

Towards A Circular Economy of Proximity? Variable-Geometry Spatiality of Urban Mining



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Abstract

The proximity principle is one of the main obligations in European regulations regarding waste management. However, this principle is not really implemented because it is not well defined in the law. Proximity is also linked to the new consensual concept of the circular economy, which highlights the local scale. The objective of this text is to understand the implementation of the proximity principle in the concept of the circular economy depending on waste management channels. The methodology is based on an analysis of the urban metabolism of three French cities and in-person interviews with stakeholders of waste management. The result of this research shows that the implementation of proximity is quite complex and affected by the principle of “variable geometry” depending on the types of waste. Some are managed at the local scale, such as putrescible and fermentable waste, bulky refuse, and final waste. Others, however, are transported elsewhere (e.g., waste with high added value or hazardous waste). We aim to identify the criteria that determine these geographical issues. The diversity of situations in each of these case studies provides the opportunity to better understand the geographical scale of implementation of a circular economy and to identify the sources of urban mining through recyclable materials.

Keywords: Waste channels; Local scales; Urban metabolism; Waste geography; Proximity; Territories

Introduction: Proximity as an Initial Hypothesis

Objective

The circular economy is a concept that is increasingly more prevalent today in the public debate, politics and the business community. And yet, it has no scientific definition. Since it is currently the subject of public policies and lobbying by federations and business clubs, its outline would deserve more precise delimitation [1-3]. Among the questions that this concept raises, there is that of the scale of its application. At what regional scale should a circular economy be established? Does the circulation of a recyclable material around the planet (which, until proven otherwise, is spherical) fall within the framework of a circular economy? Or, on the contrary, is this circular economy, by definition, one of “proximity”? Like the hierarchy principle has a new sense in the circular economy European framework [4], the proximity principle must be defined in this new policy. The purpose of this text is to understand how current waste management and recycling channels in France incorporate a legal principle established since 1992, that of the obligation of

proximity management. The objective is to build a typology of spatial scale of management according to waste categories.

While the principle of proximity is a legal obligation in terms of waste management, its application is more complex and with a variable geometry scale of application. Since the 19th century, waste management has followed an initially hygienist logic [5], namely, to avoid the exporting of environmental nuisances and to limit transportation, sources of potential hazards. Today, justifying proximity is much more multifactorial, involving a “tangle of several types of logic: political, administrative, geographical, economic, legal, organizational and practical” [6]. Many authors thus highlight the very strong proximity that waste management can induce, whether through decentralized technological modalities of waste management [7], or through the disengagement of public stakeholders and the increased responsibility of citizens [8]. However, our field study shows that in reality, large waste disposal infrastructures (without recovery, or simply energy) are often the ones that allow the greatest respect of this principle of proximity (sometimes contradictory with the

hierarchy principle of treatment methods [4]. The technical issues are then strongly intertwined with social and political issues [9].

Notion of proximity in waste management in France

Taking proximity into account in material flows [10,11] seems to be gaining in importance with the affirmation of new social and environmental issues [12]. The new dynamics of setting up short food circuits [13] make it possible to insist on the concept of proximity in the flow of materials. Regarding waste, local actors look kindly on this approach like a “self-reliant city” [14]. On the one hand, it allows for limiting the potentially negative impact of waste on their environment (limitation of the transportation of materials presenting a potential health risk, of greenhouse gas emissions and of the need for raw materials, etc.). On the other hand, the socio-economic revival of the region and the creation of local jobs are always more sought-after. In fact, it is not only a matter of treating waste on a local scale, but also of encouraging the development of industrial and agricultural activities close to cities in order to transform and use these recycled materials, referred to as “secondary raw materials” or “urban raw materials” [15]. The city thus once again becomes a provider of resources. A better consideration of the notion of “proximity” in the use of materials thus represents a sustainability issue for the city [16,17].

Since the 1990s, waste management policy in France has advocated a rapprochement between waste production and waste treatment regions, in the name of the principle of proximity. This principle is a major element of the territorialization process of this waste management policy. It first appeared in the Waste Act no. 92-646 of 1992 with the objective of limiting the transportation of waste and its inherent risks. It was reaffirmed at the regional level in the law no. 991 of 2015. Each region “must benefit from strong regional autonomy in terms of treatment facilities. ‘Waste tourism’, whether cross-border or national and often denounced at international level, should therefore be an exception to the rule” [18]. In addition to the environmental aspects, invoking the principle of proximity also makes it possible to define “a territory of belonging, and thus implicitly a territory of acceptance of the nuisances resulting from the elimination of ‘our’ waste” [19]. It is then a question of making citizens responsible for the management of their waste, proximity allowing for taking ownership of the problem [20]. In recent years, waste has started to once again be seen as a resource rather than just an environmental nuisance [21]. Proximity management thus makes it possible, via recycling channels, to reinject into the local economy the waste produced in the region.

Currently, proximity is not clearly defined in French law. The 2008 European Directive on waste states the following: “The network shall enable waste to be disposed of or waste referred to in paragraph 1 to be recovered in one of the nearest appropriate installations” (Directive 2008/98/EC, Article 16). Article L541-1 of the French Environmental Code states that it is necessary to “organize the transportation of waste and to limit it in both

distance and volume”. No information is therefore given on the regional scale to which this principle applies [20]. Lastly, the Extended Producer Responsibility (EPR) schemes, organized by professionals and no longer by local authorities, take little account of the principle of proximity [21]. EPR organizations are often not concerned by this spatial and social issue. They formalize contracts with logistics and waste treatment providers who are chosen only according to such criteria as compliance with regulations and costs of transportation and treatment. The channels are therefore organized around large treatment centers that are not linked to the planning scales, and do not take regional specificities into account.

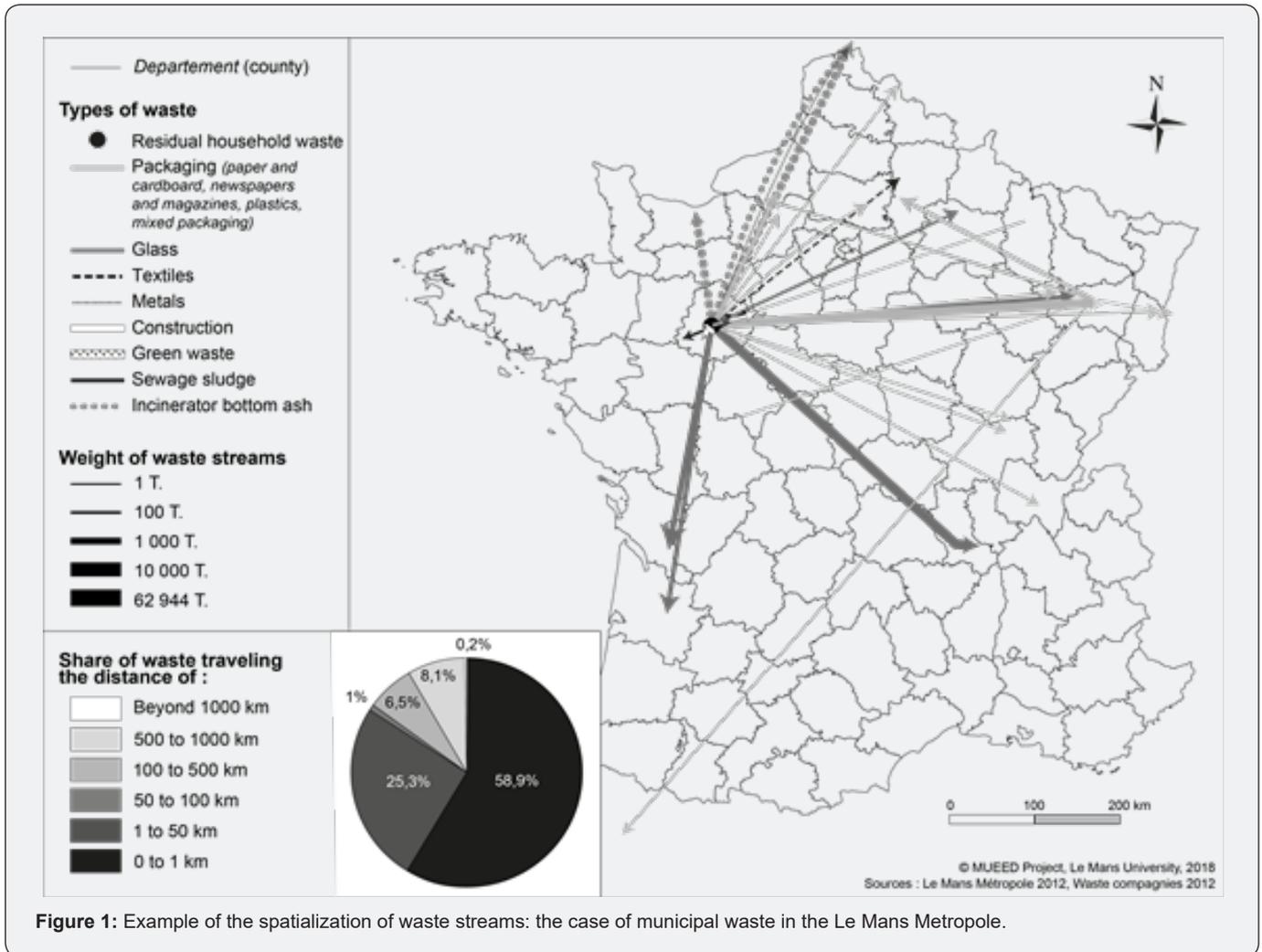
Material and Methods: Measuring the Principle of Proximity

Methodology to identify the territorialization of waste management

Identifying the application of the principle of proximity in waste management requires the implementation of a new methodology of waste streams spatialization, in order to understand spatial logics and identify several channels responding to distinct regional logics (more details about this methodology in Durand & al. [22]). To measure the application of the principle of proximity, we developed several steps.

a) The first is to identify and spatialize (map their destination) the waste streams leaving from three areas studied: cities of Rennes and Le Mans, and the SIETREM (association of municipalities in charge of collecting and treating household waste – Intercommunal Union for the Collection and Treatment of Household Waste). We included municipal waste with an easy access to data. Concerning business waste, the quantitative data available are much more limited, due to the absence of a structured database. We identified 75 types of municipal and business waste, as well as 561 different waste streams (summarized in Figure 1 for municipal wastes of the city of Le Mans). Without structured databases on an urban scale, these data had to be collected directly from stakeholders in studied territories.

b) The second approach aimed to render these quantitative results coherent with a more qualitative analysis: how is proximity viewed in public policies and in the practices of the actors in the field of waste? We conducted 52 interviews with local authorities, recycling and waste collection companies and organizations in charge of the EPR schemes management. Between 10 (Le Mans) and 15 (Rennes) interviews have been done for each of the three study territories, 3 interviews with regional waste observatories in other regions and 10 interviews with national stakeholders. 36% of these interviews were carried out with public stakeholders, 31% with private companies and 33% with associative structures (eco-organizations which manage the EPR streams, and waste recovery associations). The aim was to understand their vision of applying proximity, according to each type of waste.



Spatialization of waste streams to measure the proximity

The intersection of these two approaches engendered a reflection on coherence between the actual flows of waste, the obligation to apply the principle of proximity, and the possibilities of orientation for the choices of outlets. This methodology has been applied in three territories, chosen on the one hand, for their common population characteristics (equivalent to an average city), and on the other for having an administrative institution in charge of waste management on the other. Le Mans and Rennes are two intermediate cities in the West of France, while the SIETREM is located in the east of Ile-de-France (the region of Paris). In 2012, they had populations of 184,446 (Le Mans), 290,684 (SIETREM) and 414,149 (Rennes) inhabitants (INSEE, 2012). These figures relate to the political and administrative entities, known as the “Urban Community of Le Mans Metropolis” (Communauté Urbaine de Le Mans Métropole), the “Agglomeration Community of Rennes Metropole” (Communauté d’Agglomération de Rennes Métropole) and the “Intercommunal Syndicate for Removal and Treatment

of Household Waste” (Syndicat Intercommunal d’Enlèvement et de Traitement des Ordures Ménagères - SIETREM) which brings together several towns. The first approach (spatialization of waste streams) of this investigation was realized in the scale of these three territories, but the second approach (the interviews) was done both with actors of these territories and with national stakeholders of waste management. The three research teams were also based in these three cities, providing a historical view of waste streams management and strong interactions with local stakeholders (Figure 2).

The implementation of the spatial waste streams [23] made it possible to map the flows at the scale of the cities studied. This spatial approach (Figure 1) shows that while some waste travels far to be treated (at national and even international levels), the largest volumes are managed at the local level (some 75% of household waste managed in the department of its production). This figure illustrates spatialization of waste stream and data base which were used.

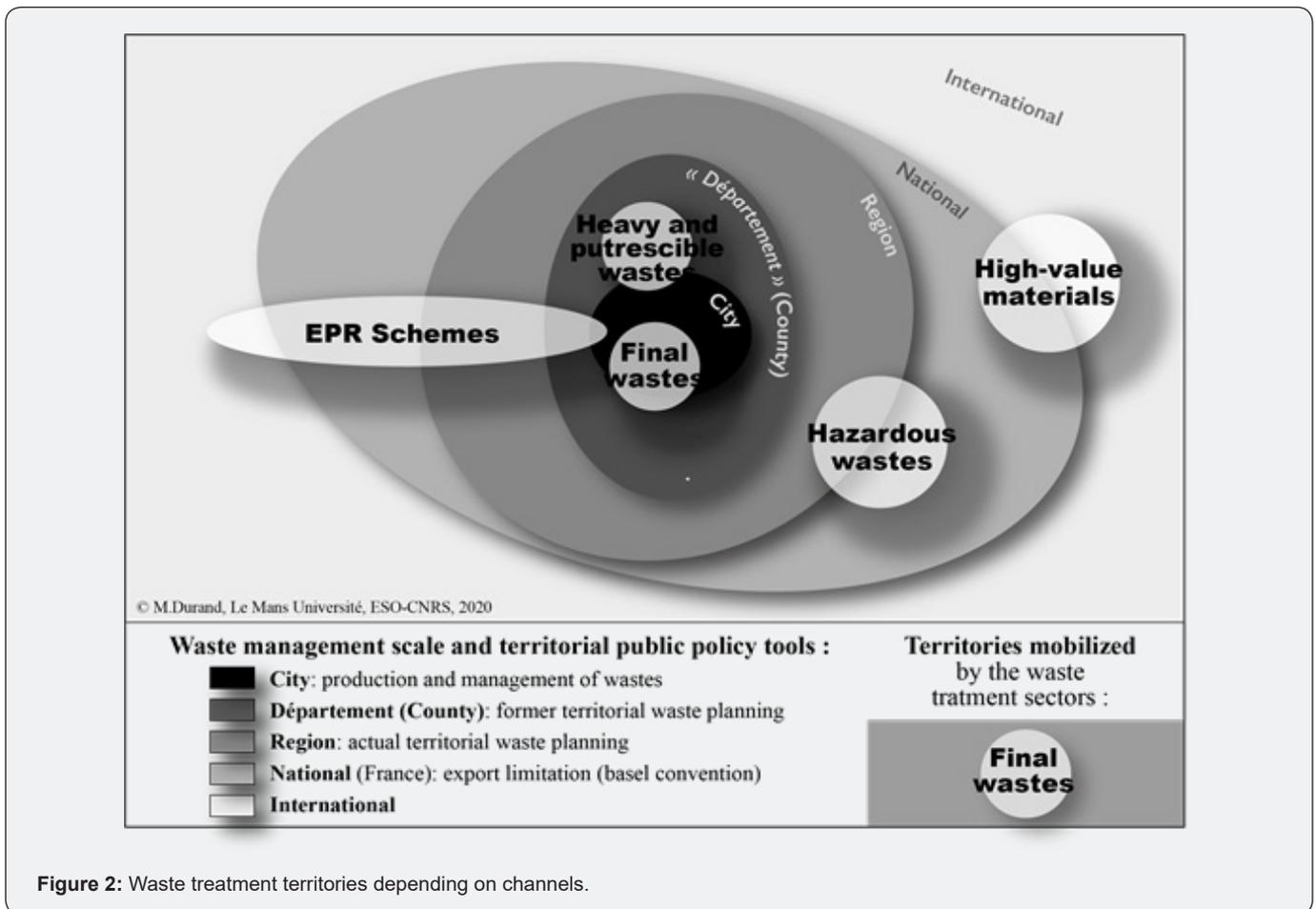


Figure 2: Waste treatment territories depending on channels.

Results and Discussion: Spatial Criteria for the Management of Channels

The methodology developed allowed for identifying the principal categories of waste, within which spatial logics were similar and comparable. This categorization was therefore based on the spatialization of the actual streams (an example is given in the previous section), as well as on the interviews that made it possible to understand the approach of proximity concept by each stakeholder. In order to analyse these results, the different sectors were grouped according to major typologies having the same characteristics of spatial operation. Some categories of wastes are characterized by a close proximity management, while others travel much further.

High value waste: a global market

High added-value waste has a market value that implies global competition for its storage. It thus travels much further afield before being recycled and reused as recoverable materials. These types of waste include ferrous and non-ferrous metals, certain specific plastics, paper and cardboard, etc. They are part of the world market for recoverable raw materials, highly dependent on the prices of virgin materials and the industrial needs of

countries. When questioning recycling operators, several factors were identified as being predominant in the spatial trajectories of this waste. Upstream, it is necessary to be close to buyers and to have a sufficiently large catchment area. Downstream, the buy-back cost is the only structuring criterion.

Priority for the buy-back cost of materials

The waste professionals emphasized the need for economies of scale and transport consolidation, in order to increasingly use the most advanced recycling technologies while making the best possible profit: "The main criterion in choosing a buyer is economic viability, nothing more" (Sorting Centre Director, 2014). The cost of transportation is marginal compared with the gains made on the resale of these products. Proximity for this kind of product is therefore at the very least on a European scale.

The operators interviewed often mentioned the case of China, described as a vacuum for recoverable materials. China was, until its refusal of badly sorted waste in 2017, the world's largest consumer of raw materials, allowing it to consolidate its growth and feed its industries. The question of the territorialized need for raw (or recoverable) materials is thus important within a European context that has largely outsourced its production of

manufactured goods. It would seem that France and Europe do not need so much in the way of recoverable materials, because, for example “the French market produces a surplus of recycled paper and many books are printed in China” (Recycling Centre Director, 2014). Thus, according to this same Recycling Centre Director, any attempt to relocate the recycling of paper and cardboard would be in vain: “This notion of proximity, or rather this absence of proximity today, can be linked to two things: Who are the consumers? And who are the manufacturers? Today China is a major manufacturer [...] As such, a short circuit cannot exist” (2014). The des-industrialization of developed economies shows secondary materials (and so recycling industry) go to production sites [24]. This role of industrial recycler for all the world has been partly taken over by other Asian countries since 2017.

Difficulties in managing the entire chain in all of the regions

While this waste can indeed represent resources for local communities and providers, many industrial and financial difficulties exist in the management of the channels and of regional constraints. Technical constraints also exist, requiring separation into numerous sub-categories of waste in order to send them to the most appropriate (recycling) outlet possible. This situation generates “great instability among recycling companies” (Waste Collection Company Director, 2015). The sectors are thus structured into small sub-categories (several types of plastics or metals, etc.), each aiming to benefit from a source that is sufficiently large to obtain a critical mass enabling the infrastructures to function. This multitude of very specialized channels “does not offer a large choice in buyers, and proximity is therefore not part of the criteria in this rather uncompetitive market” (Sorting Centre Director, 2014).

One of the obstacles is the geographic specialization of the industries concerned. For example, France exports some categories of paper (notably low quality) and imports others: “There is a logic of regional specialization in Europe. In France we export newsprint paper and import magazine paper” (EPR organization Director, 2014). There are no strategies for controlling channels in the regions, as highly specialized industries are few in number. The sector cannot be structured locally because, where metals are concerned, for example, “there are five iron and steel groups in Europe, so this is our minimum scale” (Waste Collection Company Director, 2015). Thus, the port of Le Havre is an opportunity for western France: “The western regions have a major advantage, namely the coastline for shipping. We use the port of Le Havre” (Treatment Centre Director, 2014).

Heavy and putrescible waste: constraints that impose proximity

Heavy and fermentable waste are benefitting from the greatest proximity in their management. This can be explained either by their weight, making their transportation expensive (construction

waste in particular), or by their rapid organic degradation that does not allow for transporting them over long distances (green waste, food waste, sewage sludge). Their management, which is essentially local, can therefore be explained by high costs and complex transportation conditions. Heavy and fermentable waste do not have a high added value, since they compete with products that cost relatively little (chemical fertilizers, quarry materials, etc.) and are still relatively available (even if some building materials such as sand or gypsum are tending to become scarce). It is therefore important to consider the best type of treatment for waste of this nature (elimination or recovery), because this will greatly influence the location of the outlets.

When transportation costs create forced proximity

Construction waste, despite receiving increasing attention from the public authorities, remains among the least recovered. As it presents no immediate risk (since largely inert), its elimination has always been considered less urgent. However, due to the enormous part that it represents (72% of the 345 million tonnes of waste produced in France, ADEME, 2015), combined with the growing difficulty of extracting natural resources to produce building materials, it is becoming increasingly necessary for all of the actors to reflect on how this waste could be recovered or recycled. Expensive to be transported, it can thus be eliminated or recovered only within a relatively close radius. For construction waste, “the sector generally has a radius covering at most 50km. If we increase the distance, prices explode. The further we go, the less profitable it becomes” (Treatment Centre Director, 2014). To try to overcome this difficulty, construction waste treatment centres are positioning themselves in a logic of “geographical diversification of facilities” (Treatment Centre Director, 2017) in order to ensure the greatest level of proximity as possible to the source. The catchment area of these low-cost materials is thus restricted.

The difficulty in finding local outlets

Despite the difficulty of moving heavy and putrescible waste, an obvious local outlet for recovering it does not always exist. The low transportation possibilities strongly restrict the recovery possibilities. The constrained proximity is here experienced as a loss of potential. Thus, the reuse of construction waste is not profitable compared to materials taken from quarries. This is notably the case in the Brittany region where quarries are particularly numerous and where recycling costs more than the extraction of raw materials (ADEME Engineer, 2014). In the Île-de-France (Paris) region, however, it is no longer possible to meet the requirements of a very intense construction activity using extractions from the natural environment only, this environment being already largely urbanized. Recycling is thus proving to be a solution that needs to be urgently implemented, offering a rapid outlet for construction waste. It is within this context that the YPREMA recycling centre was created in 1984 on the territory of

the SIETREM (Joint Association for the Removal and Treatment of Household Waste) in Marne-la-Vallée (YPREMA Engineer, 2014). “Regional presence” is one of the priorities implemented by construction professionals to ensure the supply of materials, whether raw or recovery (Professional Federation, 2014).

The second major category of waste, managed in a constrained proximity and facing difficulties where outlets are concerned, is organic waste. Its main mode of recovery is the return to the land, serving as an organic amendment. The agronomic recovery of green waste poses no major difficulty, since it produces a compost of a quality that is relatively easy to sell (even if the economic terms of these sales can be very variable and more or less profitable). The drop in the price of oil, however, is creating greater tension in this market as it generates greater competition with chemical fertilizers. The difficulty is even more pronounced for sewage sludge, directly spread or composted before spreading. Farmers thus react in very variable ways depending on the fluctuating price of oil, preferring chemical inputs when the price is low and waiting impatiently for sewage sludge when this is not the case (Wastewater Treatment Plant Director, 2014). Some sludge suffers from a bad image, despite all the measures taken to improve its acceptability over the past decade. The search for quality waste requires the implementation of the principle of “quality territory” [25].

“Final” waste: mass and proximity elimination

Final waste is theoretically the only waste that can be disposed of without recovery, and thus can be buried in storage facilities. In the field, buried waste is far from being limited to final waste, since it represented in 2013 some 27% of the tonnage of municipal solid waste (ADEME, 2015).

The principle of hierarchy of waste treatment methods takes precedence over the principle of proximity

For decades, logic dictated the localization of these facilities as close as possible to production territories. Each city wanted its incinerator and each French department (like an English county) its landfill. Since the 1990s, there has been a decline in the number of waste disposal facilities in favour of technical and capacity improvements to existing installations. However, the cartographic results briefly evoked in the first part of this text show that waste that does not travel great distances is mostly buried or incinerated. These two methods, arriving last in the hierarchy of waste treatment methods, are thus the main vectors of the application of the principle of proximity. We can then wonder to what extent this proximity is beneficial to the region and the environment.

The criterion that justifies the choice of managers, and first and foremost local authorities, in the implementation of an outlet, is the official hierarchy of waste treatment methods. Although from a legal point of view this principle is placed on an equal footing with the proximity principle, “we will always

promote recovery at landfill, even if it is located further away. But we nevertheless try to keep our waste within the region” (Local Authority Representative, 2017). Respect for this hierarchy is therefore the basic element. Once this idea is integrated, it is important to note that landfilling and incineration are the main technologies that enable the proximity management of waste, especially for industrial waste: “Landfill is the only real proximity solution for our industrial waste” (Waste Collection Company Director, 2015).

Energy recovery: a proximity solution?

The data collected showed that, in the three cities studied (Rennes, Le Mans – Figure 1 - and SIETREM), around 50% of the waste was treated in the region of its production. This was mostly incinerated waste. This raises the question, regularly feeding the public debate, of the place of incineration in the hierarchy of waste treatment methods. Is energy recovery the only method of treatment that makes it possible to respect both the principle of hierarchy of the waste treatment methods and that of proximity? Or, on the contrary, is it a low-cost method of recovery compared to material recovery, which cannot be put on the same level as the principle of proximity? Here we will resume only the official hierarchy of treatment methods favouring material and organic recovery over energy recovery, itself a priority on disposal (landfill + incineration without recovery).

Beyond this aspect, energy recovery has the advantage of offering greater financial stability to operators in this field, non-dependent on large fluctuations in the prices of commodities. “The prices of raw materials fluctuate too much. Final waste is good: we are paid to treat it and, if we can recover or recycle it, well, that’s the icing on the cake” (Treatment Centre Director, 2015). The risk is then to see local actors promoting the modernization of their incinerator, judged to be more effective on the criterion of proximity, to the detriment of the highlighting of new channels of waste treatment and the construction of infrastructures targeting other types of recovery than materials. “One of the arguments of the SIETREM (Marne-la-Vallée) to explain the development of an increase in the capacity of the incinerator is to avoid the creation of additional installations when we already have local facilities” (Local Community Representative, 2014). This technology then makes it possible to develop cogeneration in order to optimize the links with the energy needs of the region, especially in highly urbanized areas.

Some actors note how the idea of “zero waste”, recently disseminated in France, has put the question of localism, around the needs for recovery and energy, back on the agenda. Energy recovery is thus seen to be the best way to benefit locally from waste. The priority of public actions should, according to a director of a waste treatment centre (2015), move towards the search for recovery that is done more locally in order to avoid any loss of resources for the region: “The question of zero waste is causing an upheaval at the moment. All this already exists, and we

really need to stop shooting down storage and incineration that are doing so much to help the situation! Some 80% of industrial waste is already recycled! It is sorting that must meet local needs for secondary raw materials and energy!". Here, there is here an apparent contradiction between the use of waste to produce energy, which always requires more waste, and the objective of zero waste who which on the contrary tries to reduce its quantities.

Hazardous waste: the necessary economies of scale for quality pollution control

A very limited number of treatments centers, despite the hazardous nature of the transportation stage

Hazardous waste treatment operators are fully aware that the structuring of a spatial logic is very weak in this sector. Due to their technical specificity, these centres seek to limit the cost of treatment by grouping waste. The overriding criteria are not spatial, but rather rely on technical efficiency that lowers the cost of treatment. The proximity of treatment is not an imperative either in the discourse of the local authorities, because, as a local community representative explained (2014), "Hazardous waste must not be managed locally". The lack of outlets inhibits any nearby treatment strategy.

Since there is little competition, the waste remains within the industrial groups that were the first to capture that market. Thus, some batches cross France from Le Mans to Lyon within the same company, because "there are no regulatory or planning constraints on the destination of waste in France" (Treatment Centre Operations Director, 2014). The lack of treatment facilities economically authorizes this expensive (and ultimately hazardous) transportation of such waste because it is covered by regulations on the transportation of hazardous materials. The grid of sorting and processing centres can be very large. For batteries, for example, there are "three sorting centres in France and eleven recycling centres in Europe" (EPR organization Director, 2014). The specificity of the treatment processes, different for each category of batteries, imposes structuring in geographically distant networks.

Building trust with customers, local residents and partners

In a context of mistrust with respect to hazardous waste, treatment companies must prove that they are commendable and trustworthy. They thus develop a discourse based on trust and advice. Some operators notably inform their customers of solutions to reduce the production of hazardous waste, even though they are paid to treat it. They aim to secure their market by establishing stable relationships via "a discourse built on trust and proximity" (Sorting/Reconditioning Centre Director, 2015). Sometimes, these companies do not pass contracts with their customers in order to avoid the fear of freezing a market.

Treatment facilities also need to build trust with local residents, who can quickly become an opposition force. One operator talked about "facilitating acceptance on the part of local

residents" (Treatment Centre Director, 2015), which shows the necessity of preparing a context that meets the conditions for constructive dialogue.

The structuring of new EPR scheme: inventing proximity

EPR, which governs these sectors, derives from the polluter pays principle. Thus, producers, manufacturers and distributors must financially and operationally organize the channels and the collection of the products they put on the market. These channels have existed since 1992 (for packaging), but currently concern more and more products such as Waste Electronic and Electrical Equipment (WEEE), End-of-Life Vehicles (ELV), used tires, etc. These schemes are all organized differently, but they share a common focus on products and not materials, requiring specific treatment, and on reflecting a favourable image for consumers and mobilizing the social and solidarity economy for waste sorting, with a different application in each European country [26].

A distance justified by the need for technological specialization

EPR schemes are end-of-life product treatment channels, which makes them more complex than traditional materials channels. Thus, geographical proximity is prevalent in dismantling and sorting, but the flows end up being transported far when the added value of the extracted materials is significant. For WEEE, our study sites show that this waste is systematically collected and sorted at the local level. But after this first treatment, "the complex elements of WEEE (memory boards, etc.) are treated worldwide, because very few facilities exist to treat them" (EPR organization Director, 2014). The specificity of the processes as well as the added value of the metals represent levers for exporting this waste outside national borders.

For each new EPR scheme, specific and effective treatment processes have to be invented. EPR on furniture waste requires facilities for recycling mattresses, but "there are fewer than 15,000 such facilities in France, so those who will manage to make secondary raw materials and isolate polyurethane foam or latex for mattresses will still require trucks that will have to cross France. It's obvious!" (Recycling Centre Director, 2014). The optimization of treatment processes therefore leads to longer treatment distances.

The structuring role of Extended Producer responsibility (EPR) Organizations: price and image first and foremost

The preponderant role of Extended Producer responsibility (EPR) Organizations: in the organization of waste channels is very badly received by companies. The first criticism levelled is related to the territorialization of markets by EPR organizations, i.e., the mechanism of sharing regions between them. It seems that this sharing is devoid of regional competition for WEEE since each EPR organization has focused on a part of France: "It is the weight of the EPR organizations that determines the map" (Recycling Centre

Director, 2014). Moreover, all of them have sought primarily to concentrate their action in the big cities, because “rural locations cost more” (Recycling Centre Director, 2014). EPR organizations must manage the entire chain in order to manage their image, and they thus impose significant constraints: “Our American customer pays close attention to the choice of recyclers, and requires full transparency in the waste treatment process” (WEEE Sorting Centre Director, 2014). Certain EPR organizations sometimes choose the recycling and recovery operators themselves after dismantling and crushing.

New competition for the social and solidarity economy: the territory at stake

With the structuring of the EPR schemes and the new economic profitability of the waste management concerned, new players are entering the market. All of the associations and companies, formerly active in the recycling of high value-added waste, are now seeking a place in the new EPR market. These sectors, such as packaging, textiles, furniture, etc., were traditionally the domain of the Social and Solidarity Economy (SSE). In the days when it was not profitable to work on these kinds of products, only charities and associations with a vocation of social insertion, without the goals of profitability or economic efficiency, could intervene in the sector. Today, SSE organizations are working on markets that have become more competitive. They are therefore in direct competition with traditional waste recovery and disposal companies, even threatening their very existence.

New forms of competition are emerging between insertion companies, vocational rehabilitation centres, and humanitarian associations. The selection is no longer done on the social dimension alone: “The criterion of insertion does not necessarily tip the balance in our favour since the large groups also have centres for disabled workers” (Integration Company Director, 2014). This competition notably unbalances the model of textile collection insertion companies, since the big suppliers “use the Red Cross, which collects and sorts textiles for free, on a volunteer basis, and easily negotiates prices since the work has already been done upstream by volunteers” (Integration Company Director, 2014). Even if humanitarian associations are not intended to create employment, as opposed to integration companies, they benefit from a social image that is useful to EPR organizations and large service providers. The latter exploit a social partnership with vocational rehabilitation centres and humanitarian associations, which cannot respond to calls for tenders from EPR organizations alone, to compete on the social dimension of integration companies.

Conclusion

The methodologies for identifying waste streams make it possible to analyse the implementation of the principle of proximity. While this text has only briefly presented the spatialized and quantified results of this study, it has focused on

qualitative analysis and the identification of a typology of waste channels. We can thus note that certain waste is for the most part managed locally (heavy, putrescible or final waste) being a potentially important local source of resources for urban mining, applying the proximity principle. Other types of waste are mainly managed further away (high value added waste or hazardous waste), in order to meet strong technological specifications. The correlation between the principle of proximity and that of the hierarchy of waste treatment methods can thus be discussed and « the circularity of waste in the economy is dependent on the nature and composition of waste” [4].

While we notice, in some cases, an opposition between the needs of local management on the one hand and those for a high level of recycling on the other, this corresponds to the construction of a socio-technical model inherited from waste management policies initiated in the early 1990s and questioning the relevance of the territorial scale of circular economy. The question then moves towards the constitution of new regional models for recovery of (secondary) materials, coherence between environmental and socio-economic stakes [27], and new modes of consumption aiming at stimulating a local metabolism. While recycling requires the significant transportation of waste, reuse allows exchanges of materials at the local level [28]. The region scale is thus at the heart of the challenges of the application of the principle of the circular economy. While this regional dimension is only very little considerate for the moment in the management of simple waste, enlargement to a broader concept (the circular economy) will probably put it back at the top of the agenda.

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