collected in the Environmental Justice Atlas. In some cases, he had first-hand involvement, as in the case of the dumping of hazardous waste in the Ebro River, in Flix, one of the areas of Catalonia he knows best for family reasons.

Besides material flow analysis and socio-economic conflicts, theories and practices on waste management have also benefited from at least two disciplines that have been central in the School of Barcelona. One is multicriteria analysis, as a way to deal with conflicting views (e.g. costs, environmental impacts, alternative location of facilities), which benefited from central contributions by Prof. Giuseppe Munda. Another one is the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM), where the nexus between food, energy, water, land uses, urban metabolism and waste management are analysed. This approach was created by Mario Giampietro and Kozo Mayumi, and it has been applied to waste management by Giacomo D'Alisa (D'Alisa et al., 2012), Rosari Chifari, Samuele Lo Piano or Sandra Bukkens (Chifari et al., 2018), among others.

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These contributions have helped to understand waste management not only as a technical matter falling within the realm of engineering, as it was traditionally conceived, but also as a much more social discipline, where public participation and communication, economic analysis, public environmental policies, economic incentives and so on are fundamental.

Apart from this introduction, this chapter includes a brief discussion (Sect. 30.2) of the concept of circular economy, both globally, and in the context of the related EU policies.

Section 30.3 is the central part of the chapter and addresses a number of waste management policies, particularly based on the use of economic instruments, which proved efficient in achieving advances towards the higher tiers of the waste hierarchy (i.e. prevention, reuse and preparation for reuse and recycling). Some of the instruments presented are landfill and incineration taxes, environmental taxes on certain products, extended producer responsibility and fee-rebate schemes.

Finally, Sect. 30.4 presents the main conclusions.

30.2 A Circular Economy: Not Now, and Not Anywhere Soon

The concept of circular economy is easy to communicate, and it draws a certain parallelism with natural cycles. However, at present, the discourse on circular economy is largely disconnected from the imperatives coming from thermodynamics, and particularly from the analysis of the energy basis of the economy. In 2005, the global economy used 28 Gt/year of materials for energetic use (out of a total of 58 Gt/year of material extraction) (Haas et al., 2015). None of these materials – basically fossil fuels – are or can ever be recycled. This is, no doubt, the main criticism of the most common approach to a circular economy. A transition to a more circular economy must therefore include energy considerations as a priority and should run in parallel to a transition towards 100% renewable energy sources.

A second aspect is that current waste policies tend to focus on a rather narrow band of the material flows: especially municipal solid waste, with also some focus on industrial and construction and demolition waste. Although the targets are increasing in these areas, overall recycling remains low. At a global level, recycling was estimated to be around 6% in 2005 (Haas et al., 2015), whereas in the EU-27 it was 13%. This percentage was estimated to be around 15% in 2014 in the EU-28 when analysing only non-energy and non-food material flows (Nuss et al., 2017).

Focusing on the European Union (EU), in March 2020, the European Commission adopted the communication “A new Circular Economy Action Plan: For a cleaner and more competitive Europe” (European Commission, 2020), which succeeded the previous Circular Economy Package from 2015, which resulted in the revision of the main waste directives in 2018.

In particular, in 2018, the main objectives of the Waste Framework Directive (Directive 2008/98/EC) were revised,[1] and now a 65% recycling level of municipal waste has to be achieved by Member States by 2035, with intermediate levels by 2025 and 2030 (actual level was 47.0% in 2018; Eurostat, 2020). Although these objectives are ambitious, they are still far from circularity. If Member States comply with the objectives, in 2035, 35% of the materials will still escape from the cycle. Although we know that 100% is thermodynamically impossible, certainly, 65% still leaves a lot of room for improvement.

The Landfill Directive (Council Directive 1999/31/EC) was also revised in 2018. Its main objective, in art. 5.5, indicates that "Member States shall take the necessary measures to ensure that by 2035 the amount of municipal waste landfilled is reduced to 10% or less of the total amount of municipal waste generated (by weight)".[2] What ends up in a landfill certainly does not re-enter the economy.

Although waste incineration with (partial) energy recovery is better situated than landfills in the waste hierarchy, it is worth emphasising that in terms of the circularity of materials, it contributes exactly in the same way as landfills: what ends up in an incineration plant does not re-enter the economy either.[3]

At EU level, there are also some legal objectives regarding other important waste fractions, such as packaging waste (Directive 94/62/EC), waste from electric and electronic equipment (Directive 2012/19/EU) and construction and demolition waste (Directive 2008/98/EC), among others.

30.3 Sensible Waste Management Strategies

Traditional waste collection approaches based on environmental awareness and voluntary contributions to recycling centres and street containers for recyclables can continue to play a role, but more effective systems are needed.

Door-to-door (kerbside) separate collection schemes consistently achieve higher separate collection levels than bring schemes (Giavini et al., 2013), typically around 70–80% compared to 30–50%. This type of collection facilitates user identification and the application of pay-as-you-throw (PAYT) waste charges, thereby creating an incentive for users towards separate collection (Elia et al., 2015). Variants of pay-per-bag and pay-per-bin associated with kerbside collection are the most common PAYT schemes (Puig Ventosa et al., 2013a).

Where door-to-door is not applied, user identification is also possible using smart containers. Many possible alternatives can be applied depending on whether identification is made voluntary (open containers) or compulsory (closed containers),

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02008L0098-20180705

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01999L0031-20180704&from=EN

[3] Except for some metals recovered from the slags.

on how waste generation is measured (either volume or weight), on the waste fractions to control, on the type of technology, and so on (Saleh et al., 2019).

The question of quality should also gain importance. Separate collection is not a goal per se, it is only a means for recycling. However, truly recycling, not just *downcycling*, can only take place if the materials undertaking the recycling process are sufficiently pure, and that normally requires efficient separate collection.

In the case of biowaste (but this could also be argued for other waste fractions), the presence of impurities is statistically explained by several factors. Besides urban density and the requirement to use compostable bags, one of the factors is the type of collection system. Door-to-door collection schemes achieve the lowest average levels of impurities (Puig Ventosa et al., 2013b). This is relevant not only because the presence of impurities in biowaste causes problems during composting or anaerobic digestion (additional costs derived from the need to improve pre-treatment of biowaste and loss of treatment capacity), but specially because it has a direct impact on the quality of the output.

The quality of compost obtained in biowaste treatment facilities depends upon several variables associated with the technical specifications of the plants. However, it has been proved that the presence of improper materials (glass, plastic, etc.) leads to a negative impact on various parameters of the quality of compost, notably the concentration of heavy metals (Cu, Pb and Zn) (Rodrigues et al., 2020).

Ultimately, this is relevant because the cycle is only closed if this compost is applied to soil. Although the benefits of compost application to soil are proven (Gilbert et al., 2020), it can also cause soil pollution, if its quality is not sufficient, due to the presence of heavy metals, or due to the presence of microplastics (Lin et al., 2020).

Most European countries have landfill taxes in place for municipal waste. Some also have incineration taxes (Watkins et al., 2012; Fischer et al., 2012). These taxes are normally paid by Local Authorities in charge of waste collection, and they encourage them to adopt strategies to divert waste from landfills and incinerators, which normally include improving separate collection of biowaste and recyclables, as well as stabilising non-separately collected waste before disposal (e.g. via mechanical–biological plants).

The effectiveness of these taxes is undeniable, and they normally constitute a central piece of the waste management strategies of the countries or regions that have them in place, especially when their revenue is earmarked and dedicated to the implementation of preventive waste policies (e.g. in Catalonia; Puig Ventosa et al., 2012). However, landfill and incineration taxes do not significantly contribute to moving to the highest tiers of the waste hierarchy: advancing towards prevention and preparing for reuse implies a profound rethinking of the production and distribution strategies by the industry, and the industry is not affected by the incentives created by the landfill and incineration taxes.

Banning non-recyclable products and establishing requirements on the minimum content of recycled materials could also be positive measures in this direction, along with specific taxes on products causing significant environmental impacts (e.g. plastic bags as in Ireland (Anastasio & Nix, 2016) and disposable packaging as in Norway (Infinitum, 2020)).

Another important concept is that of extended producer responsibility (EPR). EPR "aims to make producers responsible for the environmental impacts of their products throughout the product chain, from design to the post-consumer phase" (OECD, 2016).

However, after decades of implementation, EPR has significant limitations. Public Administrations continue to sustain part of the costs that should be borne by producers even where EPR schemes exist (e.g. littering), and EPR schemes do not sufficiently incentivise recyclability and eco-design amongst individual producers (OECD, 2016; Zero Waste Europe, 2015).

Nevertheless, the main current limitation of EPR is that it is reduced to a very limited number of products. For example, within the EU, the application of EPR is only common for waste from electric and electronic equipment, batteries and accumulators, end-of-life vehicles, packaging waste, oils and tyres. For most products, it simply does not exist, and producers are allowed to put any product on the market, no matter how difficult and costly to manage when it turns into waste.

In some cases, products without EPR are a significant percentage of waste generation (such as for the case of graphic paper, furniture or textiles) or are very environmentally problematic and costly to manage (such as disposable nappies, sanitary pads, cleaning wipes, mattresses, cigarette buds, and chewing gum).

It seems unlike that extending EPR in a product-by-product approach will be able to cover a broad range of products. Thus, a new concept of generalised extended producer responsibility (GEPR) is suggested. In this case, all products put on the market would be subject to EPR, with the only exception of biowaste, which is linked to basic human metabolism.

Specific EPR schemes could continue to exist, and maybe a few more could be created, but there would also be a general scheme for all those products with no specific EPR scheme associated. GEPR could generalise incentives towards recyclability and cleaner production, particularly if some lessons are learned from past EPR experiences, and would suppose a much fairer distribution of costs, shifting them from Public Administrations to producers, and ultimately from taxpayers to consumers.

A particular form of materialising EPR is through the use of deposit-refund schemes (DRS). Although they can potentially be applied to other items, its main application so far has been on packaging, mainly beverage bottles and cans. These products are sold with a deposit, which is refunded when the empty packaging is returned. This ensures a high level of return (typically around 80–90%; Fletcher et al., 2012), sensibly higher than that achieved in street containers for packaging waste. Around 40 of these schemes are applied in different jurisdictions around the world, mainly in the EU, USA, Canada and Australia (Zhou et al., 2020). DRS can be applied to both disposable items (to ensure collection and high-quality recycling) and reusables (e.g. glass bottles are cleaned, sanitised and refilled).

There are other economic instruments with significant potential whose application has been so far very limited, such as feebate systems or Landfill Allowance Trading Schemes (LATS):

- Feebate systems make a simultaneous use of fees and rebates. Activities that take less care of the environment compared to the average are charged fees, whereas the most ecological ones receive rebates, making them more economically attractive compared to the initial situation. The more environmentally harming an activity, the higher the fee, and vice versa. Activities with the average environmental performance are neither charged nor subsidised. Globally, fees and rebates cancel each other out, and therefore beyond the administrative costs this tool is neutral for the budget of the administration that sets it up.
- Most municipalities group themselves to manage solid wastes more efficiently, sharing services and facilities. In these associations of municipalities, costs are allocated to each municipality according to some criteria (e.g. number of inhabitants or amount of waste brought to the shared facilities), which often do not provide sufficient incentives for good practices. In this context, a feebate system could be adequate to reward those municipalities making significant steps towards ecological waste management (less per capita generation, higher separate collection rates, higher biowaste quality, etc.), whilst penalising others, using the average values as a reference.
- The articulation of this instrument was proposed theoretically (Puig Ventosa, 2004), and it was successfully applied in the Metropolitan Area of Barcelona (Puig Ventosa, 2006), from 2004 to 2017.
- Landfill Allowance Trading Schemes (LATS) are useful instruments to achieve landfill diversion targets. Through LATS, allowances for landfilling of municipal solid waste (or the biodegradable part of it) are allocated to Local Authorities. The quantity of landfill allowances assigned globally is reduced annually in order to meet the landfill diversion objectives. To achieve their commitments, Local Authorities can exchange allowances among each other, or may reprofile their own allocation through banking or borrowing. Although tradable permits have been largely applied as part of climate policies, the application in the area of waste management is very limited. The main experience was the application of LATS in the United Kingdom, as an instrument to comply with Directive 1999/31/EC on the landfill of waste. Starting in 2005, it had a successful application, but it was finally abandoned in 2012 when it became redundant with the UK Landfill Tax (Calaf-Forn et al., 2014).

30.4 Conclusions

In our society, waste seems the unavoidable consequence of production and consumption. To a certain extent, waste is inevitable. Even nature produces waste. In fact, our current civilization is built entirely around one of these – fossil fuels. However, most waste could be prevented, and when not mostly recycled, as nature does.

Nevertheless, despite the advances in the political framework, especially in some regions like the EU, most of the waste is dealt with inappropriately, largely relying on incineration and landfilling, which are the lowest tiers of the waste hierarchy. Although there is a lot of room for improvement in the adoption of good practices voluntarily by citizens and industry, a main driver should come from environmental policies, and particularly from the use of economic instruments. The discipline of ecological economics has a lot to offer in terms of not only to better understand how and why waste generation is produced, but also to inform the design of such policies in the best possible way.

Waste management policies cannot only focus on the outputs of the system but also on the inputs, putting eco-design in a pre-eminent place. No recycling is possible for non-recyclable products, and still, many of them enter the market without assuming their true cost.

It is about aligning the environmental discourse with the economic. Doing things which are bad for the environment (i.e. going for the lowest tiers of the waste hierarchy) cannot come out cheaper. In this regard, advances in EPR and environmental taxation should be adopted.

Finally, the emphasis on circularity should not make us forget about the importance of the "size of the circle". Reaching higher recycling levels does not necessarily reduce environmental pressures if the system requires an increasing amount of raw materials. A broader economic vision is needed to reach social objectives, but within a framework of sufficiency.

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