Environmental Sociology

ISSN: 2325-1042 (Online) Journal homepage: www.tandfonline.com/journals/rens20

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To cite this article: Sebastian Abrahamsson (2023) A defense of waste: the case of municipal food recycling in Sweden, Environmental Sociology, 9:1, 107-116, DOI: 10.1080/23251042.2022.2124622

To link to this article: https://doi.org/10.1080/23251042.2022.2124622

Published online: 21 Sep 2022.

ENVIRONMENTAL SOCIOLOGY
2023, VOL. 9, NO. 1, 107–116
https://doi.org/10.1080/23251042.2022.2124622

Routledge
Taylor & Francis Group

A defense of waste: the case of municipal food recycling in Sweden

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ABSTRACT

This article is an empirical analysis of food waste management and food recycling in Sweden. Currently, across Sweden, attempts are being made to achieve a circular economy whereby food wastes are transformed into resources. Food waste is used to produce biogas and bio fertilizer, and the enactment of food waste as a resource turns the waste into a raw material over which waste management organizations compete. Against this backdrop, the article interferes with research in 'waste studies' that highlight transformation of waste into something valuable, and proposes instead to 'defend' waste against the CE. The paper contributes to 'waste studies' and research on the circular economy by cautioning about the risks involved both in the establishment of a circular economy, and the treatment of waste as valuable. The empirical material used draws on a research project in which interviews were carried out with 'waste workers' in Swedish waste management organizations.

ARTICLE HISTORY
Received 20 January 2022
Accepted 11 September 2022

KEYWORDS
Circular economy; waste; food waste; valuation

In the race to invent sustainable solutions and strategies to mitigate the environmental impact of current modes of production, consumption and wasting, the circular economy (CE) is currently advocated by environmental organizations and nation states across the globe. There is no coherent or unified definition of the CE, but one central aspect of it is the notion that waste is taken care of, recovered, transformed, and treated as a resource (Prieto-Sandoval, Jaca, and Ormazabal 2018; Rosenlund 2017). Proponents of said strategy suggest that through the CE 'everything previously considered waste is revived for other uses, effectively eliminating not only waste but the concept of waste altogether' (Lacy and Rutqvist 2015, 52). Hence, in contrast to a linear economy, the CE aims to create material loops through which energy, goods and materials do not go to waste but are instead re-injected into the economy through re-use, recycling and material transformations. The CE may have potential benefits over the linear economy, but the framing of CE as the panacea for environmental challenges is problematic. There is a growing body of research that engages critically with the CE (for an overview see (Corvellec, Stowell, and Johansson 2021)). This paper adds to this body of research, focusing specifically on risks with embracing a food waste CE without considering side-effects and unintended consequences that follow when waste gets associated with value in municipal waste management. There are three risks that I want to highlight here. First, a focus on getting rid of waste by treating it like a resource risks downplaying the resources used in production, transportation and consumption. Put differently: 'the resourcification of waste strips it of its power as a doomsayer urging us to curb our consumption.' (Doeland 2019, 1) Second, achieving circular material loops requires investments in infrastructure and these infrastructures rely on and potentially normalize the overproduction of waste. (Reno 2015) Finally, treating waste as a resource risks reducing the incentives to prevent waste and excess from getting produced to begin with. (Greer, von Wirth, and Loorbach 2021) This paper analyses how actors in the food waste CE negotiate and attempt to resolve these potential tensions, conflicts and risks. As such, it contributes to the growing body of critical literature on CE by highlighting the work done by 'waste workers'. The objective is to articulate these workers' practices by attending to the risks and concerns that follow when food waste is organized as valuable through Swedish municipal waste management. Doing so, I also contend that the dominant role that the CE food waste management, recycling and biogas production plays in Swedish municipalities infringes on the prioritized goal of preventing waste.

In Sweden, private and public actors are eager to treat discarded food and other wastes not as failures but as opportunities to acquire valuable matter (Ekman Burgman 2022; Rosenlund 2017). The article outlines a critique of the circular economy of municipal food waste transformation through recycling, analysing the challenges that such transformations may lead to. I have phrased this critique as a 'defence' of waste. The point of this 'defence' is neither to insist on essentialism – that waste *is* waste – nor to ignore the 'human systems of design' (Bauman 2017, 22), and the 'nonhumans' (Gumbert 2020; Holmberg 2021) that both help

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co-create and thrive on discards. Instead, the point is to defend waste against the logic, within CE waste management, through which it is considered valuable. This value-creating logic ignores the (material, economic, environmental) costs of producing foods. It is also costly in itself, in the sense that it requires work and a supporting infrastructure. Rather than encouraging the caring for foods, it risks weakening incentives to reduce food wastage.

In what follows, I first introduce the methods and materials used for the study and the research project these were generated in. I then discuss the theoretical framing and contribution of this text, by highlighting work done on value transformation in waste studies. In the subsequent part of the text, I analyse the case of food recycling in Sweden and attend to three processes of value creation. A fourth and final analytical section attends to how the dominance of recycling undermines other modes of ordering and organizing waste.

Methods and materials

The empirical material for the study comes from fieldwork in Sweden. The main project was a study of organic wastes (food and wastewater) and valuation in the CE.[1] A total of 40 waste workers and professionals working for waste management organizations and associated organizations were interviewed in three different cities.[2] We picked three cities that were big enough to have one or several waste management organization in it. But we were also curious to see whether there were geographical and regional differences that may have an effect on the organization of waste and hence in our selection of cities we ended up creating contrasts mainly in size and geography. In each city, we interviewed engineers, CEOs, information officers, and technicians. Sometimes we were all present during the interview, and we then took turns asking questions. At other times only one of us was doing the interview. Each interview lasted for around an hour, and through them we inquired about waste management practices, business models, and policies and their practical implications. Elsewhere, we have framed the methods used as 'trash tracing' (Wallsten et al. 2021). Here, instead, I focus on the *stories* that our informants shared with us. I shamelessly invoke the term 'trash talk', to describe these stories. Trash talk, or talk about trash, convey the social, material and economic transformations of wasted materials. These stories articulate struggles and negotiations about value and valuation – how objects get valued as 'good' and/or 'bad' (cf. Heuts and Mol 2013). Our main focus in the interviews was on how large-scale transformation of waste into something valuable and 'good' generates both possibilities for a 'green' economy, and at the same time solidifies unsustainable modes of production, consumption and wasting. Our starting point was that in Sweden food waste is increasingly getting organized as valuable. That is, food waste does not 'have' value in and of itself. Instead, and adhering to insights from valuation studies, we approached value as a sociomaterial practice, meaning that we approached value as something that is done (Greeson, Laser, and Pyyhtinen 2020). At the same time waste retains associations with unwanted, useless and excessive matter. We framed this tension, following Gille, as a shift in waste regimes and a shift in valorizing waste (Gille 2007). Our informants shared stories and narratives about their work practices, about tensions in current waste management policies, and about how organizing waste as a resource has affected their work. The interview material was coded thematically using in vivo codes and analyzed using coding software. In this article I draw on a sample of eight interviews that focus specifically on the transformation of food waste into biogas and bio fertilizer. Through our informants' work, food waste gets valued and articulated in different ways: in terms of an economic value and an associated market; as biogas that offers clean energy for public transports; as a potent bio fertilizer that returns vital nutrients to deprived soils. These enactments make use of an infrastructure involving paper bags and containers, trucks, digestion chambers, bacteria, and a host of other actors. Households, restaurants and supermarkets are expected to separate their food waste for recycling, which is then collected by waste management organizations and shipped off to treatment facilities where biogas and bio fertilizer is produced. This is all celebrated as the good thing to do. And yet, as the Swedish Natural Protection Agency cautions in a study of food waste in supermarkets: there is a

> Tendency to view food waste as less of an issue in cases where it is used as a resource (e.g., biogas [. . .]). This can reduce incentives to prevent the emergence of food waste in earlier stages. (Sörme 2019, 11)

Hence when recycling gets valued as 'good' this further strengthens the incentives to recycle. As my informants expressed, this risks stabilizing and normalizing both the continuous generation of food waste as well as the resources that are made from it.

Waste, value and transformation

Waste studies attends to the socioeconomic, techno-political, and environmental dimensions of discarded matters and wasting practices. At the center of this research is a concern with the materiality of different kinds of wastes and the ways in which this materiality gets transformed through landfilling (Reno 2016), recycling (Hawkins 2006), repair (Graham and Thrift 2007) and management (Corvellec and Hultman 2014). For

the purposes of this paper, this section will focus on the lines of waste research that highlight value transformations; research that 'focus on the productive afterlives of waste – its impact on and significance for humans and nonhumans.' (Reno 2015, 558). More specifically, I will highlight research on the CE, and position this paper in relation to this.

The CE is championed by the European Commission as promising increased economic growth, innovation and jobs while at the same time protecting the environment and supporting sustainable ways of living. It is a contested (Valenzuela and Böhm 2017) and ambiguous term (Kirchherr, Reike, and Hekkert 2017). A growing body of critical engagements with the CE has highlighted the troublesome association between waste and the economy that is generated through the business models that emerge through present day CE implementations by corporate and state actors. This association not only depoliticizes waste, it also creates a demand for it. At the core of the CE is the idea – as simple as it is alluring – that wastes generated by both production and consumption practices get collected, refurbished, revamped, and recycled such that the loss of resources and energy is kept to a minimum. This ideal of purified material flows rests on an essentialist 'modernist logic' (Isenhour et al. 2022) by which economic and human activities are separate from 'natural' ones. In waste management practices however, pollutants and toxic materials, such as PFAS, that are involved in food production as well as waste management, risk contaminating the soil when compost and fertilizer from food waste CE are used. Drawing on interviews with affected food waste processors, Isenhour et al. (2022) suggest that for food waste CE to become safe policies need to attend to actors upstream. A similar point is made by Thakali and MacRae (2021) who analyse the risks with continuous use of treated food waste and compost for food production. Heavy metals, antibiotic resistance genes, pathogens and other contaminants risk entering the circularity, thus jeopardizing the food system's safety. This points to the fact that, as Holmberg and Ideland (2021) contend, the closed material loops that the food waste CE is meant to achieve are both permeable and fragile. All suggest that more efforts need to be made upstream, and that maintenance and management work is crucial for circularity to be achieved. Hence, waste management needs to work more effectively and policies and regulations need to focus efforts upstream.

This article takes inspiration from the cited studies but has a slightly different focus. While these studies are critical of the implementation of CE and suggest how to improve it, I analyze the hesitance towards practices of recycling and economization expressed by informants during fieldwork (cf. Gregson, Watkins, and Calestani 2013). This hesitance grows out of a concern about the increasing volumes of waste generated and processed, but it also relates to the recognition that waste management and transformation relies on the construction of infrastructure and that this infrastructure creates dependency on waste. Such infrastructure stabilizes the continuous production of waste so that alternatives get sidelined. Similar to the notion of path dependency, this stabilization resembles the situation that Corvellec, Zapata Campos, and Zapata (2013) call a 'lock-in'. A lock-in describes how technological systems lock-in 'producers, users, and regulators in dynamic webs of technologies, legislation, standards, physical infrastructures, politics and cultural norms' (2013, 33). In their study they show how waste incineration is locked-in with district heating in Gothenburg and how, as a result, achieving more sustainable solutions to municipal waste gets hampered through material, economic, political and cultural rationales. In a similar manner, Swedish municipal food waste management risks moving toward a food waste lock-in, which may hamper work to waste less. A growing number of organizations and social movements in Sweden and elsewhere are increasingly putting into question the recycling of food waste into biogas. Feedback, a global food waste campaign group launched in 2013, suggests that food waste to biogas recycling at best 'provides sticking a plaster to problems like food waste and the intensive livestock industry, and at worst it is actively expands polluting industries'. (Feedback 2022) These groups call for a revised food system based on minimal resource use and thriftiness. Similar to the 'careful circularities' of community composting that Morrow and Davies analyze, or the informal CE of soap makers in Spain that Ibáñez and de Laet, M detail, a hesitance to recycling and economization has the potential to slow down the will to transform waste to value, to cultivate a space of thinking and doing things differently (Morrow and Davies 2021; Ibáñez Martín and de Laet 2018, see also Abrahamsson and Bertoni 2014). Similar also to the waste minimization practices discussed by Bissmont in this journal, this hesitance to recycling invites us to engage in creatively acting to avoid, reduce and minimize (Bissmont 2020).

Food recycling in Sweden

In 2018, 133 kilos of food per person was wasted in Sweden equalling 1,3 million tons in total. Estimates suggest that 95 kilos come from households, and the remaining 38 kilos come from restaurants, supermarkets and production. (Andersson and Stålhandske 2020). In 2019 the Environmental Protection Agency concluded that 38% of all food waste was recycled for biological treatment and extraction of nutrients. A smaller portion, 33% of all food waste, was recycled for both nutrient extraction and energy. (Sörme 2019)

One of the stipulated goals for food waste recycling is that by 2023, at least 75% of all food waste generated by households, restaurants, caterers, and supermarkets had to be sorted, treated and recycled to make biogas and bio fertilizer. To stimulate municipalities, regions, companies and industries to reach environmental goals, the Environmental Protection Agency has launched an investment program – *Klimatklivet* [*The Climate leap*] – that funds investments in infrastructure, such as food waste treatment facilities. Between 2015 and 2020, a total of 1,2 billion SEK was invested to support the 41 biogas production initiatives. (Andersson and Stålhandske 2020) In first section below I focus on the economic value of food waste and how investments in food waste recycling, both through increasingly ambitious policies and plans of actions and in terms of a growing number of actors, transform food waste into a market good. In the two sections that follow I turn instead to analyze what becomes of the food waste once it has entered the transformation process.

A market for waste

The biogas plant in City X is part of the municipal waste and water management organization. To produce biogas and fertilizer the plant needs raw material, i.e. food waste. And in order to keep up with the market demand for the output, the right amount of raw material is needed. Preferably, there should be more raw material than what is actually needed, to allow for redundancies and potential breakdowns. During an interview with one of the engineers at the plant, Anders, I was told about some of the difficulties with the current way of organizing incoming and outgoing transactions. At the moment, Anders told me, the plant charges a fee for collecting food waste, but this is likely to change. Here, Anders spoke at lengths about the troublesome situation with a newly opened competing plant. While he welcomes that more actors get involved, competition for raw materials inevitably means adjustment in value. In a not-so-distant future, he continued, the demand may even increase so much that in order to guarantee continued production of biogas and fertilizer, the plant will have to pay for food waste. At the plant in City X, the fluctuating prices have already had an impact both on contracts with other municipalities and on the economy of the plant. In the longer run, however, with the increased national efforts to collect food wastes in neighboring municipalities the market will hopefully stabilize as more waste gets collected. When it was first built, the biogas plant in City X collected local food waste from the city in exchange for a 'receiver fee' which was financed through waste tariffs. As the plant expanded, adjacent municipalities that lacked the infrastructure to treat the waste sent it to the plant, in exchange for receiver fees. With the recent opening of the competing plant, this fee has been pushed down, and some municipalities that used to send their waste off to the plant in City X have now decided to send it to the competitor, because their the fee is lower.

What is food waste transformed into here? First, the biogas plant made profit on collecting and treating the waste, and transformed it into, and made profit on, biogas and fertilizer. This profit, in turn, was used to expand the plant and increase its capacity. Now, as the region is seeing new actors competing for the same raw material, the biogas plant faces a different situation altogether. Anna, who works for an organization that advises interested actors on renewable fuels in City X, commented in an interview on the current developments in the region as follows

> It is easier for large-scale plants to make ends meet and if there are too many actors on the market and food waste is the only raw material that can be used to generate revenue then that is far from an optimal situation. Food waste can be transported, and the competition increases because of its transportability [. . .] The problem right now, in this region, is that there are too many biogas plants that need and want food waste. (interview with Anna, biogas advisor)

If the current situation endures, the fee will be replaced by a cost for the plant in City X. This shift – from unwanted waste collected and treated in exchange for a receiver fee to a precious good that has a price tag – plays straight into the waste as resource discourse, embraced and endorsed by waste management organizations and proponents of the CE. In this configuration, food waste is made to be something over which competing waste management actors struggle because of the value associated with it. In market terms, it is made to be a good – like any other – that actors on the market wish to procure. It is indeed no longer *waste* but instead an input and a raw material with a price tag. Configuring food waste as such, creates a local and regional economy, a market, where the logic of supply and demand turns discarded food into a valuable and desired good.

Competition over discarded materials between different actors is not problematic in itself. The practice of dumpster diving, for example, which entails looking for foods in dumpsters outside supermarkets may be viewed in terms of competition (Lehtonen and Pyyhtinen 2020) (Abrahamsson 2019). But whereas the dumpster diver is often motivated by the promise of a potential free meal, competition between biogas plants involves not only the creation of costly and largescale waste management infrastructures – it also creates a demand for more food waste. In the 'waste

economy' that is hence created there is no such thing as 'too much' waste (Kinnunen et al. 2020).

Making green fuel

At the biogas plant in City X, and across Sweden, food waste gets enacted as a raw material, a potent and necessary input without which the production of biogas would come to an abrupt halt. Without the biogas, city buses that currently run on said gas would also come to a standstill. Hopes are that the current competition, and the subsequent fall in fees, will subside when the new – more ambitious – waste collection policies are realized. To get there, infrastructure needs to be put in place, and efforts to increase the amount of collected food waste need to be made.

In order to make households aware of and comply with food waste policies waste management organizations make use of campaigns. Next to expectations about increased compliance and awareness, the long-term aim of such campaigns is also to tap in to all the currently unused food waste that gets sorted in the wrong bins (cf. Wallsten and Krook 2016). Campaigns get advertised online, in leaflets, on city buses, or on advertisement spaces in cities. There are different versions of such campaigns but the ones we have encountered during this project all configure wasted foods as a resource (Holmberg and Ideland 2021). They do so by explicitly downplaying 'waste' and highlighting fuel. Here is an example of such a campaign.

The campaign is advertised on a board in City X, Sweden, in the spring of 2020. Big black letters read 'thank you for the bus fuel!' Below the print is of a brown paper bag filled with banana peel, the head of a pineapple, sweet pepper and some lettuce. Two logos are printed on the bag: one is for the municipal waste management organization and the other for the regional public transport organization. In the setting where the advertisement is produced, food waste is sorted and binned by households, and waste management organizations collect this and transform it into biogas. This biogas is used to fuel city buses. In this very specific setting, food waste may be configured as a gift – something that is offered and valued, albeit differently, by all parties. It is also in this very specific setting that the makers of the advertisement can get away with saying thank you for one thing (bus fuel) and presenting a photograph of something else (food waste). For someone not yet convinced, the small print in the poster explains the details: 'your food waste becomes fossil free biogas that runs the buses in city X.' Here, food waste is not a good to be sold but is instead presented as a gift; a gift with the potential of giving back fossil free fuel to keep public transports running.

This strong association between biogas and bus fuel is not coincidental. Ever since food waste collection was made compulsory in City X, the biogas producer and the public transport organization have had tight and continuous collaborations to ensure that investments in transport infrastructure and biogas vehicles is matched by efforts to produce, and availability in gas. In an analysis of the biogas market in the south of Sweden, Corvellec regards the alliance thus created between food transformed into biogas and the promise of mobility as exemplary of our times when he suggests that:

> the transformation of food waste into biogas binds two objects of gluttony – food and mobility – back to back. Food, which can be considered a proxy for life, feeds mobility, which one could call another proxy for life. (Corvellec 2014, 155)

With the recent introduction and subsequent expansion of electrified vehicles in City X there is, however, potential future decline in the demand for biogas to run public transport. When asked about the future for biogas in City X, Anna, who was quoted above, expressed concerns about the potential ensuing tensions:

> There is clear interest in increased electrification in public transport, especially in inner cities where most buses today run on biogas. There is also clear competition between biogas and electricity [. . .] We think that there are many valid points in electrification: health, emission, noise. And there are also limits to how much biofuels we can produce, so yes, electrifying public transport is wise. (interview with Anna, biogas advisor)

Commenting on the plans for City X's public transport, Anna added that the city intends to switch biogas buses to regional traffic and that

> buses that run on biogas work better, in terms of the technology, in regional traffic where there are less bus stops, and less interruptions, making them more resource efficient. (interview with Anna, biogas advisor)

A couple of hours' drive from City X, in City Y, the problem is not that biogas vehicles get replaced by electric vehicles. Instead, the problem that the biogas plant in City Y is facing is that there is a lack in demand for and, hence, an excess production of biogas. City Y has had these problems ever since they started producing biogas a couple of years ago. Big investments in both infrastructure and a sorting system for the city were not matched by investments in buses. During an interview with an engineer at the biogas plant the challenge was articulated in the following way:

> now that we have begun with the production process, we must find an outlet for a substantial volume of biogas. To make this work, economically, we have a lot to do in a short amount of time. It takes a lot of time for businesses to convert to gas. We are currently building a gas station, but the process has taken 4-5 years due to administrative and legal issues (interview with Arvid, engineer)

Here, the situation is opposite to the one in City X. There is not only excess of food waste, but also excess of biogas. Rather than producing a highly valued green fuel, the biogas plant generates excessive and – in this particular setting where there is no possibility to use it – useless gas that has to be burnt. These two examples – the threat from competing fuels and the lack of infrastructure and outlets – point to the fragile and uncertain conditions under which current biogas production operates. But the examples also illustrate that despite efforts to treat food waste as a resource, the outcome of all endeavors to create value, may end up being unsuccessful. Rather than creating a CE, wherein wastes are taken care of and reinjected into the economy and society, wasting has merely been postponed, finding its outlet in the burning of biogas.

Repairing soils

Swedish waste management organizations are eager to advertise biogas in their campaigns about food waste recycling. By contrast, the remainder of the biogas production process, bio fertilizers, are rarely made public. A reason that was mentioned to us is that bringing in fertilizers makes the message to complex. Another reason is the target audience for most campaigns, i.e. people living in cities. While bio fertilizers get acknowledged as important to continued food production internally, biogas production gets all the attention in the public domain. The communication officer responsible for the campaign in city X phrased it in the following manner during an interview, when commenting on the absence of bio fertilizers in the campaign:

> We talk about bio fertilizer as a byproduct for biogas production. So the primary product is biogas and the byproduct is bio fertilizer. We try to be clear that the bio fertilizer is used on local farmlands, that it becomes fertilizer for new food. So there is an ambition to promote this circularity, too. But contrary to the biogas, the fertilizer is not prioritized. (interview with Erik, communication officer)

A big difference between biogas and bio fertilizer is that whereas there is profit to be made from biogas, there is hardly any money to be made from bio fertilizer. The biogas plant in City X sells fertilizer to nearby farms but also pays for the transport, making the transaction a zero-sum game. The value of the bio fertilizer, then, lies elsewhere. In an interview, Jonas who is also an engineer working at the biogas plant in City X, articulated the value in terms of nutrients and elements vital to the soil:

> Yes, there is a lot of focus on biogas, but what gets lost in this is the reintroduction of nutrients to farmlands. If we do not take care of the nitrogen, the phosphorus, and the potassium – that which we call nutrients in the food waste – and return it to the farmlands, we might just as well close down the plant. (interview with Jonas, engineer)

Adding a host of selected anaerobic bacteria to the slurry, digestion chambers at biogas plants produce methane and CO2. What remains is a fertilizer that is rich in nutrients and vital elements. Internally, however, this remainder is not a remainder, but instead gets articulated as the very raison d'être for food waste treatment. The dominant value here is environmental, rather than economic. Swedish bio fertilizer is a certified product, which means its quality gets assured by *Avfall Sverige*, the national waste management association in Sweden. The quality assessment is meant to assure the potential users of the fertilizer that the fertilizer is not contaminated, that it does not contain too much methane, and that the production chain, from raw material to finished product, has been scrutinized and is transparent.

With the words of Puig de la Bellacasa, we could call this a mode of soil care (Puig de la Bellacasa 2015). Soils, she suggests, a vital component of food, and by extension of life, are increasingly at risk. To avert agricultural and food crises, different forms of soil care need to be cultivated. And indeed, food production is notoriously costly not only in economic terms, but also in terms of resources. A recurring topic in anti-wasting campaigns emphasizes the double wastage of food waste, highlighting the resources that get folded into food and get wasted. In this context, the production and use of bio fertilizers is meant to recover unused resources and reintroduce them in the soils. In the region of City X, however, there are specific problems, as Anders explained:

> Nitrogen and phosphorous is problematic in this region, where we have a lot of grain farms. What usually happens is they just add more and more mineral fertilizer which means there is a depletion of the soils. But if you introduce the bio fertilizer you get back some of these organic substances, nitrogen and phosphorous. The phosphorous we use in the mineral fertilizer today is extracted in mines, so that is actually a fossil product. (interview with Anders, engineer)

In the story told about bio fertilizers, food waste gets enacted in terms of its capacity to feed the farmlands and, by extension, to work as a fuel for continued food production. Just as biogas gets enacted as a good, sustainable alternative through juxtaposition with traditional fossil fuels, the valuation of bio fertilizers is done in relation to a less good alternative: mineral fertilizer. What gets lost in this transformation, however, is that which motivates the creation of bio fertilizer; namely the use of mineral fertilizer on the one hand, and the excessive production of foods on the other hand.

Things could be otherwise

Municipal food waste management in Sweden is successful both in associating food waste with values and transforming it into new valuable products. Many of our informants welcome the transition to a CE, but many of them also caution about the risks with creating a demand for food waste. They hesitate: on the one hand they take pride in their work and do the best with what they have got. On the other hand, they express concern over the increasing amounts of waste they process. Through all efforts to create efficient, reliable and stable practices of municipal food waste management, recycling gets stabilized while alternative solutions – food sharing, composting, food donations, reduced production and consumption etc. – get sidelined. From the point of view of the biogas plant, such solutions would interfere with and upset the creation of biogas. In this section I shift and analyze stories from fieldwork that resist and complicate this ambition to treat waste as a resource. These stories, I suggest, do not necessarily undermine the current state of affairs but point instead to the possibility of acting and thinking differently. As such they point to the potentiality that the current organization of food waste in Sweden could be otherwise (cf. Woolgar and Lezaun 2013).

Parallel to the incentives to re-appropriate waste as a resource there is also, at the policy level, the ambition to reduce and minimize waste. The European Waste Hierarchy is an attempt to rank the desirability of practices of production, consumption and disposal from least desirable to most desirable in terms of 'ecological, economic and social benefits' (Hultman and Corvellec 2012, 2414: 2414). At the top of this hierarchy is prevention, which is followed by re-use, recycling, recovery and disposal. Hence, as one of our informants in City Y, Ingrid, phrased it, 'the best waste is the waste that *never is*' (Interview with Ingrid, communication officer). Prevention, however, is not the focus of the waste management organization where Ingrid works. As she recalls during our interview:

> When I began working here we talked a lot about reuse and reduction. We had a leaflet with tips and tricks for households. And it is very important to talk about those parts of the waste hierarchy. But these last years I think we have taken a couple of steps back on this hierarchy. Now we focus almost exclusively on sorting waste for recycling. Because that is where most people are. So in my work, when communicating to our clients, I have stepped down in the waste hierarchy. (interview with Ingrid, communications officer)

What sets prevention apart from recycling is the recognition that waste, while it may be 'upcycled' as a resource in a production process, is wasteful in itself. As the stories from City X and City Y above suggest, municipal recycling is not an antidote to waste. To successfully transform food waste into a resource infrastructure needs to be put in place. Next to this, the input and raw materials used for producing biogas need to match the demand. To achieve circularity, recycling infrastructure creates a demand both for that which gets recycled and the output that recycling generates (Gille 2012). Solving the problem with waste by recycling rather than preventing it, is in this sense an example of an infrastructural 'lock-in' whereby the creation of waste treatment plants normalizes waste (Corvellec, Zapata Campos, and Zapata 2013). In various ways all informants offered stories similar to Ingrid's above: that the dominance and stabilization of recycling practices easily sidelines other practices. Thus, the establishment of recycling practices and infrastructures make it increasingly difficult to act differently. Even stronger: while waste management organizations get backed up by governmental funding to recycle food waste into biogas, the difficult yet important task of preventing waste is left to individual actors to sort out.

Josef, a communications officer at the regional waste management company that we interviewed in City Y, phrased recycling in terms of 'less bad' than landfilling.

> It is great that food waste can be turned into biogas, to be used for vehicles instead of using fossil fuels. However, research suggests that it is ten times better that food does not go to waste. But somehow we have a society, today, where we are willing to give a brown paper bag and a brown plastic holder to all households, build a special garbage truck and a pretreatment facility that makes a slurry, and a biogas production facility that makes biogas and fertilizer out of the slurry. All of this in order to reach this thing that is ten times worse than not generating food waste to begin with. (interview with Josef, communications officer)

Rather than addressing the problem with excess, Josef suggests, recycling takes a shortcut to achieve a cosmetic solution. Bio fertilizers get distributed to farms to return organic substances to depleted soils. Soils that are depleted because of intensive farming. In City X more discarded foods are needed so that prices do not drop. In City Y by contrast, more buses need to be built and bought to match the gas production.

What sets these stories apart from those in the previous sections is that they offer resistance to the transformative logic of recycling materials. They question the internal logic of waste management as resource creation. The space for thinking differently that these stories variously shape articulate the *wastefulness* of discarded food, irrespective of their potential value. They slow down the transformative logic of the CE of municipal waste management that stipulates that discards and organic materiality is destined to become revalued and reenacted as resources. And as such, I contend, they conjure a valuable lesson to waste studies: a focus on

transformation, mutability and fluidity risks obscuring the loss of value and the wastefulness that precedes the creation of something new. More specifically: these stories caution that successful transformations of materiality do not necessitate a successful outcome.

Discussion

Academic engagement with the CE has demonstrated that it is an ambiguous term in theory, and that in practice the CE is often less than what it promises. While some (e.g. Thakali and MacRae (2021)) advocate 'fixing' the problems with the CE through regulations, information and campaign work or technological intervention, this article has explored a hesitation toward the premises of the CE and a municipal food waste CE tout court. This hesitation contends that waste is wasteful, and not valuable. Hence, it 'defends' waste against the particular 'solution' that has been invented for it through the CE. Municipal food waste recycling is a provisional, historically, and geographically situated 'solution' to two related concerns. One is the growing awareness of the energy, resources and money that go to waste when food that is produced for human consumption ends up being discarded. This happens while soils are getting depleted due both to exploitation of resources, and excessive production of foods. It also happens while a growing number of people face hunger and malnutrition. The second concern is the realization that organic wastes may be enacted as potent and valuable raw materials, used in the production of 'sustainable' energy and valuable resources. To create this alliance between wastes and 'sustainability', household, restaurants, waste management industries, bacteria, bus manufacturers, engineers, and a host of other actors need to work together. An effect of said alliance is that wastes get enacted not in terms of a loss of value, but as a resource that is generative of economic and environmental values. The concern that our informants voiced and that I want to echo here is that food waste recycling also effectively short-circuits interventions that aim at reducing waste. By organizing food waste as recyclable matter and stabilizing this through largescale infrastructures, alternatives are left out. There are at least three problems with this.

First, food recycling is put in place to achieve something valuable, sustainable and good. The alternatives against which this is configured as good (e.g. incineration or landfill) implies either the loss of potential value through incineration or emission of methane in landfills. But both these alternatives take waste as a given. The alternative to recycling is not necessarily landfill or incineration but, as our informants as well as the European Waste Hierarchy suggest, reduction. The time, money and effort spent in creating infrastructures and practices that transform organic waste as recyclable make other solutions absent. Secondly, current municipal waste management in Sweden requires large investments over long periods of time. The infrastructure is not only costly, but also immutable. This means that it is both fragile and inflexible with regard to potential policy and legislative changes and unforeseen events, such as food shortage. Thirdly, to the extent that waste research highlights the mutability, transformation, fluidity of value, there is a risk that it overlooks other alternatives. Through detailed empirical work on specific materials, waste studies has made very clear that waste is not an end point. Things that have no value here and today get second lives and new value elsewhere or later. This is a valuable and important lesson. But as I have shown through this specific case, an emphasis on value as relational and situated risks making the wastefulness of waste absent, while making it increasingly difficult to think, let alone act, differently.

Notes

1. The research team included four other researchers – Tora Holmberg, Malin Ideland, Björn Wallsten and CF Helgesson.
2. No ethics review was deemed necessary by the ethics board. All informants have given their informed consent to participate in the study. They have also been anonymized using pseudonyms, and the three cities have been given the names X, Y and Z.

Acknowledgement

I am grateful to Tora Holmberg, Malin Ideland and Björn Wallsten for generously thinking along through the concerns addressed here. Thanks also to Katja de Vries for commenting on the numerous iterations of the text. Finally, I am deeply grateful to the informants who shared their stories about their work, and to the three anonymous reviewers and their generous feedback on previous versions.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Vetenskapsrådet [DNR 2017-02142].

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