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Introducing a system operator in the waste management industry by adapting lessons from the energy sector

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Governance of waste management is historically based on local issues, with different applications and rules across countries. To meet the increasing number of circular economic goals, countries worldwide are seeking to improve the efficiency of waste management markets in terms of environmental performance and cost efficiency. For this market to effectively move toward a more circular perspective, sound reforms are needed at the market design level. We suggest that a system operator should be introduced in the industry to coordinate and support the healthy functioning of the market. We develop our idea starting from lessons learned from the energy market that apply governance characteristics and environmental goals. Focusing on the industry structure, we identify tasks and duties that a waste management system operator should perform to boost the transition toward a more circular economy. Our proposal has policy ramifications, with the most important identifying an appropriate legal entity. The study has managerial implications, and we suggest that a system operator is needed for reporting environmental results, ensuring the universality of service, planning and monitoring environmental goals, and supporting local authorities, as well as other coordination activities. These activities will facilitate a move toward a more circular economy, addressing issues concerning the complexity of waste management industries, markets, and outputs.

KEYWORDS

waste management, system operator, circular economy, market regulation, environmental policy, recycling, energy markets, environmental agency

Introduction

The governance of public services is critical in modern economic systems (Boggio, 2016), especially since the demand for public services has increased over time (Huang, 2022) and environmental goals have become more common and binding. To meet their goals, public service industries require policies and institutions to make the market more efficient by both maximizing social welfare and minimizing costs (Asquer et al., 2017). Economic and political factors have different influences (Plata-Díaz et al., 2014), as do environmental issues (Xiao et al., 2020), on the waste management hierarchy and waste management circularity (Colasante et al., 2022).

Waste management is a complex system, in which multiple services must be organized and coordinated in a way to reduce the environmental impact, for example, through activities aimed at promoting the reduction of waste production, as well as recycling, energy recovery, and the minimization of landfilling (Bognetti, 2012; Di Foggia, 2022). This is a sector characterized by multilevel governance where the principles of economy, effectiveness, and efficiency are all relevant. There have been multiple factors that are revolutionizing environmental public services, and waste management is no exception. Like other industries that have historically been characterized by a strong public sector presence, existing governance models need to be updated to meet the challenges and opportunities of following environmental targets and planning investments in innovation activities.

As one example, an efficient waste management sector is the backbone of the development of secondary raw materials (SRMs) markets that are intended to decrease the generation of waste and increase economic system resilience, improving the safety of material supply. SRMs include materials that can be recycled and subsequently reintroduced as new raw materials into the economy. In a Circular Economy (CE), SRMs can replace primary raw materials, enhancing supply. However, SRMs currently only make up a small proportion of the total amount of materials utilized (European Commission, 2021) not only in Europe.

These opportunities can be taken if industry players operate in efficient markets supported by effective governance, such that interactions among regulators, public officers, infrastructure and utility firms, public service providers, citizens, and civil society organizations are facilitated (Asquer et al., 2017). Yet, varying laws in different areas, autonomous recycling targets, and their constant updates represent barriers. Based on available case studies (Di Foggia and Beccarello, 2022), we envisage the opportunity to introduce into waste management systems a legal entity to support policymakers and regulators and to coordinate a multitude of activities and services run by market operators, i.e., a system operator (SO). A previous study described the role of SOs in some infrastructure industries including the different types and their role as coordinating entities (Cave, 2013). Another study looked at the evolving role of SOs and how their efficiency might be evaluated (Pollitt, 2012). Since countries are facing new challenges stemming from the need to improve waste management efficiency, waste management sectors must be compatible with higher environmental goals. As seen in other network industries, such as aviation, railways, telecommunication, natural gas, and energy, different kinds of reform are needed.

In this context, the novelty of our study is a governance shift of waste management market design aimed at initiating governance reforms by creating an adequate level playfield, expanding competitiveness, guaranteeing service universality, and meeting CE goals. The added value of this parallelism lies in the fact that both policy and managerial implications arise. For policy implications, we believe that the government should define the proper legal entity in light of the market structure, including the coexistence of private and state-owned companies. Tasks and duties shall be granted to defined legal entities. We suggest that an SO in the waste management industry is needed for reporting environmental results, ensuring the universality of service, long-term planning, monitoring of environmental goals, supporting local authorities, and other coordination activities.

First, we provide a brief introduction to the various forms of regulation based on the different market conditions. Next, governance is addressed, accounting for organizational architecture that must take into consideration the directions of the different institutional actors involved. Aspects of the development perspectives of an SO are introduced, given that the strengthening of CE goals constitutes a challenge in terms of organizational efficiency choices. Then, we provide some insights from energy markets given that in the energy markets rapid changes have brought opportunities and challenges to SOs and other market participants (Liu, 2021).

Background and literature

Market

Competition policy and economic regulation aim to promote and protect social welfare (Ferro, 2018; Fox, 2018; Sviták, 2018). There are various ways to achieve these goals, in particular, through addressing the forms and structures of the market that are deemed most appropriate to maximize social welfare and minimize the negative externalities and opportunity costs resulting from possible alternatives (Ducci, 2019). Fair competition stimulates economic performance (Teece, 2020), and offers consumers a wider choice of products and services that tend to correspond to better quality at more competitive prices. Therefore, it is important to correctly define the conditions, goals, and effects of different regulatory and competition policy options when comparing alternative or complementary market and non-market arrangements (Tian, 2020; Dierx, 2021). Assuming that institutions and policies affect the degree of competition in the market, it must be ensured that effective environmental policies do not affect the functioning and structure of the market—even indirectly, e.g., by reducing incentives for innovation (Charreire, 2021).

In some cases, the structure of the industry is influenced by the competition-restricting behavior of operators (Bel, 2021); in other cases, it is influenced by the form of the market that policymakers or regulators consider to be functional for the industry and their goals (Captain, 1997; Bryant, 2016; Garcia et al., 2020; Chen et al., 2022). Hence, a key objective is finding the balance between alternative approaches to maximize social welfare while avoiding restrictions on the functioning

of the market (Chirita, 2018; Wang, 2018; Gouri, 2020). Municipal waste management has similarities with other public environmental services and, therefore, it is useful to consider the experience of other services characterized by multilevel regulation and environmental goals. Also, we can analyse the various existing models of competition policy and economic regulation, including in the energy sector where SOs are an important element in the maturation of the market.

Regulatory scope

To achieve a crossover between the different regulatory options relevant to the organization of the supply chain, it is necessary to focus on the interaction of the different models of economic regulation pertinent to competition policy (Hulten, 2018). Economic regulation and competition policy can have overlapping scopes, as shown in Figure 1. Competition policy aims to strengthen the functioning of the market by preventing or incentivising certain business choices. By contrast, economic regulation generally involves altering the market to counteract market failures. Although competition policy and economic regulation often share the same objective, it is generally recognized that there may be critical issues arising from overlaps (Gundlach et al., 2019; Lyu et al., 2020). We provide in this section a non-exhaustive and introductory taxonomy of some possible market arrangements. The aim is to envisage hypotheses of interaction between competition policy and regulation, contextualizing them to the municipal waste management sector. As also can be seen in Figure 1, we can assign to the notion of competition both the definition of competition for the market, i.e., the left side, and the definition of competition in the market, i.e., the right side. In a sector in which the market forces alone are not or may not be unable to safeguard social welfare, regulation must provide for appropriate measures to stimulate the efficiency of the sector to generate social welfare while preserving non-discriminatory conditions for firms (Sarra et al., 2020). It follows that in the presence of this type of market, it is necessary to think in terms of competition for the market, choosing the companies to be entrusted with the provision of services using public selection procedures. The term *regulation* is often used for the combination of rules, goals, and mechanisms imposed by the legislature to regulate specific, well-defined aspects of the economy, yet some have adopted a broader definition that includes any form of direct intervention by the public sector in the economy (Baldwin et al., 2013; Di Foggia, 2018; Marques et al., 2018).

Another form of regulation that may be necessary where price and market entry regulations already exist is known as deregulation. The motivations behind deregulation policies are manifold, the most common being excessive bureaucracy and alleged inefficiency of public apparatuses in producing both administrative decisions and public services. Deregulation models can act either on price restrictions or on the freedom to enter a given market (Belloc et al., 2014; Stankov, 2018). A further case, a central part of Figure 1, is when interest groups negotiate agreements with service providers, bearing in mind that these agreements between the parties must be approved by the regulator (Decker, 2014). Because the regulation of entry into the public service sector often has to do with efficiency and productivity, it is important to explore whether there would be an entry into the market in the absence of a regulatory scheme. Such considerations underlie what is referred to as the contestability theory of markets. In this type of market, the concepts of economies of scale and the role of information are essential; specifically, asymmetric information may represent a barrier because incumbents generally possess an advanced level of know-how compared to potential competitors.

These general principles must be considered in a new regulatory framework for waste management, in which an economic, technical, and qualitative regulatory framework aimed at achieving CE goals is to be adopted with the help of a SO to support the functioning of the market.

Governance

There are different areas where competition policy and economic regulation coexist. The presence of sector-specific regulation suggests that market supervision aimed at maintaining effective competition is insufficient. In economic terms, the organization and regulation of municipal waste management require a balance between technical efficiency, i.e., the most suitable market forms and economic regulation, as well as economic efficiency to ensure the production of the service at the lowest cost to society. They must preserve universality in quantitative and qualitative terms, i.e., a fair and non-discriminatory field for all operators and potential competitors (Massarutto, 2007; Antonioli, 2012). The organizational architecture must take into account the various actors: the central government defining the national waste management plan; regions defining national waste management plans; municipalities for collection and transport activity coordination; a dedicated authority for economic, technical, and commercial quality regulation (Rodrigues et al., 2018; Dagiliene et al., 2021). Many countries have experienced re-municipalisation in the public service sector, with no exception for urban waste management (Romano et al., 2022). Because waste management is also at the heart of the ecological transition process (European environmental sustainability goals, public purpose of general interest), it has traits in common with other sectors, such as energy. There is a need to introduce independent bodies into the governance of the sector and also, if necessary, to temporarily perform operational functions that market operators are unable to perform.

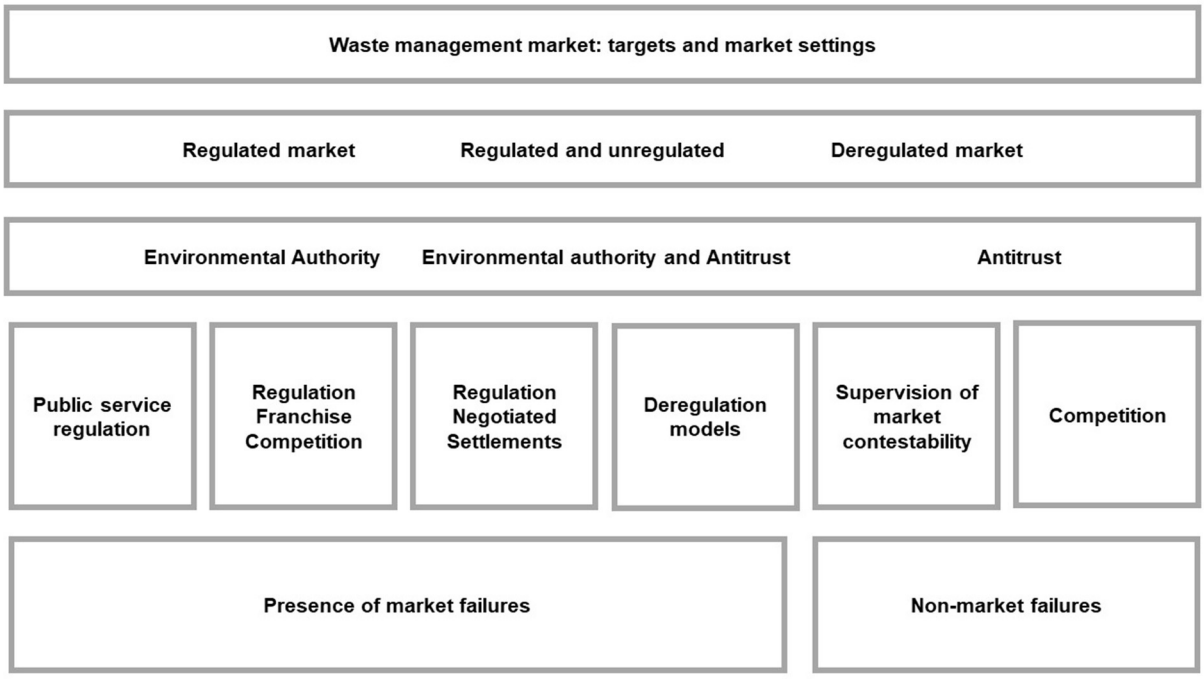


FIGURE 1
Market structure, competition policy, and regulation. Source: own elaboration based on (Decker, 2014).

In the governance system outlined above, there is a need for a third-party operator to be assigned public-sector functions. In a structure such as the one depicted, there is a need for a supporting activity of multilevel regulation carried out by a SO. While the term SO has been used in various ways and contexts, the core defining feature of such organizations can be understood as their engagement in some form of coordination activity. A prominent purpose of SOs is the achievement of coordination efficiencies among different operators of the industry to avoid coordination failures. Distinct types of institutions can aim to facilitate the healthy functioning of the markets. Such facilitation is core to what SOs do, and they typically have additional responsibilities regarding the efficient operation of an industry.

Perspectives of a SO in the waste industry

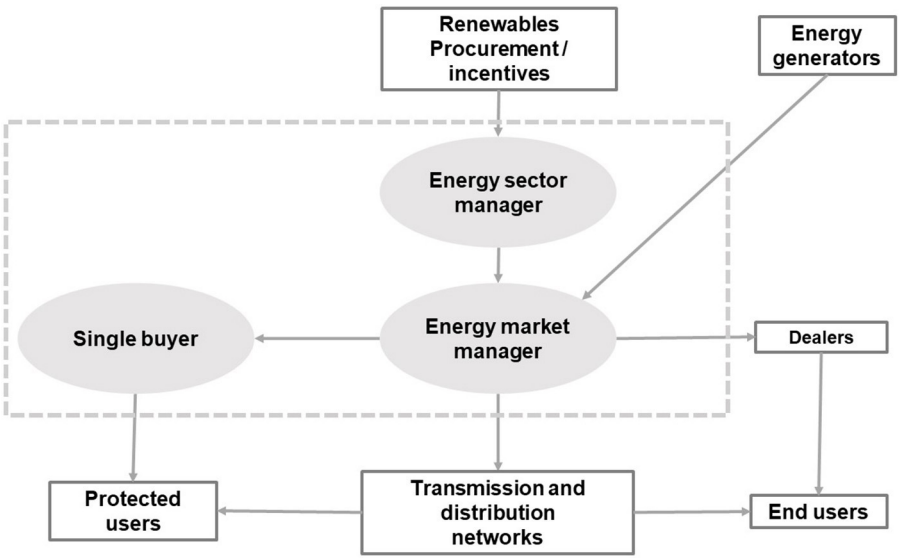
Since the waste management service is a complex system, in which multiple services must be organized and coordinated in such a way as to reduce environmental impacts, the waste management chain can create complex interdependencies. As such, an information-providing mechanism is essential. Providing information concerning waste management constitutes a key element to knowing and understanding the trends in material prices, market demand, and recycling capacity to verify the progress toward long-term sustainability goals. The potential role of a SO in the realization of CE goals can be met by drawing on experiences from other sectors. Although they are different, it is useful to refer to private certification bodies and public companies that perform market support functions. The market infrastructure of quality certification services for products or services offers a useful example. In this context, organization and institutionalization in the market can be traced back to interests that are held in common among the market players, but not pursued by individual market players because of their own negotiating activities. This is the case for common interests in the dissemination and sharing of the results of technical and scientific evolution, from which the technical standardization bodies originated; for the interest in the structuring of conformity controls to technical standards, from which the certification bodies originated; and for the organization of accreditation systems for quality certifiers, which gave rise to the relevant accreditation bodies. The reference to these experiences is significant because it concerns all bodies that remain private, even though they carry out activities for which impartiality in the markets should be guaranteed.

Such issues can be addressed through different solutions: in the case of technical standardization bodies, the ability to formulate technical specifications that meet the interest

of the generality of market players is resolved through representation within the bodies. Businesses, consumers, and public administrations are represented within the governing bodies, each a stakeholder. For private quality certifiers, the problem of the certifier's impartiality is resolved through accreditation, which is relevant both for the subject's initial qualification and for subsequent control of the maintenance of professionalism and reputational requirements. The third-party status and impartiality of these bodies are, in turn, guaranteed through laws that define accreditation as an activity subject to an exclusive right by a single private or public operator, independent from market dynamics, and under public control. Yet, some critical issues emerge. First, it is essential to reflect on ways this could be established and different options must be taken into consideration depending on the specific case: unbundled from an existing monopoly business, established through government action, or developed through inter-company coordination. Second, the scope and form of its duties and the powers it has when seeking to meet its duties. Third, separation of SO activities. Fourth, the institutional form and, in particular, its ownership and governance or topics related to cost efficiency (Granderson, 2019). A fifth regards regulation.

Business case

As mentioned, for many network services characterized by multilevel regulation and environmental purposes, SOs are needed to ensure the proper functioning of the market. Sometimes they are aimed at supplementing the technical and managerial competencies of segments of a service that are not the responsibility of the regulators. In other cases, they serve as partial or total temporary replacements for operational functions that market players are unable to perform. In the electricity market, SOs manage the operations of the electricity grid, the facilitation of the market for specific electricity markets, the planning of the electricity system, and the management of peak demand, to name a few functions. For the different segments of the electricity market to function effectively, market operators need non-discriminatory access to the grid to supply energy to customers. SOs may aim to make the internal market work in their respective country and, at the same time, optimally manage transnational exchanges. The electricity market has many traits in common with the waste management service: environmental goals, market segments carried out under concession, liberalized market segments, and regulated market segments. There is a multilevel regulatory set-up comprising the government, local institutions and local authorities. There must be efficient management of the market, economic regulation of grid services, procurement, and regulation of protected end customers. In the Italian electricity sector, the most important entity providing a service to support the proper functioning of the market is the energy sector manager (GSE). It ensures the proper pursuit of environmental goals by qualifying plants based on renewable sources that contribute to achieving the goals set by the National Integrated Energy and Environment Plan. Similarly, it qualifies energy efficiency interventions incentivised through white certificates. Through a subsidiary company, the energy market manager (GME), manages the platforms for energy trading. The GSE, through a subsidiary company, namely



FIGUR E 2
Independent body supporting market functioning in the energy sector.

the single buyer (AU), purchases energy under the control of the authority for protected customers. The GSE is entrusted with the connection and national reporting activities concerning the carbon emission market. In addition, the GSE is entrusted with many functions of accountability and reporting. These are functional market activities carried out under the guidance of regulators.

The possible parallelism between the SO in the waste management sector and the tasks performed by the GSE raises questions as to the nature of the two entities. The GSE is a public company and, by statute, performs public functions relating to the electricity sector. The GSE qualifies the activities functional to the market, essentially as a publicist, because they ensure its proper functioning. The public nature of the GSE allows it to play a more pronounced role in this direction, vis-à-vis the sector operators themselves. For waste management, concerning the general environmental performance goals, the universality of the service stems from a territorial basis. For qualification and standardization of the market —on an operational level—the SO sector could assume a similar role to that which the GSE assumes in the electricity market, based on a framework such as that shown in Figure 2 and on the characteristics of the municipal waste management system summarized in Figure 3.

For this reason, the SO may play an analogous role, guaranteeing the proper functioning of the waste cycle market; the protection of technical quality and accountability support; and subsidiary functions to ensure the universality of the service. A SO is needed for reporting the environmental results of the waste management supply chain to increase transparency for stakeholders. A legislative framework facilitates coordination of meetings between the different operators is necessary to create a level playing field and shared knowledge. Another important task is planning and monitoring the different extended producer responsibility systems. Since municipalities play an important role within the governance framework, as shown in Figure 4, supporting local authorities that are lagging in meeting environmental targets is critical. Guidance and technical support for companies in packaging design are important because waste management systems are characterized by heterogeneous quality levels of products. An SO in the waste management industry may also improve the quality and rate of separate collection through the verification of collection systems, provide support to the SRM market, and back public administration for the implementation of environmental policies. The SO should provide information and services to ensure that institutions and the public administration can implement their policies. Also, it could support the integration of the waste markets, by developing common networks and market rules. Furthermore, it should deter market manipulation and abusive behavior.

It follows from Table 1 that a SO could assist policymakers in designing an efficient and more interconnected market. Figure 5 highlights the production chain, starting from the extraction of the raw material and ending with the disposal of waste, recycling and reuse activities (European Commission, 2021). This can be implemented with various categories of information, relating to governance and stakeholders, the different disposal options, and the role of SRMs in reducing dependence on the import of raw materials.

In this context, in Figure 5 we can see the potential role of a SO that, as already highlighted above, in addition to carrying out operational tasks within the waste management chain, could act as an information provider and coordinator for public policies and the regulation of the sector. What are those essential elements to ensure that the waste market can develop and bring added value to the economy by improving the resilience of production chains and consequently developing the most competitive economic systems? Answering this is of much importance. There is little or no agreement across Europe on the governance, legislation and rules that govern waste management industries. This stems from heterogeneity in perspectives among waste management system operators, policymakers, academics, and industry operators (Simões, 2012; Jacobsen et al., 2013; Rodrigues et al., 2018). As for other network industries, it is important to make additional efforts toward market integration given that a more circular society for the creation of a single market for waste is necessary.

Discussion

Waste management is a complex system in which multiple services must be organized and coordinated in such a way as to reduce the environmental impact. A modern regulatory process within a multilevel governance framework requires a strategic vision capable of efficiently realizing environmental goals and a regulatory framework capable of ensuring high-quality standards. For economic efficiency, it is necessary to include industrial policy guidelines in terms of market models to promote more competition through procurement *via* direct contracting. Clear guidelines are needed for the scale of the organizational model, which is a prerequisite for market tenders between operators to ensure the management of areas already optimized in terms of economies of scale. Also, concerning competition, the strategic vision of the market must be the basis for guidelines regarding the presence of vertically integrated operators along certain stages of the supply chain, the relevant minimum conditions for overcoming possible restrictions to competition, and indications of the qualification of dominant positions that could condition the proper development of a competitive structure.

The prerequisite for outlining a shared framework among institutional actors lies in one of the fundamental axioms of the competition paradigm: correct information for the benefit of regulation. For example, in Italy, many antitrust investigations emphasize the issue of competition in terms of creating barriers

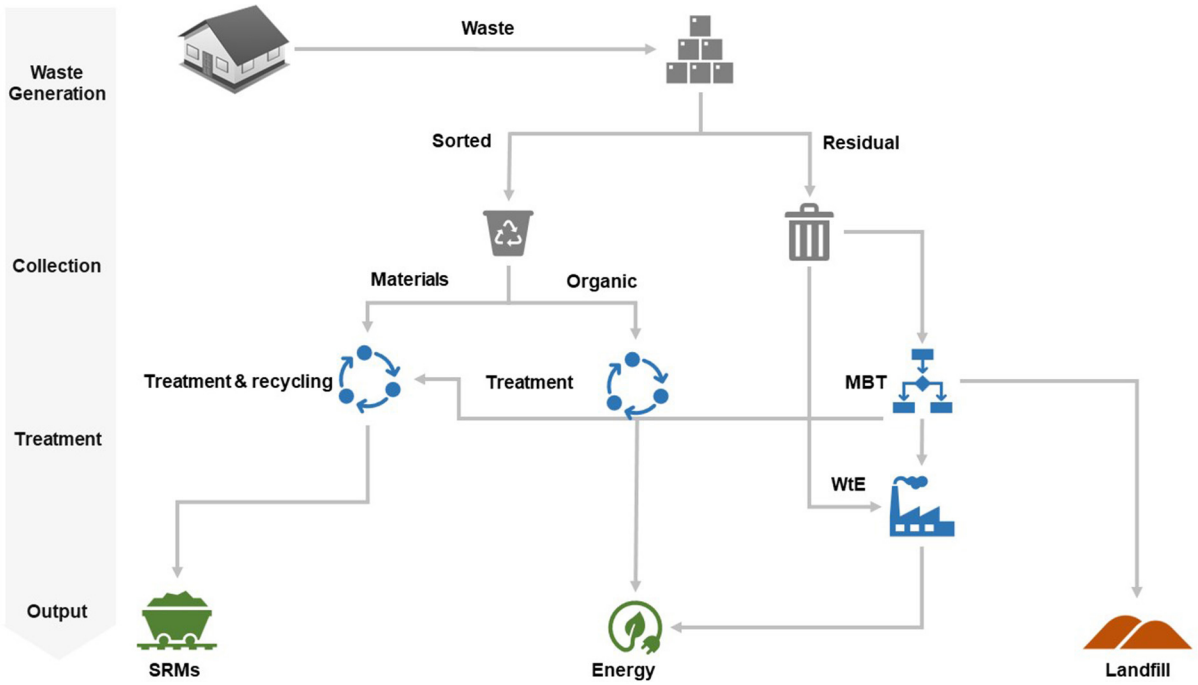


FIGURE 3
The waste management system.

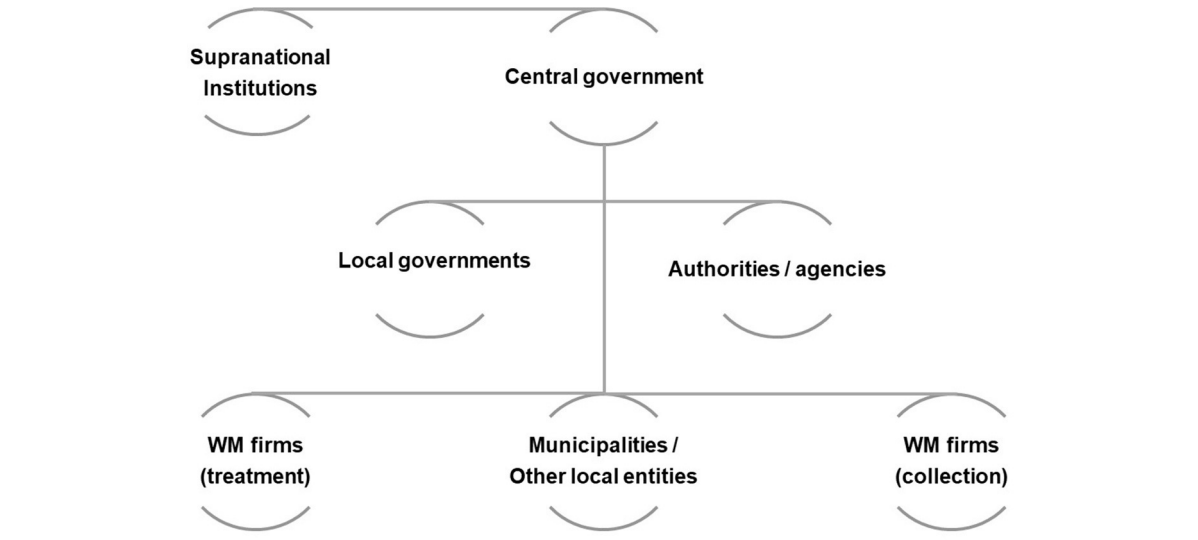


FIGURE 4
Multi-level governance scheme.

to entry and other strategies. We have observed how, in the application of tariff methods designed by regulators, the issue of information represents a nodal aspect on the part of the administrators that did not directly and autonomously disclose technical-economic information (except indirectly through the operators to whom the service was entrusted). Therefore, there is an objective problem of information—or rather of the ability to process the primary information—on the part of the institutions that govern waste management. Considering the similarities analyzed and the central priority

TABLE 1 Prominent activities of a waste management service operator.

Scope	Aim	Added value
Universality	Support to local administration and companies to run the service	Overcome discrepancies in service price for similar quality level
Economic justice	Vulnerable customer support	Poverty alleviation
Information	Reporting, data collection, accountability	Provide stakeholders with relevant information
Accountability	Support for requirements on tariffs	Compliance with regulatory financial account requirements
Compliance	Organization of working groups	Training of legislative updates
Polluters pay principle	Monitoring extended producer responsibility systems	
Subsidiarity	Support municipalities in defining programs and waste collection plans	Temporary replacement of waste management firms if unable to run the service
Internal market	Promotion of efficient and economic use of SRMs	SRM trading support
Market facilitator	Competition enhancement	Lowering market access barriers
Community involvement	Community engagement	Coordination of sensibilization campaigns
Standardization	Guidelines and rules for the market operators	Level playing field
Coordination	Coordination efficiencies across material chains	Quality of information
Policy	Intermediary for environmental regulators.	Policy making inclusion
Technical advice	Improve the quality of legislation and regulations	Support for policymakers and regulators
Supervision	Ensure that citizens get reasonable service	Increase social wellbeing

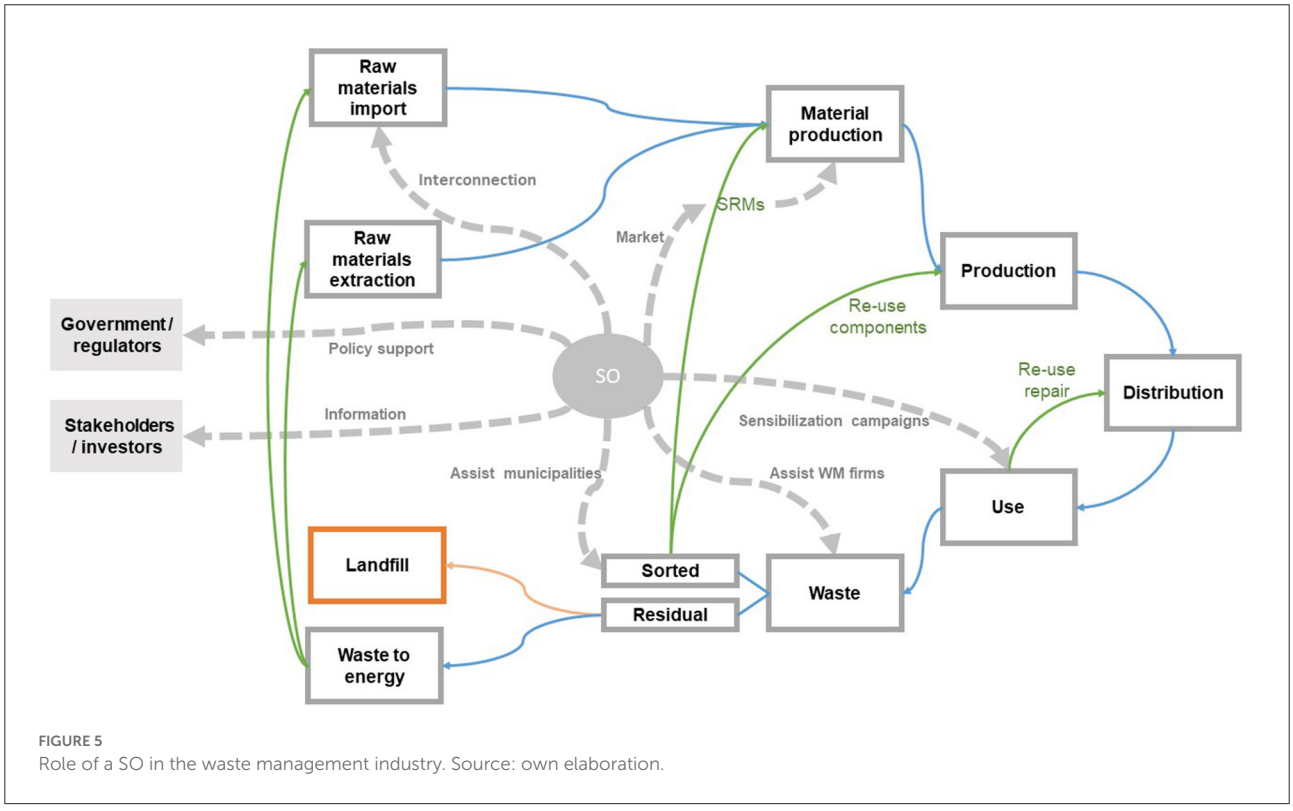


FIGURE 5
Role of a SO in the waste management industry. Source: own elaboration.

given to material recovery within CE goals, we believe that a SO could assume important relevance within the sector in ensuring the quality of information for the development of an efficient market. This is a functional role, both for the implementation of the goals of incentive regulation but also, and with greater relevance, for the information requirements necessary for the policies of both central government and local authorities.

The recognition and utilization of the information contributed by the SO require a shift to a market design that includes the recognition of a third-party role concerning the market. Such an independent body would constitute a virtual facility aimed at performing tasks that help governments, institutions and regulators to implement policies, and market operators run the services they manage. Indeed, the regulation of essential facilities in many of the network services in the European Union has already experimented with governance models that allow private entities to support general interests with the guarantee of third-party status for all operators in the sector. By providing for an independent private body, a series of issues arise that are related to the mechanisms to ensure impartiality so as not to distort competition, such as stakeholder representation or transparency in financial reporting. Drawing from some lessons in the energy market and previous literature, we identified a set of potential tasks the waste management SO could oversee to overcome some structural barriers that still prevent this potential market to develop. SRMs can be used through simple reuse, recycling or restoration. In the context of CE, the economic system of a country generates SRMs that are subsequently marketed as advocated by the European CE strategy. The production and subsequent reuse of SRMs have not only the advantage of decreasing the generation of waste but also improving the supply of materials. As far as quality is concerned, the lack of standards at the European level leads to uncertainties regarding the quality of SRMs and makes it difficult to form a transparent and comparable price system. A common European market is needed with more liquidity and dynamism—public policies are needed to support the development of such a market.

Conclusion

Governance of the waste management sector must evolve to provide the best conditions for market operators, institutions and citizens. To meet circular economy goals, countries are seeking to improve the efficiency of waste management markets in terms of environmental performance and cost efficiency, and we have underlined that for this market to move toward a more circular perspective, governance reforms are needed at the market design level. Particularly rigorous CE goals constitute a major challenge for the organization of waste management. In this paper, we have provided a brief introduction to the various forms of regulation based on the different market conditions. This reveals regulatory options available in different waste management phases and has clarified some important governance aspects that the organizational architecture must take into account. We introduced aspects of the development of a SO in the waste management industry. This takes into consideration lessons learned from energy markets given that, in the energy markets, the rapid changes have brought opportunities and challenges to SOs. We analyzed the waste market and suggested that a SO could be useful for it to coordinate and support the industry. We suggested that a SO in the waste management industry is needed to perform both operative and informative tasks, such as providing information, reporting environmental results, ensuring the universality of service, planning and monitoring environmental goals, assisting municipalities and other local authorities, developing coordination activities, and defining communication campaigns to engage citizens. Such activities are playing an increasingly important role in moving toward a more circular economy.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

Both authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Antonioli, B. and Massarutto, A. (2012). The municipal waste management sector in Europe: shifting boundaries between public service and the market. *Ann. Public Coop. Econ.* 83, 505–532. doi: 10.1111/j.1467-8292.2012.00475.x

Asquer, A., Becchis, F., and Russolillo, D. (eds.) (2017). *The Political Economy of Local Regulation*. London: Palgrave Macmillan. doi: 10.1057/978-1-137-58828-9

Baldwin, R., Cave, M., and Lodge, M. (2013). *Understanding Regulation: Theory, Strategy, and Practice*, *2nd Edn*. Oxford: Oxford University Press.

Bel, G. and Sebo, M. (2021). Watch your neighbor: strategic competition in waste collection and service quality. *Waste Manag.* 127, 63–72. doi: 10.1016/j.wasman.2021.04.032

Belloc, F., Nicita, A., and Sepe, S. M. (2014). Disentangling liberalization and privatization policies: is there a political trade-off? *J. Comp. Econ.* 42, 1033–1051. doi: 10.1016/j.jce.2013.11.003

Boggio, M. (2016). From public to mixed ownership in local public services provision: an empirical analysis. *Local Gov. Stud.* 42, 420–440. doi: 10.1080/03003930.2016.1146138

Bognetti, G. and Obermann, G. (2012). Local public services in European countries: main results of a research project by ciriec international. *Ann. Public Coop. Econ.* 83, 485–503. doi: 10.1111/j.1467-8292.2012.00474.x

Bryant, G. (2016). Creating a level playing field? The concentration and centralisation of emissions in the European Union Emissions Trading System. *Energy Policy* 99, 308–318. doi: 10.1016/j.enpol.2016.06.007

Captain, P. F. and Sickles, R. C. (1997). Competition and market power in the European airline industry: 1976–90. *Manag. Decis. Econ.* 18, 209–225.

Cave, M. and Stern, J. (2013). Economics and the development of system operators in infrastructure industries. *Util. Policy* 26, 56–66. doi: 10.1016/j.jup.2013.06.001

Charreire, M. and Langlais, E. (2021). Should environment be a concern for competition policy when firms face environmental liability? *Int. Rev. Law Econ.* 67, 105990. doi: 10.1016/j.irle.2021.105990

Chen, J., Xie, X., Liu, J., and Rong, C. (2022). Privatisation policy with different oligopolistic competition in the public utilities market. *Econ. Res. Istraz.* 12, 1–23 doi: 10.1080/1331677X.2022.2048188

Chirita, A. D. (2018). Competition policy's social paradox: are we losing sight of the wood for the trees? *Eur. Compet. J.* 14, 367–416. doi: 10.1080/17441056.2018.1533366

Colasante, A., D'Adamo, I., Morone, P., and Rosa, P. (2022). Assessing the circularity performance in a European cross-country comparison. *Environ. Impact Assess. Rev.* 93, 106730. doi: 10.1016/j.eiar.2021.106730

Dagiliene, L., Varaniute, V., and Bruneckiene, J. (2021). Local governments' perspective on implementing the circular economy: a framework for future solutions. *J. Clean. Prod.* 310, 127340. doi: 10.1016/j.jclepro.2021.127340

Decker, C. (2014). *Modern Economic Regulation: An Introduction to Theory and Practice*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9781139162500

Di Foggia, G. and Beccarello, M. (2018). Improving efficiency in the MSW collection and disposal service combining price cap and yardstick regulation: the Italian case. *Waste Manag.* 79, 223–231. doi: 10.1016/j.wasman.2018.07.040

Di Foggia, G. and Beccarello, M. (2022). An overview of packaging waste models in some European countries. *Recycling* 7, 38. doi: 10.3390/recycling7030038

Dierx, A. and Ilzkovitz, F. (2021). EU competition policy: an application of the failing forward framework. *J. Eur. Public Policy* 28, 1630–1649. doi: 10.1080/13501763.2021.1954063

Ducci, F. and Trebilcock, M. (2019). The revival of fairness discourse in competition policy. *Antitrust Bull.* 64, 79–104. doi: 10.1177/0003603X18822580

European Commission (2021). *3rd Raw Materials Scoreboard: European Innovation Partnership on Raw Materials*. Publications Office

Ferro, G. and León, S. (2018). The use of efficiency measures to compute welfare improving: an application for competition policy. *J. Financ. Regul. Compliance* 26, 227–245. doi: 10.1108/JFRC-09-2016-0072

Fox, E. M. (2018). Competition policy at the intersection of equity and efficiency: the developed and developing worlds. *Antitrust Bull.* 63, 3–6. doi: 10.1177/0003603X18756130

Garcia, F., Paz y Miño, J. M., and Torrens, G. (2020). The merger paradox, collusion, and competition policy. *J. Public Econ. Theory* 22, 2051–2081. doi: 10.1111/jpet.12448

Gouri, G. (2020). Convergence of competition policy, competition law and public interest in India. *Russ. J. Econ.* 6, 277–293. doi: 10.32609/j.ruje.6.51303

Granderson, G. (2019). The impact of firm membership in an independent system operator (ISO) on production cost and cost efficiency in the generation sector of the U.S. electric utility industry. *Manag. Decis. Econ.* 40, 159–168. doi: 10.1002/mde.2990

Gundlach, G. T., Frankel, R., and Krotz, R. T. (2019). Competition policy and antitrust law: implications of developments in supply chain management. *J. Supply Chain Manag.* 55, 47–67. doi: 10.1111/jscm.12196

Huang, W. (2022). Public service provision with a limited budget: service design, privatization and subsidies. *Comput. Ind. Eng.* 27, 108374. doi: 10.1016/j.cie.2022.108374

Hulten, S. and Helgesson, C.-F. (2018). "Regulation in network industries," in *Regulation and Organizations: International Perspectives*, eds G. Morgan and L. Engwall (London: Routledge), 191–208. doi: 10.4324/9780203704424-10

Jacobsen, R., Buysse, J., and Gellynck, X. (2013). Cost comparison between private and public collection of residual household waste: multiple case studies in the flemish region of Belgium. *Waste Manag.* 33, 3–11. doi: 10.1016/j.wasman.2012.08.015

Liu, Y. and Wu, L. (2021). Integrating distributed energy resources into the independent system operators' energy market: a review. *Curr. Sustain. Energy Reports* 8, 233–241. doi: 10.1007/s40518-021-00190-8

Lyu, S., Buts, C., and Jegers, M. (2020). Case studies in competition policy research: a systematic literature review. *Eur. Compet. Regul. Law Rev.* 4, V–XXVII. Available online at: https://core.lexxion.eu/data/article/15795/pdf/core_2020_02-018.pdf

Marques, R. C., Simões, P., and Pinto, F. S. (2018). Tariff regulation in the waste sector: an unavoidable future. *Waste Manag.* 78, 292–300. doi: 10.1016/j.wasman.2018.05.028

Massarutto, A. (2007). Municipal waste management as a local utility: options for competition in an environmentally-regulated industry. *Util. Policy* 15, 9–19. doi: 10.1016/j.jup.2006.09.003

Plata-Díaz, A. M., Zafra-Gómez, J. L., Pérez-López, G., and López-Hernández, A. M. (2014). Alternative management structures for municipal waste collection services: the influence of economic and political factors. *Waste Manag.* 34, 1967–1976. doi: 10.1016/j.wasman.2014.07.003

Pollitt, M. G. (2012). Lessons from the history of independent system operators in the energy sector. *Energy Policy* 47, 32–48. doi: 10.1016/j.enpol.2012.04.007

Rodrigues, A. P., Fernandes, M. L., Rodrigues, M. F. F., Bortoluzzi, S. C., Gouvea da Costa, S. E., and Pinheiro de Lima, E. (2018). Developing criteria for performance assessment in municipal solid waste management. *J. Clean. Prod.* 186, 748–757. doi: 10.1016/j.jclepro.2018.03.067

Romano, G., Marciano, C., and Minoja, M. (2022). Successful remunicipalization processes in Italian waste management: triggers, key success factors, and results. *Int. Rev. Adm. Sci.* doi: 10.1177/00208523221077574

Sarra, A., Mazzocchitti, M., and Nissi, E. (2020). Optimal regulatory choices in the organization of solid waste management systems: empirical evidence and policy implications. *Environ. Sci. Policy* 114, 436–444. doi: 10.1016/j.envsci.2020.09.004

Simões, P. and Marques, R. C. (2012). On the economic performance of the waste sector. A literature review. *J. Environ. Manage.* 106, 40–47. doi: 10.1016/j.jenvman.2012.04.005

Stankov, P. (2018). Deregulation, economic growth and growth acceleration. *J. Econ. Dev.* 43, 21–39. doi: 10.35866/caujed.2018.43.4.002

Sviták, J. and van Sinderen, J. (2018). Economic impact of competition policy: a look beyond consumer surplus. *Econ.* 166, 23–40. doi: 10.1007/s10645-017-9312-9

Teece, D. J. (2020). Innovation, governance, and capabilities: implications for competition policy. *Ind. Corp. Chang.* 29, 1075–1099. doi: 10.1093/icc/dtaa043

Tian, G. (2020). From industrial policy to competition policy: a discussion based on two debates. *China Econ. Rev.* 62, 101505. doi: 10.1016/j.chieco.2020.101505

Wang, Z. (2018). Economic competition, policy interdependence, and labour rights. *New Polit. Econ.* 23, 656–673. doi: 10.1080/13563467.2018.1384452

Xiao, S., Dong, H., Geng, Y., Francisco, M. J., Pan, H., and Wu, F. (2020). An overview of the municipal solid waste management modes and innovations in Shanghai, China. *Environ. Sci. Pollut. Res.* 27, 29943–29953. doi: 10.1007/s11356-020-09398-5