# Urban Solid Waste Management

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Urban solid waste management is one of the most important local services, and its effective economic regulation can be a driver for the sector toward innovation, sustainability, and efficiency. Prominent economic topics include, among others, the analysis of the market structure, the regulatory frameworks, charging models of waste management services, economic efficiency, and environmental goals.

Keywords: municipal solid waste ; market power ; waste to energy ; landfill ; waste regulation ; concentration indexes ; competition policy

## 1. Introduction

Waste management sustainability targets are at the heart of policies [1] worldwide due to global commitment in sustainable development goals, given that by 2050, 3.40 billion tons of waste annually are expected to be generated globally, one and a half times more than today [2]. In Europe, these targets are highlighted in the so-called circular economy package [3].

It is no wonder that efficient regulation of the waste management chain is essential [4] if environmental sustainability targets are to be met while economic efficiency is improved.

Differently from other utilities such as water, gas, or electricity, stages of the MSW management chain are virtually independent, i.e., not linked from physical elements used to transport the material from one stage to the following.

The MSW management chain includes two consequential stages that differ both technically and economically. First comes the collection and transport (CT) stage, in which the separation of unsorted and sorted waste takes place, and second comes the treatment and disposal stage (TD), where recyclable waste is treated, and residual waste is disposed of. Disposal typically happens by landfilling or incinerator options, among which waste to energy (WTE) plants that generate energy from waste [5] are placed before landfilling in the waste hierarchy [6] given, generally, their lower environmental impact compared to landfilling. However, it is worth noting that that WTE plants have several problems associated with emissions and the pollutant ashes eventually have to be disposed of also by mean of landfills.

The MSW management chain and the role of the different operators in it varies considerably both across and between countries [7]. Consequently, it is increasingly important to lay the foundations for benchmarking and comparative purposes to design environmentally, economically, and socially efficient waste management systems [8].

Previous literature has provided insights on the functioning of the market as a complete cycle, frequently using economic variables such as total cost of the service [9], the efficiency of the service [10], or even options to regulate the service [11]. The sector is constantly expanding, giving rise to new challenges in terms of economic regulation, taking into account the existing balance and the difficulty in distinguishing between public service and the market. One aspect that is evident is that the space for competition in the market has become much larger, and likewise, the role of regulation has also increased [12]. The legal basis of competition in MSW management is rooted in the Treaty on the Functioning of the European Union that aims to prevent distortions on and restrictions of competition. Specifically, Articles 14, 59, 93, 106, 107, 108, and 114 for public services, services of general interest, and services of general economic interest [13].

The design of efficient regulation calls for the analysis of the MSW management chain industrial structure, including market concentration measures and the boundaries between public services and the market [12]. Indeed, competition analysis relies on the market definition paradigm, under which a relevant market is defined in order to make inferences about market power [14]. The inferences relate to the importance of the relevant market in the analysis of the competition and, in particular, the economic substitutability of products as measured according to the notion of market power in the relevant market [15]. Currently, nevertheless, there is a significant information asymmetry preventing the sound regulation of the MSW management industry [16] and in this paper, we focus on the information inherent in market power.

Our goal is to reduce the information gap to help overcome the regulatory failures that affect the functioning of the waste management market, since the degree of concentration in the TD stage, in particular of TD of residual waste, is likely to increase in the short and medium-term. Therefore, problems of market regulation and issues regarding the regulation of access to the infrastructure typical of network industries arise with operators with high market power [17].

## 2. Market Structure of Urban Waste Treatment and Disposal

Concentration measures within the waste management chain are important in services of general economic interest given that the reference to a market is an undefined concept that can contain different types of services, including those that, despite not having a reference market, can be provided in a potentially economic context.

As mentioned, the MSW management chain comprises the CT stage, in which the separation of unsorted and sorted waste takes place, and the TD stage. Due to key differences in the industrial structure of the stages, each of them shall be differently regulated in light of the characteristics of services provided in each. From a completion policy perspective, one shall note that there are many companies operating in the two stages, not necessarily in an integrated way. In many countries, the CT stage is regulated through a competitive market approach where potential providers bid to provide the service on pre-specified terms and conditions over a specified period. The structure of the TD resumes an oligopoly; in these cases, ad hoc regulatory mechanisms to control concentrated markets are needed, especially in cases of asymmetric information [18].

In light of the consideration made regarding the relevant market and concentration measures [19][20][21], it is unlikely that the authorities regulating the functioning of the market will identify competition problems if the HHI is less than 1500. Instead, competition authorities tend to monitor the market where the HHI is less than 2000. Values above 2000 may indicate a need for more in-depth evaluations, depending on the type of market under analysis. In our case, it is necessary to consider that WTE plants are generally characterized by high technological complexity and may present relatively high fixed investment costs. In any case, there is no evidence of sub-additivity of costs. Therefore, the most efficient solution for carrying out these activities is not to concentrate production in the hands of a single operator.

However, considering only the WTE plants as the product market, one notes a CR1 index close to 36% and an HHI that equals 1909. The second consideration concerns the governance model in MSW management and the implications in terms of the cost of waste management services.

We underline the fact that the results refer to the Italian market and are therefore reliable with regard to their internal validity. They are also reliable for possible variations in the geographic extension in calculating the concentration indexes. We have used the entire national territory as a geographic dimension. However, it might make sense to consider smaller geographic areas. This is because the characteristics of this market are compatible with limited management at a territorial level. The purpose is to limit as much as possible the movement of waste to different areas because the transport of waste is correlated with environmental costs and economic costs [22]. Independent of the case study of this paper, the results are hypothetically extendable to any country. It is important that policymakers consider a geographical size appropriate to the objectives of a circular economy and simultaneously to the morphological and socio-economic characteristics of the territory.

We welcome regulations in accordance with the provisions of European directives on the circular economy discouraging landfills, for example, through an eco-tax and efficient tariffs aimed at raising the opportunity cost of avoiding landfills [23][24]. These measures, at least in the short–medium term, encourage alternative systems such as WTE. In addition, incentive regulation should make WTE economically more convenient [25][26]. We also advise national coordination between the local and central levels of government to determine the waste treatment capacity of unsorted waste in the various areas of individual countries [27]. This is a particularly important issue because the construction of WTE plants is often subject to the NIMBY syndrome [28][29]. To ensure that this tendency is overcome, coordination is needed between the various levels of government to reach an agreement on the WTE plants necessary to ensure that the objectives of the circular economy can be achieved. It is also necessary to minimize the environmental and social costs arising from inefficiency in the location of WTE plants.

Our results provide a possibly encouraging way forward on waste management regulation compliant with development goals, making recommendations to support policymakers to develop local solutions for waste management. Policymakers should equip regulatory agencies with the tools and the mandate needed to gain market data information with the aim of modeling the relevant market to properly regulate and incentivize the best organizational form of each stage of the MSW management chain. Our paper may prompt additional research regarding the market structure of TD of residual waste

treatment focusing on a global level being an international perspective that should be better analyzed. In addition, there is also another noteworthy aspect, i.e., alternative scenarios with respect to the estimated increase in waste over the coming years that would lead to different possible developments, opportunities, and threads.

## 3. Conclusions

Given the gradual reduction of waste sent to landfills as foreseen by circular economy directives, the need to understand the path to a new equilibrium in waste treatment justifies a corpus of literature related to waste management market structure. In particular, it should be taken into consideration that the strengthening of the dominant position in an oligopolistic market could neutralize the potential entry of third parties into the relevant market. Consequently, the reduction in alternatives available to operators active in the market upstream may impact the total cost of service with negative externalities to society.

Depending on the scenarios as per product and geographical markets, the concentration may vary significantly. That said, from the shreds of evidence presented, several considerations for policy can be drawn. Under a scenario in which only WTE plants are considered, results show that even in a relatively big market, the third, if compared to other EU Member States, a moderately concentrated market emerges. As shown, the HHI index is 1909 and could rise in the coming years due to the reduction in waste sent to landfills. It is no wonder that this scenario may prompt serious challenges for competition policy as the geographical market for waste management shall not be as large as a whole country like Italy if the constraint of limiting waste transportation is respected. Therefore, given the inverse relation between the size of the geographical market and the concentration, all else being equal, the HHI index may be higher in smaller geographical markets as demonstrated in this paper. Indeed, our results confirm that by narrowing the geographic market size, concentration increases significantly not only for WTE plants but also for landfills.

Besides, the relationship between the waste governance model and cost of service seems to exist even if additional research is required to fine-tune statistical analysis. The results suggest that a market model based on the free movement of waste and negotiation of treatment prices is associated with efficient costs.

Our results are helpful in the development and design of competition policies because, in the short-medium term, WTE plants will progressively acquire market shares compared to landfills. Therefore, it is important to reflect on the implications of this evolution in terms of market structure and organization in light of the fact that WTE plants can be thought of as an oligopolistic market with local monopolies characterized by significant economies of scale and long payback times. At the same time, they can be considered essential infrastructure for waste management that shall be regulated by appropriate laws and principles to protect competition.

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