social sciences

MDPI

Review

Advancing Sustainable Bio-Waste Management through Law and Policy: How Co-Creation Can Help Pursue Fair Environmental Public Policies in the European Context

Ireneu Mendes *, Pedro Rocha and Alexandra Aragão

Faculty of Law, University of Coimbra, Pátio da Universidade, 3004-528 Coimbra, Portugal; pedro.rocha@fd.uc.pt (P.R.); aaragao@fd.uc.pt (A.A.)
* Correspondence: ireneu.mendes@fd.uc.pt

Abstract: Alongside production and consumption, bio-waste management is central to the food systems debate. To achieve sustainable food systems—an essential component of the Sustainable Development Goals and the world they envision—public authorities must address the shortage of current bio-waste-management policies and strive towards a new paradigm of bio-waste management, where environmental justice primarily informs policy design and decision making. In order to achieve fair environmental policies, particularly in the context of food systems and bio-waste management, it is essential to understand what drives public policy in these matters. In the present review, we seek to contribute by closing a gap in the literature by proposing a set of bio-waste-management drivers in the European context. Moreover, we focus on the "policy and legislation" driver, hoping to examine its main components and understand both their limitations and the opportunities they provide. Finally, we explore the role that co-creation can play as a facilitator of a public-governance paradigm that promotes sustainable development.

Keywords: sustainability; circular food systems; bio-waste management; co-creation; governance

Citation: Mendes, Ireneu, Pedro Rocha, and Alexandra Aragão. 2023. Advancing Sustainable Bio-Waste Management through Law and Policy: How Co-Creation Can Help Pursue Fair Environmental Public Policies in the European Context. *Social Sciences* 12: 572. https://doi.org/10.3390/socsci12100572

Academic Editor: Pedro Miguel Alves Ribeiro Correia

Received: 25 August 2023
Revised: 19 September 2023
Accepted: 9 October 2023
Published: 12 October 2023

1. Introduction

There is no shortage of solutions for the sustainable management of bio-waste, such as material recovery by composting or anaerobic digestion, the go-to waste-to-energy method that transforms bio-waste into biogas, a process from which digestate is also created (Gadaleta et al. 2021).

Although the methods for the sustainable management of bio-waste—understood as the "biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants" (European Union 2008, Directive 2008/98/EC)—are well known to the scientific community and practitioners, it largely remains to be understood how to move away from more traditionally linear methods, such as landfilling and incineration—considered as such when not matched with energy recovery (Dhanya et al. 2020)—and towards more circular methods, such as composting and anaerobic digestion. Therefore, understanding which factors determine the development of bio-waste management systems (Contreras et al. 2010) is increasingly essential. We are dealing with the issue of the drivers of bio-waste management (Márquez and Rutkowski 2020), the understanding of which will allow us to act with greater confidence on bio-waste management systems.

The growing prominence of sustainability and sustainable development has drawn researchers to the theme of waste management and, in particular, to bio-waste management, the food waste portion of which is understood as an essential component of the construction of circular food systems (Jurgilevich et al. 2016). As the interest in this topic has grown, so has the attention given by researchers to the drivers of bio-waste management, as shown by the multiplication of reviews of waste-management drivers over the last decade and a

half (Agamuthu et al. 2009; Contreras et al. 2010; Márquez and Rutkowski 2020; Wilson 2007; Zaman 2013).

However, the differences between the drivers of waste management in general and bio-waste management in particular remain to be explored, with most studies focusing on waste management generally. Similarly, scientific research is lacking a unitary, comprehensive, and comparable review of drivers of bio-waste management in the European context. Hoping to provide a first step in addressing these challenges, this paper also aims to offer to deepen the understanding of the policy and legislation driver by highlighting co-creation's contribution to making bio-waste management systems more circular.

After exploring the centrality of the circular economy in the pursuit of more sustainable bio-waste management systems, this review addresses the relevance of food and circular food systems for the pursuit of a more sustainable planet, before shifting its attention to the bio-waste management component of circular food systems. We then focus our study on an analysis of the most relevant collections of waste-management drivers suggested by the literature, based on which we propose a set of bio-waste management drivers in the European context, seeking to contribute in closing a gap in the literature on the subject. After then focusing on the policy and legislation driver—examining its main components with the aim of understanding both their limitations and opportunities—we explore the role that co-creation can play as a facilitator of a public-governance paradigm that promotes sustainable development.

2. Circular Economy at the Heart of the Sustainable Development Challenge

Brought forward by the famous study, "The Limits to Growth" (Meadows et al. 1972), and defined in the Brundtland Report ("Our Common Future") as the development that allows the present generations to meet their needs without compromising the ability of future generations to meet their own (World Commission on Environment and Development 1987), sustainable development has been part of the global agenda since the Stockholm Conference in 1972. Today, the discussion of the sustainable development of the planet focuses on the Sustainable Development Goals (SDGs). As part of the 2030 Agenda, approved at the United Nations Sustainable Development Summit in 2015 (United Nations General Assembly 2015), the SDGs offer an ambitious holistic vision (Hickel 2019) of sustainable development.

Some authors find in the circular economy the answer to the challenges raised by the SDGs (Belmonte-Ureña et al. 2021; Sachs et al. 2019), which has prompted this concept to gain increasing prominence in the discussion on sustainable development, particularly in the context of industry (Uemura Silva et al. 2021; Velenturf et al. 2019) and natural resource management more broadly (Barros et al. 2020; Ingrao et al. 2018).

Diametrically opposed to the linear economy, based on the abundance of resources and the unlimited capacity to generate waste (Jurgilevich et al. 2016; Puntillo et al. 2021), the circular economy is characterized by the return of materials to the previous stages of natural or manufacturing processes, seeking to extract the greatest utility possible (and, consequently, the greatest value) from them (Östergren et al. 2014).

In other words, through a tripartite action (Esmaeilian et al. 2018), the circular economy seeks to slow down, close, and narrow the product cycle (Geissdoerfer et al. 2017), replacing the linear economy business model (take–make–consume (Ghisellini et al. 2016; Hartley et al. 2020; Merli et al. 2018) or take–make–consume–dispose (Puntillo et al. 2021) with the make–use–return model (Ellen MacArthur Foundation 2013), where profit is generated by the flow of materials over time (Puntillo et al. 2021).

In addition to having found great expression in industry (Uemura Silva et al. 2021; Velenturf et al. 2019; Winans et al. 2017), the concept of the circular economy is currently central to natural-resource-management issues (Barros et al. 2020; Ingrao et al. 2018), finding particular relevance in waste management, and, especially, in the management of bio-waste, which can be reintroduced into the food-production chain in the form of nutrients, energy, or even packaging materials (Gaspar et al. 2021).

The great prominence that the concept of the circular economy finds in natural resource management is reflected by the concept of the circular bioeconomy, which has emerged and gained increasing expression since 2015 (Stegmann et al. 2020). Despite different perspectives—compiled by Stegmann et al. (2020)—on the relationship between the concepts of the circular economy, bioeconomy, and circular bioeconomy, a circular bioeconomy seeks to "minimize the depletion of resources (. . .), prevent the loss of natural resources (. . .) and stimulate the reuse and recycling of inevitable by-products, losses or wastes" (Muscat et al. 2021, p. 561), making it easy to understand how the idea of a circular bioeconomy fits in with the pursuit of more sustainable development.

3. The Role of Bio-Waste Management in Building Circular Food Systems

In the European Union (EU), the Circular Economy Action Plan for a cleaner and more competitive Europe launched in 2020 (European Commission 2020a) constitutes one of the main pillars of the European Green Deal. The aim of the Action Plan is to "accelerate the transition to a regenerative growth model that gives back to the planet more than it takes", "reduce its consumption footprint", and "double its circular material use rate in the coming decade". Similarly, Directive 2018/851 of the European Union (2018), amending Directive 2018/98/EC, establishes in its Article 11 recycling targets, according to which by 2025, a minimum of 55% of municipal waste by weight should be recycled or prepared for reuse, a target that rises to 60% in 2030 and 65% in 2035 (Directive 2018/851). Regarding food, the Farm to Fork Strategy for a fair, healthy, and environmentally friendly food system (European Commission 2020b) states that "The circular bio-based economy is still a largely untapped potential for farmers and their cooperatives. For example, advanced bio-refineries that produce bio-fertilizers, protein feed, bioenergy, and bio-chemicals offer opportunities for the transition to a climate-neutral European economy and the creation of new jobs in primary production".

Food constitutes one of the most important sectors of the economy, accounting for 8.3% of jobs and 4.4% of GDP in Europe (Lemaire and Limbourg 2019). As they consume 79% of the food produced annually (FAO 2019), cities are the main driver of food systems (Calori et al. 2017), thus positioning themselves as an element of the utmost importance for the discussion on food sustainability.

The debate on food sustainability and cities includes the concept of a circular food system, understood by Jurgilevich et al. (2016) as one that "implies reducing the amount of waste generated in the food system, re-use of food, utilization of by-products and food waste, nutrient recycling, and changes in diet towards more diverse and more efficient food patterns" (p. 2). Distinguishable from linear food systems by their concern for reducing emissions and waste at all stages of the food system and by its environmentally responsible treatment of food waste, circular food systems involve action at three stages: production, consumption, and waste management (Jurgilevich et al. 2016).

To this end, the scientific community has focused a great deal of effort on the issue of food waste, defined by the United Nations Environment Programme (UNEP) as food and the associated inedible parts removed from the human food supply chain (to landfill, controlled combustion, sewer, litter/discards/refuse, co/anaerobic digestion, compost/aerobic digestion, or land application) in the sectors of manufacturing of food products, food and grocery retail, food service, and households (UNEP 2021).

This interest can be justified by the data released by UNEP, which indicate annual food waste of around 931 million tons in 2019 (UNEP 2021), corresponding to the waste of one-third of all the food produced globally in a year and whose use would feed two billion people (UNEP 2015). In the European Union, the most recent data indicate food waste of 59 million tons in 2020, corresponding to 131 kg per inhabitant (Eurostat 2023).

Alongside these, the renewal (both in volume and type) of food needs in developing countries (Lemaire and Limbourg 2019; Porter et al. 2016) places growing pressure on global food systems, further justifying the SDG concern with production and consumption (and food waste associated with these stages of the food system), as stated in SDG 12

(Responsible Consumption and Production) and its target 12.3 ("By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses"), as well as in target 2.4 ("By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality") of SDG 2 (Zero Hunger) (United Nations General Assembly 2017).

Despite different definitions of food waste—from those that understand food waste as the edible material that is ultimately wasted from production to consumption (FAO 1981; Gustavsson et al. 2011; Jurgilevich et al. 2016) to those that also include in their definition the inedible material that is ultimately wasted (Ladele et al. 2021; Östergren et al. 2014)—food waste constitutes a much broader set of losses than just the food itself.

The production of food that ends up wasted has significant impacts on the use of natural resources, fertilizers, and fuels (Krishnan et al. 2020; Sehnem et al. 2021), as well as those arising from water use—with Lemaire and Limbourg (2019) pointing to an expenditure of 306 cubic kilometers of water in the production of food that is eventually wasted—and from greenhouse gas emissions resulting from the landfilling of this food or its treatment in similarly environmentally inefficient ways (Gokarn and Kuthambalayan 2017; Jurgilevich et al. 2016; Sehnem et al. 2021). This set of losses, with an estimated economic impact of USD 490 billion (Esparza et al. 2020), makes food waste equivalent to the third most polluting country in the world (UNEP 2015).

Notwithstanding the importance of acting on production and consumption (and the problem of food waste underlying both these phases), it is on the third phase or element of circular food systems—bio-waste management—that we will focus for the remainder of this study.

Papargyropoulou et al. (2014) developed a food waste hierarchy and suggested that action on food waste should be preferred, in the following order: prevention, reuse, recycling, recovery, and finally, disposal. Thus, after efforts to prevent surplus food generation and food waste generation, the focus of food waste management policy should shift to the reuse of excess food produced, namely through surplus food distribution (Garrone et al. 2014). For undistributed food and food rendered inedible, the food waste hierarchy suggests its conversion into animal feed (Esparza et al. 2020) or its composting.

A succeeding option to composting—and in opposition to the understanding that the choice of methodology to be used in food waste management should be dependent on an analysis of the concrete circumstances of the context where the waste is generated (Weidner et al. 2020)—is recovery, understood as the conversion of food waste material into energy, namely through anaerobic digestion (Papargyropoulou et al. 2014).

At the tip of the reverse pyramid suggested by Papargyropoulou et al. (2014)—and with the agreement of the scientific community (Cobo et al. 2018; Greben and Oelofse 2009)—is landfilling. Indeed, while it is possible—and, increasingly, legally required—to recover gases from landfill decomposition (Dhanya et al. 2020; Pearse et al. 2018), that is still not the norm, helping to make waste disposal the third largest human source of methane emissions (Esparza et al. 2020). In addition to occupying large areas and causing unpleasant odors, the impacts of landfilling are, according to Gao et al. (2017), ten times higher than those generated by any of the other available treatment methods, making landfilling the most "linear" solution for managing bio-waste. Nevertheless, landfilling remains the most popular bio-waste conversion method worldwide, particularly in developing countries (Feiz et al. 2020).

For Esparza et al. (2020), there is no one-size-fits-all solution for bio-waste management. Rather, the choice of how to deal with bio-waste should depend on an analysis of several factors, such as population density, volume of waste generated, installed collection practices, expected social acceptance, political–administrative availability for the implementation of projects, and assimilation capacity of generated products (Weidner and Yang

2020). Thus, the ideal bio-waste-management policy is one that adapts and chooses the most appropriate management methods for each reality it faces (Esparza et al. 2020).

4. Bio-Waste Management Drivers

4.1. A Comprehensive Review of Bio-Waste Management Drivers

To improve bio-waste-management policies, it is necessary to understand what pushes them forward or pulls them back (Márquez and Rutkowski 2020). We are dealing with the issue of drivers, understood as the "factors that positively (termed facilitators) or negatively (termed constraints) alter an existing waste management system" (Agamuthu et al. 2009, p. 625), or, according to Wilson (2007), the "mechanisms or factors that significantly impact development in (. . .) waste management" (p. 198). In fact, current bio-waste management systems have no single raison d'être but, rather, result from the impact of several factors, which vary across space and over time (Contreras et al. 2010).

Although there is not an abundance of literature on the drivers of waste management (and, in particular, bio-waste management), some authors have, over time and in different contexts, offered their own reviews of drivers (see Table 1 below), such as Wilson (2007), who, comparing bio-waste-management policies in developed and developing countries, highlights the drivers of public health, environmental protection, resource value of waste, closing the loop, institutional and responsibility issues, and public awareness, or Agamuthu et al. (2009), who analyze the Asian context and identify four categories of drivers: human, economic, institutional, and also highlighting the environment as a driver in its own right.

Table 1. Drivers vs. authors' comparative analysis.

Authors/ Drivers	Public Health	Environmental Protection	Resource Value of Waste/ Economic Dimension	Institutional and Repons-ability Issues	Public Awareness	Human	Technology Development/ Scientific Knowledge	Legal
Agamuthu		+	+	+		+		
Contreras			+/—	+/—			+	+
Márquez & Rutkowski	+	+	+			+		+
Wilson	+	+	+	+	+			
Zaman		+	+		+			
Labels								
+	Directly expressed by the author							
+/—	Indirectly expressed by the author							
	Subject of direct analysis in the paper							

In turn, Contreras et al. (2010), studying waste management in Yokohama and Boston, analyze the temporal evolution of four distinct categories of drivers: socio-economic drivers, regional and international drivers, technology development and institutional drivers, and legal drivers. Zaman (2013) distinguishes three categories of drivers: social (which he subdivides into personal behavior, local waste management practice, and consumption and generation of waste), economic (where he highlights the resource value of waste, the economic benefit from waste-treatment facilities, and the landfill tax), and environmental (mentioning both global climate change and environmental movement and awareness). Finally, Márquez and Rutkowski (2020), in a historical analysis of waste management in Colombia, suggest the following drivers: public health, decentralization, financial sustainability, environmental protection, free competition, social control, integrated waste management, and inclusive recycling.

Despite the variation in the impact of each driver depending on the space and time under analysis, we believe it is possible to build, based on the literature analyzed, a logical and comprehensive summary of factors that can positively or negatively influence the evolution of bio-waste management in the European context. We therefore highlight the

following drivers: resource value of waste, public health, environmental protection, public awareness, scientific knowledge, and policy and legislation.

In fact, the first driver of bio-waste management was the resource value of waste (UNEP 2015), with waste pickers being at the center of the early stages of waste management generally (Rodić and Wilson 2017). Under the transition from the idea of "waste management" to an idea of "resource management" (UNEP 2015), and particularly in the context of the bio-waste portion of waste, the resource value of waste drivers is completely different in nature today than it was originally. Furthermore, given their impact on the choices made surrounding waste management policy, the costs of inaction on waste and issues related to financing waste management deserve consideration (UNEP 2015).

The second historical driver of waste management (namely bio-waste) was public health. Although it has since been surpassed as the main driver of waste-management policies, public health was one of the first and most important facilitators of these policies, which have evolved with the aim of stopping the spread of diseases in the urban environment resulting from uncontrolled waste disposal (UNEP 2015). Its relevance as a motivator for the adoption of new public policies on these issues remains significant in developing countries (Márquez and Rutkowski 2020), which have not yet overcome these challenges, and it has not yet been forgotten in developed countries either.

Moreover, among the drivers traditionally highlighted in the literature is environmental protection. The environmental movement established in the 1960s and 1970s (UNEP 2015) sharpened focus on the growing concern for waste in discussions about the sustainability of the planet. Nevertheless, the idea of environmental protection as a driver of bio-waste management has been disregarded by authors such as Agamuthu et al. (2009), for whom environmental protection constitutes a natural consequence of the action of other drivers. In fact, some authors have pointed out limitations to the analysis of drivers, highlighting the difficulty of understanding the actual influence of each driver, since they are interconnected (Zaman 2013), interacting in ways that can contaminate the analysis of the individual impact of each driver alone (Agamuthu et al. 2009).

Alongside these, we highlight drivers that only more recently have gained prominence. One example is the public awareness driver. Incredibly important for understanding the evolution (and future prospects) of bio-waste management, the public awareness driver can be divided into two components: public acceptance and personal behavior (Esmaeilian et al. 2018). Although initiatives on sustainable and circular bio-waste management have multiplied over the last years (Lemaire and Limbourg 2019), there is still a general lack of public awareness on the subject, which manifests itself both in the weak pressure exerted by citizens on public authorities and in the lack of sustainable practices of citizens themselves in bio-waste management (Weidner et al. 2020). Public acceptance and personal behavior promise to gain renewed importance as the EU pushes towards a brown-bin bio-waste collection system (Directive 2018/851).

Equally worthy of attention is the driver of scientific knowledge. Among its contributions to the design of new and more sustainable bio-waste management systems, it should be highlighted that scientific knowledge has contributed to the perfecting of existing bio-waste management technologies. In addition to the evolution of bio-waste management systems depending on the ability of scientific knowledge to improve existing methodologies through technological development, they also depend on the ability of scientific studies to analyze the efficiency of the different methods available and to propose the most correct solutions for each context. In this sense, the driver of scientific knowledge can be broken down into two dimensions: one theoretical, relating to the accumulation and maturation of the themes studied in the different forums by the literature, and one practical, relating to the creation of methodologies, instruments, and techniques of bio-waste management, and therefore more closely associated with an operational (or technical) dimension.

Finally, the policy and legislation driver should be considered. From political debate are born the legal instruments that seek to concretize the community's vision on each topic, and, in this case, on bio-waste management (Lemaire and Limbourg 2019; UNEP 2015). By

establishing the framework within which action on bio-waste must take place and the rules to which it must comply, legislation is both the limit and the guide to action on bio-waste management.

4.2. The "Policy and Legislation" Driver as a Make-or-Break Approach to a More Sustainable Bio-Waste Management

Legislation constitutes one of the main repositories of the secondary objectives associated with bio-waste management, such as public health, environmental protection, or resource value of waste (UNEP 2015), playing an essential role in the evolution of bio-waste-management policies.

In the European context, the influence of this driver on bio-waste-management policies is very closely linked to the European institutions, which have been the leading promoters of innovation in bio-waste management, particularly through the adoption of Directives. The first steps towards sustainable bio-waste management were made by the Landfill Directive (Directive 1999/31/EC) (Buratti et al. 2015), which set targets for a reduction in the volume of bio-waste landfilled and demanded the collection of the gases generated therein. Nine years later, although not addressing bio-waste in particular, Directive 2008/98/EC (Waste Framework Directive) established in the European legislative framework fundamental principles (polluter pays principle)—manifested in "pay-as-you-throw" (Ukkonen and Sahimaa 2021), "pay-as-you-own" (Messina et al. 2023), and "pay-as-you-differentiate" (Le Pera et al. 2023) schemes which have been studied and have proposed to encourage sorting at the household level (Chua and Yau 2022)—and concepts (producer extended responsibility and waste hierarchy) of current waste management (Taelman et al. 2018).

The next significant step in the field of waste management—and particularly in the field of bio-waste management—was taken by Directive 2018/851, which, amending the Waste Framework Directive approved ten years earlier, reinforced the need for Member States to take measures to reduce waste generation (Directive 2018/851). As it concerns bio-waste management, Directive 2018/851 highlighted the need to carry out selective collection of bio-waste, indicating that, to this end, by 31 December 2023, Member States should ensure the selective collection of bio-waste and its separation from other types of waste. This measure constitutes, for all intents and purposes, an obligation to implement a brown-bin system (Weidner et al. 2020).

Although the Waste Framework Directive (and amending Directive 2018/851) are recognized as being largely responsible for the significant advances recognized in waste management (and, in particular, bio-waste management) in Europe (Grosso et al. 2010; Zorpas et al. 2015), there is still much progress to be made in terms of sustainable bio-waste management. In addition to suggesting, given its specific characteristics, the development of a separate Directive for bio-waste, shortcomings are attributed to the European Directives approach to the subject of bio-waste.

Thus, we highlight the criticism of Garske et al. (2020), for whom it seems incomprehensible that Directive 2018/851 did not adapt the waste hierarchy of the Waste Framework Directive to bio-waste, especially when authors such as Papargyropoulou et al. (2014) had already suggested their own version of a food waste hierarchy. In addition, Garske et al. (2020) criticize the lack of a "quantified, measurable and thus sanctionable" food-waste-reduction target (p. 9), despite the fact that the Waste Framework Directive—as amended by Directive 2018/851—anticipates in its article 9 the possible creation of such a target.

Whereas the European Directives are given the role of determining how Member States should deal with the collection and treatment of waste, the regions and municipalities are tasked with deciding how to establish and control the implementation of their waste management policy (Taelman et al. 2018). It is therefore within the legislative framework established by these Directives that public entities throughout the European Union must approve legislation and implement public policies aimed at transitioning to more sustainable waste-management systems. In this sense, we highlight in the following section, under the "policy and legislation" driver, the emerging trend of co-creation, which can offer

significant contributions to the environmental transition of current bio-waste management systems.

5. Co-Creation as a Facilitator of Public Governance Which Promotes Sustainable Development

The magnitude and urgency of environmental problems (Scotford 2021), including the need to transition to a circular economy, require innovative approaches for fast and effective results. In the words of the Commission, "The sustainability challenge posed by key value chains requires urgent, comprehensive and coordinated actions" (European Commission 2020a).

In the EU, innovation for sustainability has received institutional support since 2015 by the European Research Area and Innovation Committee, and benefits from dedicated funding such as the Innovation Fund (European Commission, Directorate-General for Climate Action 2022). Moreover, an innovative process for normative production has been developed in the context of the so-called better regulation guidelines (European Commission 2021) and toolbox (European Commission 2023). One of the tools in the toolbox for better regulation is stakeholder consultation.

However, the participation of different social actors, including citizens, in the decision-making process in the public sphere is not a disruptive phenomenon. The forms of participation of multiple societal agents have varied in terms of their scope and intensity (Torfing and Ansell 2021). For this to continue to occur, it is essential that instruments that enable and enhance the participation of all parties exist and that they produce robust results from a coordinated effort based on a common purpose.

With prominence from the mid-1980s, the reforms of New Public Management (NPM) aimed to increase the involvement of citizens (users of public services), letting them choose freely among the different service providers, in a perspective in which private management gained primacy over traditional public management, recognizing at that time the implementation of different practices, models, and instruments coming from the atmosphere of private management (Hood 1991). According to this perspective, service users were seen as customers with heterogeneous needs and demands, and their participation in the design and delivery of the service was practically nil, an aspect referred to by various authors (E. Ostrom and Whitaker 1973; V. Ostrom and Ostrom 1971; Parks et al. 1981).

Several of the limitations of NPM have been recognized and debated in the literature, which has meant that the scientific community has since been attracted to a new, more innovative trend, that of "co-production", which is strengthened by growing budget constraints, new demands from citizens, the search for innovative solutions to complex problems (Wicked Problems) (Akamani et al. 2016), and the need to restore trust and foster transparency between voters and elected officials (Torfing and Ansell 2021). Efforts to promote the active involvement of citizens and other stakeholders in public governance have been spreading across a wide range of public sectors, insofar as the coordinated collaboration of different actors (volunteers, community organizations, and a broader ecosystem of actors) can constructively contribute to the implementation of collaborative-based public policies. In this sense, co-production has been considered in the construction of service systems and in the development of innovative solutions for public actors (Osborne and Strokosch 2013). The focus on the concepts of co-production and co-creation adopted in the public sector is based on the evolutionary trends in the private sector. The first source of new ideas on co-production and co-creation in the public sector came from the field of design. The second source emanates from new thinking about how private companies interact with their customers (Torfing and Ansell 2021).

In this review, we join the definition of co-creation presented by Torfing et al. (2019) that embodies "a process through which two or more public and private actors attempt to solve a shared problem, challenge, or task through a constructive exchange of different kinds of knowledge, resources, competences, and ideas that enhance the production of public value in terms of visions, plans, policies, strategies, regulatory frameworks, or

services, either through a continuous improvement of outputs or outcomes or through innovative step-changes that transform the understanding of the problem or task at hand and lead to new ways of solving it" (p. 802).

By defining co-creation—in contrast to co-production as a problem-focused process aimed at creating new and innovative outcomes that generate public value, it is possible to perceive co-creation as a tool for public governance, aimed at mobilizing and harnessing society's resources (Torfing and Ansell 2021). Hence, according to these authors, one of the values of the concept of co-creation is that, like collaborative governance, it relates to other emerging trends in governance (Torfing and Ansell 2021). One of the most important characteristics of co-creation is that it emphasizes the role of collaboration in achieving innovation. The literature on public sector innovation highlights the importance of involving wider groups of stakeholders in collaborative innovation processes (Sørensen and Torfing 2019).

Adopting a design attitude, co-creation sees innovation as built on the distributed experience, knowledge, resources, and insights of users, citizens, and other stakeholders, who are seen as sources for creative solutions to problems when brought together in arrangements that increase the likelihood of formulating and implementing social innovation (Brown and Wyatt 2010).

One of the virtues of co-creation processes is that they adopt a proactive strategy, rather than the usual reactive positioning. It is in this context that the agenda for collaborative governance has been gaining prominence, associated with a concern with the mediation of conflicts between the constituent parts of a given institutional arrangement (formal or informal). Thus, the process of co-creation has been understood as a mitigating filter to the barriers associated with collaborative governance, positioning itself as a potential "collaborative advantage" for working together (Huxham and Vangen 2013).

Notwithstanding the advantages of co-creation presented above and recognizing the broad relevance of co-creation to public governance, some associated risks have also been noted. A recent qualitative study considered co-creation processes in three Scandinavian municipalities and found that while co-creation emerges almost spontaneously at the level of administrative service delivery and design, public managers and elected officials are reluctant to adopt co-creation as a tool for social well-being, as a problem solver and as a tool for policy making (Bentzen et al. 2020). At the administrative level, co-creation is mainly considered in urban-development projects, where it is crucial to mobilize local resources and support. The barriers to co-creation at the political level are even stronger (Torfing and Ansell 2021).

Another difficulty associated with co-creation relates to the lack of alignment between the expectations of (unelected) public managers about the role of politicians and what their function actually is. Another barrier relates to the lack of institutional platforms for co-creation that engage citizens, politicians, and relevant stakeholders in creative problem-solving processes.

Co-Creation as a Driver for SDG Implementation

The ambition to meet the Sustainable Development Goals requires a paradigm shift in everyone's actions. In this sense, in order for the process of change to occur, there is an urgent need for the search, formulation, implementation, empirical testing, and evaluation of innovative solutions that can be developed within the framework of collaborative governance. In this context, several cities and national governments have called for the co-creation of innovative climate solutions, and there is already positive experience with co-creation in public planning and service production (Hambleton 2019; Hofstad et al. 2023; Sørensen and Torfing 2018).

Both the European Commission and the United Nations emphasize the importance of promoting the involvement of citizens and other stakeholders in the implementation, codesign, and co-assessment of climate resilience. The objectives formulated can only be achieved (or at least come closer to being achieved) if action is developed through

partnerships, networks, and other collaborative governance platforms. Although there are associated barriers, as previously mentioned, co-creation is present in today's public policy making, mainly due to its ability to mobilize social resources, stimulate problem solving, share risks, and build joint ownership of new and differentiated solutions (Torfing and Ansell 2021). Although the importance of co-creation processes has been made clear in theoretical terms, efforts to conduct co-creation processes associated with climate change have received weak buy-in from researchers and public managers (Hofstad and Vedeld 2021). The rise of collaborative governance supported by networks and partnerships has been driven by the growing appreciation of mutual dependence between public and private actors, sometimes associated with decentralization exercises, although not always well anchored in a stable budgetary envelope, or with legal vicissitudes, hindering their proper implementation.

Thus, the current panorama indicates that many local governments are making efforts to produce innovative solutions to achieve the goals set at national level, although with poor alignment with the regional and local reality. At the same time, it is crucial to continue to foster broad support from communities for green change, which should be supported by clear information on the processes, their objectives, and actions to be taken, objectively warning that this change will mean some disruption compared to what we have been used to until today, as it concerns the way we live, work, and consume. To this end, the formulation of urban-climate-mitigation strategies must be inclusive and participatory, and must facilitate a balance between sustainability goals and social justice.

6. Conclusions

Concerns about the sustainability of our planet have found justified reflection in the issue of food systems. As we have explored, food production results in significant environmental impacts, which increase as global population numbers grow and as developing countries' food evolves. The concept of the circular economy, which has become increasingly popular over the last years, has forced us to shift discussions on this matter to the concept of circular food systems and, consequently, to rethink the way society deals with food waste and, more generally, bio-waste. Among the issues surrounding this matter, the drivers of bio-waste management assume a part of the utmost importance, with their analysis offering an understanding of the factors that push bio-waste management forward or hold it back (Márquez and Rutkowski 2020).

Seeking to respond to the challenge outlined at the beginning of this review, we highlighted the following drivers: resource value of waste, public health, environmental protection, public awareness, scientific knowledge, and policy and legislation. With this exercise, we sought to contribute to a unitary, comprehensive, and comparable review of bio-waste management drivers in the European context, hoping both to offer a basis for further research on the matter and to inform public decision makers about the factors that can contribute to advancing or hindering the construction of more sustainable bio-waste management systems.

This study also allows us to highlight the centrality of the policy and legislation driver in the current European panorama of bio-waste management. In particular, the significant influence of European Directives on the development of bio-waste management systems in European countries, particularly through Directive 2008/98/EC and Directive 2018/851 and the brown-bin policy they put forward, should be noted. At the same time, we sought to highlight the role of co-creation as an instrument to facilitate a public-governance paradigm capable of promoting sustainable development.

It is commonly accepted that co-creation processes that mobilize the experiences, resources, and ideas of various public and private actors in the creation of public solutions have been gaining prominence. There are already significant examples of local governments making efforts to promote citizen involvement in the provision of public welfare services and in solving social and political problems and challenges. Also at a regional level, there are examples of co-creation processes in strategic planning and transport, involving

private stakeholders. At the national level, governments have fostered the creation of collaborative convergence forums to monitor and follow up on the processes of formulating and implementing collaborative-based public policies that can meet the needs and demands of the community. In some countries (with a special emphasis on Northern European countries), there is already a long tradition of citizens, civil society organizations, and public authorities using co-creation processes to find solutions to common problems.

In this sense, co-creation may become central to bio-waste management in the near future. As an innovative element in the creation and implementation of public policies for sustainability, co-creation can adopt the same role in bio-waste management, an area particularly suited to the convergence of local governments, citizens, and other stakeholders for the collaborative construction of solutions that are better suited not only to the specific circumstances of each community and the interests of the various actors but also to the interests of the planet.

The limitations of the present article should not be ignored. To this end, this article has not explored the differences between European countries in terms of the bio-waste management systems that they have in place and the factors that influence them. This meant that, in terms of the "policy and legislation" driver, no attention was paid, for example, to the differences between national legislations or political and/or cultural values. At the same time, having opted for an informed review of the drivers that are most suited to the European reality, the relative impact of each of the drivers pointed out or the perception of professionals in the field about their impact remains to be studied.

Achieving the vision of more sustainable bio-waste-management systems, however, requires a significant effort by the scientific community, namely through the production of municipal, inter-municipal, or regional studies that analyze existing trends in the impact (or lack thereof) of collaborative arrangements on the pursuit of more sustainable bio-waste management. Researchers should aim to use the information gathered therein to create a database that brings together current best practices, which could then serve as a benchmark to be applied on a wider scale. Similarly, as the European context under analysis in the current article is not homogenous, studies should be carried out that explore and compare between-countries trends and how these could influence supra-national trends. Studies of national-level drivers should also not be ignored, as their understanding can play a key role in achieving bio-waste-management targets.

Author Contributions: Conceptualization, methodology, validation, I.M., P.R. and A.A.; formal analysis, I.M. and P.R.; investigation, I.M., P.R. and A.A.; writing—original draft preparation, I.M., P.R. and A.A.; writing—review and editing, I.M. and P.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

Agamuthu, Pariatamby, K. M. Khidzir, and Fauziah Shahul Hamid. 2009. Drivers of sustainable waste management in Asia. *Waste Management and Research* 27: 625–33. [CrossRef] [PubMed]

Akamani, Kofi, Eric J. Holzmueller, and John W. Groninger. 2016. Managing Wicked Environmental Problems as Complex Social-Ecological Systems: The Promise of Adaptive Governance. In *Landscape Dynamics, Soils and Hydrological Processes in Varied Climates*. Edited by Assefa Melesse and Wossenu Abtew. Berlin/Heidelberg: Springer International Publishing, pp. 741–62. [CrossRef]

Barros, Murillo Vetroni, Rodrigo Salvador, Antonio Carlos de Francisco, and Cassiano Moro Piekarski. 2020. Mapping of research lines on circular economy practices in agriculture: From waste to energy. *Renewable and Sustainable Energy Reviews* 131: 109958. [CrossRef]

Belmonte-Ureña, Luis Jesús, Plaza-Úbeda, José Antonio, Diego Vazquez-Brust, and Natalia Yakovleva. 2021. Circular economy, degrowth and green growth as pathways for research on sustainable development goals: A global analysis and future agenda. *Ecological Economics* 185: 107050. [CrossRef]

Bentzen, Tina Ø., Eva Sørensen, and Jacob Torfing. 2020. Strengthening public service production, administrative problem solving, and political leadership through co-creation of innovative public value outcomes? *The Innovation Journal: The Public Sector Innovation Journal* 25: 1–28.

Brown, Tim, and Jocelyn Wyatt. 2010. Design Thinking for Social Innovation. *Development Outreach* 12: 29–43. Available online: www.ssireview.com (accessed on 10 August 2023). [CrossRef]

Buratti, Cinzia, Marco Barbanera, F. Testarmata, and Francesco Fantozzi. 2015. Life Cycle Assessment of organic waste management strategies: An Italian case study. *Journal of Cleaner Production* 89: 125–36. [CrossRef]

Calori, Andrea, Egidio Dansero, Giacomo Pettenati, and Alessia Toldo. 2017. Urban food planning in Italian cities: A comparative analysis of the cases of Milan and Turin. *Agroecology and Sustainable Food Systems* 41: 1026–46. [CrossRef]

Chua, Mark Hansley, and Yung Yau. 2022. Institutional Analysis and Development (IAD) Approach for Determining the Effects of the Waste Charging Scheme on Household Food Waste Recycling. *Sustainability* 14: 16120. [CrossRef]

Cobo, Selene, Antonio Domínguez-Ramos, and Ángel Irabien. 2018. From linear to circular integrated waste management systems: A review of methodological approaches. *Resources, Conservation and Recycling* 135: 279–95. [CrossRef]

Contreras, Francisco, Satoshi Ishii, Toshiya Aramaki, Keisuke Hanaki, and Stephen Connors. 2010. Drivers in current and future municipal solid waste management systems: Cases in Yokohama and Boston. *Waste Management and Research* 28: 76–93. [CrossRef]

Dhanya, B. S., Archana Mishra, Anuj K. Chandel, and Madan L. Verma. 2020. Development of sustainable approaches for converting the organic waste to bioenergy. *Science of the Total Environment* 723: 138109. [CrossRef] [PubMed]

Ellen MacArthur Foundation. 2013. *Towards the Circular Economy—Economic and Business Rationale for an Accelerated Transition, vol. 1*. Available online: https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an (accessed on 28 July 2023).

Esmaeilian, Behzad, Ben Wang, Kemper Lewis, Fabio Duarte, Carlo Ratti, and Sara Behdad. 2018. The future of waste management in smart and sustainable cities: A review and concept paper. *Waste Management* 81: 177–95. [CrossRef] [PubMed]

Esparza, Irene, Nerea Jiménez-Moreno, Fernando Bimbela, Carmen Ancín-Azpilicueta, and Luis M. Gandía. 2020. Fruit and vegetable waste management: Conventional and emerging approaches. *Journal of Environmental Management* 265: 110510. [CrossRef]

European Commission. 2020a. *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe.* Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2020%3A98%3AFIN (accessed on 10 August 2023).

European Commission. 2020b. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions—A Farm to Fork Strategy for a Fair, Healthy and Environmentally-Friendly Food System.* Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0381 (accessed on 10 August 2023).

European Commission. 2021. *Commission Staff Working Document—Better Regulation Guidelines*. SWD (2021) 305 final Brussels. Brussels: European Commission.

European Commission, Directorate-General for Climate Action. 2022. *Innovation Fund Progress Report—Report from the Commission to the European Parliament and the Council, August 2022*. Luxembourg: Publications Office of the European Union. [CrossRef]

European Commission. 2023. *Better Regulation Toolbox*. Available online: https://commission.europa.eu/system/files/2023-07/BR_toolbox_Jul_2023_en.pdf (accessed on 11 August 2023).

European Union. 2008. *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives*. OJ L 312/3. Brussels: European Union. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098 (accessed on 18 August 2023).

European Union. 2018. *Directive 2018/851 of the European Parliament and of the Council of 30 May 2018 on Waste*. OJ L 150/109. Brussels: European Union. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L0851 (accessed on 18 August 2023).

Eurostat. 2023. *Food Waste and Food Waste Prevention—Estimates*. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Food_waste_and_food_waste_prevention_-_estimates&stable=0&redirect=no (accessed on 4 August 2023).

FAO. 1981. *Food Loss Prevention in Perishable Crops*. Rome: FAO.

FAO. 2019. *The Milan Urban Food Policy Pact—Monitoring Framework*. (Issue October). Available online: https://www.milanurbanfoodpolicypact.org/the-milan-pact/ (accessed on 3 August 2023).

Feiz, Roozbeh, Maria Johansson, Emma Lindkvist, and Jan Moestedt. 2020. Key Performance Indicators for Biogas Production-Methodological Insights on the Life-Cycle Analysis of Biogas Production from Source-Separated Food Waste. *Energy* 200: 117462. [CrossRef]

Gadaleta, Giovanni, Sabino De Gisi, and Michele Notarnicola. 2021. Feasibility analysis on the adoption of decentralized anaerobic co-digestion for the treatment of municipal organic waste with energy recovery in urban districts of metropolitan areas. *International Journal of Environmental Research and Public Health* 18: 1820. [CrossRef] [PubMed]

Gao, Anqi, Zhenyu Tian, Ziyi Wang, Ronald Wennersten, and Qie Sun. 2017. Comparison between the technologies for food waste treatment. *Energy Procedia* 105: 3915–21. [CrossRef]

Garrone, Paola, Marco Melacini, and Alessandro Perego. 2014. Opening the black box of food waste reduction. *Food Policy* 46: 129–39. [CrossRef]
Garske, Beatrice, Katharine Heyl, Felix Ekardt, Lea Moana Weber, and Wiktoria Gradzka. 2020. Challenges of food waste governance: An assessment of European legislation on food waste and recommendations for improvement by economic instruments. *Land* 9: 231. [CrossRef]
Gaspar, Marisa C., João Leocádio, Cátia V. T. Mendes, Martim Cardeira, Naiara Fernández, Ana Matias, Maria G. V. S. Carvalho, and Mara E. M. Braga. 2021. Biodegradable film production from agroforestry and fishery residues with active compounds. *Food Packaging and Shelf Life* 28: 100661. [CrossRef]
Geissdoerfer, Martin, Paulo Savaget, Nancy M. P. Bocken, and Erik Jan Hultink. 2017. The Circular Economy—A new sustainability paradigm? *Journal of Cleaner Production* 143: 757–68. [CrossRef]
Ghisellini, Patrizia, Catia Cialani, and Sergio Ulgiati. 2016. A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production* 114: 11–32. [CrossRef]
Gokarn, Samir, and Thyagaraj S. Kuthambalayan. 2017. Analysis of challenges inhibiting the reduction of waste in food supply chain. *Journal of Cleaner Production* 168: 595–604. [CrossRef]
Greben, Harma A., and Suzan H. H. Oelofse. 2009. Unlocking the resource potential of organic waste: A South African perspective. *Waste Management and Research* 27: 676–84. [CrossRef] [PubMed]
Grosso, Mario, Astrid Motta, and Lucia Rigamonti. 2010. Efficiency of energy recovery from waste incineration, in the light of the new Waste Framework Directive. *Waste Management* 30: 1238–43. [CrossRef] [PubMed]
Gustavsson, Jenny, Christel Cederberg, and Ulf Sonesson. 2011. *Global Food Losses and Food Waste*. Düsseldorf: Save Food at Interpack.
Hambleton, Robin. 2019. The New Civic Leadership: Place and the co-creation of public innovation. *Public Money and Management* 39: 271–279. [CrossRef]
Hartley, Kris, Ralf van Santen, and Julian Kirchherr. 2020. Policies for transitioning towards a circular economy: Expectations from the European Union (EU). *Resources, Conservation and Recycling* 155: 104634. [CrossRef]
Hickel, Jason. 2019. The contradiction of the sustainable development goals: Growth versus ecology on a finite planet. *Sustainable Development* 27: 873–84. [CrossRef]
Hofstad, Hege, and Trond Vedeld. 2021. Exploring city climate leadership in theory and practice: Responding to the polycentric challenge. *Journal of Environmental Policy and Planning* 23: 496–509. [CrossRef]
Hofstad, Hege, Eva Sørensen, Jacob Torfing, and Trond Vedeld. 2023. Leading co-creation for the green shift. *Public Money and Management* 43: 357–66. [CrossRef]
Hood, Christopher. 1991. A Public Management for All Seasons? *Public Administration* 69: 3–19. [CrossRef]
Huxham, Chris, and Siv Vangen. 2013. *Managing to Collaborate: The Theory and Practice of Collaborative Advantage*. London: Routledge. [CrossRef]
Ingrao, Carlo, Nicola Faccilongo, Leonardo Di Gioia, and Antonio Messineo. 2018. Food waste recovery into energy in a circular economy perspective: A comprehensive review of aspects related to plant operation and environmental assessment. *Journal of Cleaner Production* 184: 869–92. [CrossRef]
Jurgilevich, Alexandra, Traci Birge, Johanna Kentala-Lehtonen, Kaisa Korhonen-Kurki, Janna Pietikäinen, Laura Saikku, and Hanna Schösler. 2016. Transition towards circular economy in the food system. *Sustainability* 8: 69. [CrossRef]
Krishnan, Ramesh, Renu Agarwal, Christopher Bajada, and Kaur Arshinder. 2020. Redesigning a food supply chain for environmental sustainability—An analysis of resource use and recovery. *Journal of Cleaner Production* 242: 118374. [CrossRef]
Ladele, Oluwatomilola, Jamie Baxter, Paul van der Werf, and Jason A. Gilliland. 2021. Familiarity breeds acceptance: Predictors of residents' support for curbside food waste collection in a city with green bin and a city without. *Waste Management* 131: 258–67. [CrossRef] [PubMed]
Le Pera, Adolfo, Miriam Sellaro, Francesco Sicilia, Roberto Ciccoli, Beatrice Sceberras, Cesare Freda, Emanuele Fanelli, and Giacinto Cornacchia. 2023. Environmental and economic impacts of improper materials in the recycling of separated collected food waste through anaerobic digestion and composting. *Science of the Total Environment* 880: 163240. [CrossRef]
Lemaire, Anais, and Sabine Limbourg. 2019. How can food loss and waste management achieve sustainable development goals? *Journal of Cleaner Production* 234: 1221–34. [CrossRef]
Márquez, Ana Julieth Calderón, and Emília Wanda Rutkowski. 2020. Waste management drivers towards a circular economy in the global south—The Colombian case. *Waste Management* 110: 53–65. [CrossRef]
Meadows, Donella H., Dennis L. Meadows, Jorgen Randers, and William W. Behrens III. 1972. *The Limits to Growth—A Report to the Club of Rome's Project on the Predicament of Mankind*. New York: Universe Books.
Merli, Roberto, Michele Preziosi, and Alessia Acampora. 2018. How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production* 178: 703–22. [CrossRef]
Messina, Giovanna, Antonella Tomasi, Giorgio Ivaldi, and Francesco Vidoli. 2023. 'Pay as you own' or 'pay as you throw'? A counterfactual evaluation of alternative financing schemes for waste services. *Journal of Cleaner Production* 412: 137363. [CrossRef]
Muscat, Abigail, Evelien De Olde, Raimon Ripoll-Bosch, Hannah H. E. van Zanten, Tamara A. P. Metze, Catrien J. A. M. Termeer, Martin K. van Ittersum, and Imke J. M. de Boer. 2021. Principles, drivers and opportunities of a circular bioeconomy. *Nature Food* 2: 561–66. [CrossRef] [PubMed]

Osborne, Stephen P., and Kirsty Strokosch. 2013. It takes two to tango? Understanding the co-production of public services by integrating the services management and public administration perspectives. *British Journal of Management* 24: S31–S47. [CrossRef]

Östergren, Karin, Jenny Gustavsson, Hilke Bos-Brouwers, Toine Timmermans, Ole-Jørgen Hansen, Hanne Møller, Gina Anderson, Clementine O'Conno, Han Soethoudt, Tom Quested, and et al. 2014. *FUSIONS Definitional Framework for Food Waste*. Gothenburg: SIK-The Swedish Institute for Food and Biotechnology.

Ostrom, Vincent, and Elinor Ostrom. 1971. Public Choice: A Different Approach to the Study of Public Administration. *Public Administration Review* 31: 203–16. [CrossRef]

Ostrom, Elinor, and Gordon Whitaker. 1973. Does Local Community Control of Police make a Difference? Some Preliminary Findings. *American Journal of Political Science* 17: 48–76. [CrossRef]

Papargyropoulou, Effie, Rodrigo Lozano, Julia K. Steinberger, Nigel Wright, and Zaini bin Ujang. 2014. The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production* 76: 106–15. [CrossRef]

Parks, Roger B., Paula C. Baker, Larry Kiser, Ronald Oakerson, Elinor Ostrom, Vincent Ostrom, Stephen L. Percy, Martha B. Vandivort, Gordon P. Whitaker, and Rick Wilson. 1981. Consumers as co-producers of public services. *Policy Studies Journal* 9: 1001–11. [CrossRef]

Pearse, Lauretta Feyisetan, Joseph Patrick Hettiaratchi, and Sunil Kumar. 2018. Towards developing a representative biochemical methane potential (BMP) assay for landfilled municipal solid waste—A review. *Bioresource Technology* 254: 312–24. [CrossRef]

Porter, Stephen D., David S. Reay, Peter Higgins, and Elizabeth Bomberg. 2016. A half-century of production-phase greenhouse gas emissions from food loss & waste in the global food supply chain. *Science of The Total Environment* 571: 721–29. [CrossRef]

Puntillo, Pina, Carmela Gulluscio, Donald Huisingh, and Stefania Veltri. 2021. Reevaluating waste as a resource under a circular economy approach from a system perspective: Findings from a case study. *Business Strategy and the Environment* 30: 968–84. [CrossRef]

Rodić, Ljiljana, and David C. Wilson. 2017. Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries. *Sustainability* 9: 404. [CrossRef]

Sachs, Jeffrey D., Guido Schmidt-Traub, Mariana Mazzucato, Dirk Messner, Nebojsa Nakicenovic, and Johan Rockström. 2019. Six Transformations to achieve the Sustainable Development Goals. *Nature Sustainability* 2: 805–14. [CrossRef]

Scotford, Eloise. 2021. Legislation and the Stress of Environmental Problems. *Current Legal Problems* 74: 299–327. [CrossRef]

Sehnem, Simone, Susana Carla Farias Pereira, Deborah Godoi, Luis Henrique Pereira, and Silvio Santos Junior. 2021. Food waste management: An analysis from the circular economy perspective. *Environmental Quality Management* 31: 59–72. [CrossRef]

Sørensen, Eva, and Jacob Torfing. 2018. Co-initiation of Collaborative Innovation in Urban Spaces. *Urban Affairs Review* 54: 388–418. [CrossRef]

Sørensen, Eva, and Jacob Torfing. 2019. Designing institutional platforms and arenas for interactive political leadership. *Public Management Review* 21: 1443–63. [CrossRef]

Stegmann, Paul, Marc Londo, and Martin Junginger. 2020. The circular bioeconomy: Its elements and role in European bioeconomy clusters. *Resources, Conservation and Recycling* 10: 100029. [CrossRef]

Taelman, Sue Ellen, Davide Tonini, Alexander Wandl, and Jo Dewulf. 2018. A Holistic sustainability framework for waste management in European Cities: Concept development. *Sustainability* 10: 2184. [CrossRef]

Torfing, Jacob, and Christopher Ansell. 2021. Co-creation. The new kid on the block in public governance. *Policy and Politics* 49: 211–230. [CrossRef]

Torfing, Jacob, Eva Sørensen, and Asbjørn Røiseland. 2019. Transforming the Public Sector Into an Arena for Co-Creation: Barriers, Drivers, Benefits, and Ways Forward. *Administration and Society* 51: 795–825. [CrossRef]

Uemura Silva, Vitor, Maria Fátima Nascimento, Pablo Resende Oliveira, Tulio Hallak Panzera, Marilia Oliveira Rezende, Diogo Aparecido Lopes Silva, Vinicius Borges de Moura Aquino, Francisco Antonio Rocco Lahr, and André Luis Christoforo. 2021. Circular vs. linear economy of building materials: A case study for particleboards made of recycled wood and biopolymer vs. conventional particleboards. *Construction and Building Materials* 285: 122906. [CrossRef]

Ukkonen, Aino, and Olli Sahimaa. 2021. Weight-based pay-as-you-throw pricing model: Encouraging sorting in households through waste fees. *Waste Management* 135: 372–80. [CrossRef] [PubMed]

UNEP. 2015. *Global Waste Management Outlook*. Available online: https://www.unep.org/resources/report/global-waste-management-outlook (accessed on 1 August 2023).

UNEP. 2021. *Food Waste Index Report*. Available online: https://www.unep.org/resources/report/unep-food-waste-index-report-2021 (accessed on 1 August 2023).

United Nations General Assembly. 2015. *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York: United Nations. 40p, Available online: http://digitallibrary.un.org/record/1654217 (accessed on 2 August 2023).

United Nations General Assembly. 2017. *Resolution Adopted by the General Assembly on Work of the Statistical Commission Pertaining to the 2030 Agenda for Sustainable Development (A/RES/71/313)*. New York: United Nations. Available online: https://ggim.un.org/documents/a_res_71_313.pdf (accessed on 2 August 2023).

Velenturf, Anne P. M., Sophie A. Archer, Helena I. Gomes, Beate Christgen, Alfonso J. Lag-Brotons, and Phil Purnell. 2019. Circular economy and the matter of integrated resources. *Science of the Total Environment* 689: 963–69. [CrossRef] [PubMed]

Weidner, Till, and Aidong Yang. 2020. The potential of urban agriculture in combination with organic waste valorization: Assessment of resource flows and emissions for two european cities. *Journal of Cleaner Production* 244: 118490. [CrossRef]
Weidner, Till, João Graça, Telmo Machado, and Aidong Yang. 2020. Comparison of local and centralized biowaste management strategies—A spatially-sensitive approach for the region of Porto. *Waste Management* 118: 552–62. [CrossRef] [PubMed]
Wilson, David C. 2007. Development drivers for waste management. *Waste Management & Research* 25: 198–207. [CrossRef]
Winans, Kiara, Alissa Kendall, and Hui Deng. 2017. The history and current applications of the circular economy concept. *Renewable and Sustainable Energy Reviews* 68: 825–33. [CrossRef]
World Commission on Environment and Development. 1987. *Our Common Future ('The Brundtland Report')*. Available online: https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf (accessed on 25 July 2023).
Zaman, A. U. 2013. Identification of waste management development drivers and potential emerging waste treatment technologies. *International Journal of Environmental Science and Technology* 10: 455–64. [CrossRef]
Zorpas, Antonis A., Katia Lasaridi, Irene Voukkali, Pantelitsa Loizia, and Christina Chroni. 2015. Promoting Sustainable Waste Prevention Strategy Activities and Planning in Relation to the Waste Framework Directive in Insular Communities. *Environmental Processes* 2: 159–73. [CrossRef]