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Abstract

The importance of waste management has increased in the last decade. Resources are becoming scarcer and the need for a circular mindset has become prominent. We need to reduce the amount of waste, and reuse and recycle as much as possible. Plastic packaging waste is a substantial problem when it comes to waste management. It is often contaminated with food waste, and it is hard to sort and recycle due to mixed polymers.

Producer responsibility organisations (PRO) are important actors on the Norwegian waste market. They are financed by the producers and arrange for different waste fractions to be recycled. Municipalities are responsible that waste is collected, and they have coinciding interests with PROs as they reimburse them for the amount of packaging waste that is collected. There has been little to none research regarding how this relationship works and how they try to help each other improve. Therefore, we set out to explore and understand this relationship as well as the municipalities role as a supplier, to better understand how we can increase recycling and reach current targets.

We conducted a multiple case study where we interviewed the two operating PROs, as well as four municipalities or inter-municipal companies in eastern Norway. One important factor for choosing interview objects was their choice of collection system. The collection system is an important factor when it comes to the amount that is collected and sorted, so we wanted to see whether there were any relational differences between the systems.

The results were not too surprising, as we did not expect the relationship to be very important, however we were able to apply exiting B2B literature in this unique setting. There is no evidence to support that the relationships and roles significantly impact recycling or choice of system, but there is potential for closer relationships. Other than this, it was emergent that rules and regulations need to be improved and that sorting of food waste is of bigger importance than we first anticipated.

Key Words

Waste management, Communication, Relationship, B2B, recycling, Extended producer responsibility, EPR, Municipal solid waste, MSW, inter-municipal companies

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Jenny og Oscar
Oslo, June 2023

Contents

Master in business - Major in Supply Chain and Operations Management 1
Abstract 2
Contents ii
1.0 Introduction 1
1.1 Research justification 3
1.2 Research questions 4
2.0 Literature review: 5
2.1 Circular economy & Reverse logistics 5
2.2 Municipal Solid Waste (MSW) 7
2.3 Waste management 9
2.4 Systems and resources 11
2.5 Recycling behaviour 13
2.6 Extended producer responsibility (EPR) 14
2.7 Business relations (B2B) 17
3.0 Conceptual Framework 19
4.0 Research methodology 23
4.1 Research strategy 23
4.2 Research design 24
4.3 Data collection 25
4.3.1 Data protection 25
4.3.2 Primary data 26
4.3.3 Sample 29
4.3.4 Data collection timeline 30
4.3.5 Secondary data 31
4.4 Quality of research 31
4.5 Research considerations 33
5.0 Research context – MSW management in Norway 34
5.1 Municipalities role 35
5.2 Producer responsibility (EPR) and return companies (PROs) 36
5.2.1 Deposit refund system (DRS) 38
5.3 Composition of waste 39
6.0 Findings 40
6.1 Grønt Punkt / Plastretur 40

6.1.1 ROAF – Romerike avfallsforedling IKS 45
6.1.2 ØRAS – Øvre Romerike avfallsselskap IKS 53
6.1.3 RfD – Renovasjonsselskapet for Drammensregionen (IKS) 59
6.2 Norsirk 66
6.2.1 Municipality of Oslo – Renovasjon og gjenvinningsetaten (REG) 70
7. Discussion 77
7.1 Central sorting facilities 78
7.2 The issue with food waste 80
7.3 Increasing the quality by centralising decision making 81
7.4 Relationship & Commitment 82
7.5 Internalizing EU targets 85
7.6 Design for recycling 87
8. Conclusion 88
8.1 Limitations 89
8.2 Further research: 90
9. References 91
10. Appendix 98
Appendix A: Interview guide municipalities (English) 98
Appendix B: Interview guide PRO (English) 100
Appendix C: Interview guide Municipalities (Norwegian) 102
Appendix D: Interview guide PRO (Norwegian) 104

Tables and figures index:

Table 1: Municipalities with collection systems 27
Table 2: Criteria for interview with municipalities 28
Table 3: Data collection timeline 31
Table 4: Recycling requirements for return companies (Avfallsforskriften, 2004, §7-9a) 37

Figure 1: Models for Extended producer responsibility (Lindhqvist, 2000) 15
Figure 2: Conceptual framework 19
Figure 3: Waste composition in Oslo (residual, plastic and food waste) (Oslo Kommune, 2021) 39
Figure 4: Plastic packaging life cycle - Plastretur 41
Figure 5: Plastic packaging life cycle - ROAF 46
Figure 6: Plastic packaging life cycle - ØRAS 53
Figure 7: Plastic packaging life cycle - RfD 60
Figure 8: Plastic packaging life cycle - Oslo 71

1.0 Introduction

Waste management has gotten increasingly important over the years. Populations are growing and countries are getting wealthier leading to increased consumption and waste generation. By 2050, global waste generation is expected to grow to 46 billion tonnes, of which about 2.7 billion tonnes are Municipal Solid Waste (MSW) (Maalouf & Mavropoulos, 2022). Growing populations, altered lifestyles, and the creation and consumption of products made of less biodegradable materials have all contributed to the increase in waste generation. This has created a variety of challenges for municipal solid waste management (MSWM) in different cities across the world (Asese et al, 2009). The world is on a trajectory where waste generation will drastically outpace population growth by more than double by 2050 (Kaza et al., 2018). Another study reported that MSW is expected to grow at 26-45% between 2019 and 2050 (Maalouf & Mavropoulos, 2022). This is clearly grounds to say that the world needs to continue the move from a linear waste trajectory to recycling and a circular economy where waste is recovered and recycled instead of being disposed of.

As the world's resources are becoming scarcer and scarcer, the concept of circularity has become prominent, and the value of waste has increased. Businesses seek to find better and more sustainable sources of material, and recycled waste is one of the solutions. The demand for recycled material is becoming greater, and with it some quality demands. For recycling to be efficient, sorting processes must be of a high quality. The different fractions need to be clean, preferably mono-material and without too much contamination. Unless a lot of the waste will be lost in sorting and too hard to recycle in the end. Therefore, waste management companies (WMC) need to direct more focus towards achieving cleaner waste fractions and producers need to work towards products that are easier to sort and recycle.

Incorrect sorting from the households also leads to other issues, underlining the need for better sorting solutions. A recent news article from NRK explains how

waste facilities are experiencing troubles with fires starting due to incorrect recycling of batteries (Olsen & Damsgaard, 2023). This news article reflects the need for municipalities to implement better recycling practices to increase the quality of the waste.

In Norway municipalities are independently responsible for the collection of household waste, and by such they are also suppliers of recycled materials to the market. How the municipality chooses to solve this task and what practices they implement is up to themselves. More often than not they arrange this through inter-municipal companies (IKS). An article from Aftenposten explains how different waste management practices around Norway result in completely different amounts of plastic waste collected per capita (Bjørnestad, 2019). There are clear differences in Norwegian waste management. The different practices are made up by combinations of separate sorting of basic fractions at the source (glass, paper/cardboard, residual, plastic and biowaste), pick-up/collection points, waste/recycling stations and different treatment facilities. Treatment facilities can be different sorting and recycling facilities, as well as energy recovery and biowaste facilities. The differences stem from what fractions are collected where and how, as well as how the fractions are treated after collection. For instance, while one municipality collects plastic in a separate bin, another may mix it with the residual waste and a third mixes it with residual waste, only in a separate-coloured bag.

Although the differences in collection probably can be explained by several factors such as the municipality’s demography or the policies set by the government, we would like to focus on the municipality's role as a supplier. We plan to explore the relationship and communication between the municipality and downstream actors. Downstream actors range from energy recovery firms to sorting and recycling firms and more importantly producer responsibility providers. Producer responsibility organisations (PROs) usually take care of most fractions, meaning the municipalities don’t have direct contact with either sorting or recycling facilities. In these settings the municipalities can be considered commercial actors in the waste value chain. When the different waste fractions are traded on the waste market, the municipalities and inter-municipal waste companies obtain a new role as a supplier. The original role is to be waste

administrators that are responsible that waste is collected. This is something they must balance, and we want to understand to what extent they consider themselves as suppliers as well as waste administrators and how this affects decision making.

The PROs are responsible for most of the fractions. Only some fractions are economically profitable such as cardboard (Zacho et al., 2018), but because of the extended producer responsibility schemes, other fractions are still valuable to the municipalities as they are reimbursed for collection. This works as an incentive for collecting the different fractions. Other fractions like residual waste they must pay for it to be energy recovered so there is an incentive to sort out as much as possible.

We have chosen to mainly focus on the three fractions residual, plastic packaging, and food waste. The reason for this is that these fractions have the most differences in collection schemes. In some municipalities the fractions are all collected from the same bin, either in different coloured bags or just completely mixed with each other. Considering glass and metal, we believe the differences in collection systems are much smaller and there is less controversy and complexity when it comes to the contents and qualities of the sorted waste.

1.1 Research justification

According to new EU directives published in May 2018 (Directive 2018/851 amending Directive 2008/98/EC), there is a need to transition towards a more circular economy, and thus they have set new targets for collection of municipal waste. EU's binding regulation states a need to increase the recycling of household waste to 50% by 2020 with a further increase to 65% by 2035. In 2020 Norway recycled 45% of their household waste (Miljødirektoratet, 2022) which is 5% less than the target. This makes our thesis topic relevant as there is a need for municipalities to explore the best possible solutions and what might be barriers to meet the enhanced goals.

The Aftenposten article mentioned above gives a great example of the huge differences the specific practices have on how much plastic packaging waste that is collected. In Romerike, they managed to collect 17,7 kg of plastic packaging

per capita. There, plastics are mixed with residual waste (ROAF, 2023) before it is turned over to the central sorting (CS) facility. In comparison, the average amount collected by regions using source separation, either with its own bin or bag system was only 7,3 kg (Bjørnestad, 2019). The poorest result was in Oslo where they use a coloured bag system, with only 3,4 kg per capita collected. However not concerning plastic, another example was in Kristiansand. Prior to 2019 they changed the collection of glass and metal from a bring-in solution to curb-side source separation by introducing a new bin. This change resulted in a 5kg/inhabitant increase from the previous year, from 8 to 13 kg (Brennsæter, 2022).

The Oslo Agency for Renovation and Recycling (REG) mentions in their report about resource-efficient waste management for Oslo that there is a particular need for further development of material recycling of plastic (Renovasjons- og gjenvinningsetaten, 2022). Additionally, in a news article from NRK (Nordvåg & Alisubh, 2021) about plastic sorting in mid-Norway, only 44% of 350kg of residual waste is actually residual waste. They state that there is more to gain from plastic sorting, as out of the remaining 56% of waste, or 196 kg, recyclable plastic accounts for 44 kg of it. These arguments have been highly influential in our decision to give focus to the plastic fraction of the household waste.

1.2 Research questions

As previously mentioned, we would like to investigate how municipalities act as suppliers of waste. We also see the importance of improving the recycling grade and quality of waste to increase the efficiency of the recycling market and contribute on the road to the circular economy. This is also in the interest of the municipality, as more value is created for both parties.
Therefore, we have phrased our research question as such:

How do municipalities and inter-municipal companies as commercial actors collaborate with recyclers and extended producer responsibility (EPR) providers on achieving recycling targets and increasing the quality of recyclable materials?

2.0 Literature review:

We searched for scientific articles, reports, and similar information sources by using Google Scholar and the Web of Science. There was not one clear search string, because we searched for multiple different themes regarding MSW and B2B relations. It was hard to find sources relevant to the research we wanted to do, so we tried several different strings and collected relevant sources as the strings were tested. Main words included in the different search strings were "MSW", "Waste management", "B2B", "relation*" and "collab*", but also other words were tested for different results. We found little prior research in which B2B relations were researched in a MSW or waste management context. Most of this was relating to inter-municipal companies and regional collaboration, and nothing concerning the relationship between recycling firms, return companies and waste companies. Therefore, B2B relations and waste management is treated separately in the following literature review.

2.1 Circular economy & Reverse logistics

The circular economy has been an important part of the evolution in the waste management sector in recent years. The Ellen MacArthur foundation (n.d) has defined the circular economy as "A systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution." The framework is based on the three principles of eliminating waste and pollution, circulating products and materials and regenerating nature. The main goal of the circular economy is to prevent waste from being generated in the first place.

The path to achieve a circular economy is dependent on reverse logistics (RL), and its ability to deliver value and circulate waste back to new producers. As defined by Johnson (1998), reverse logistics is "the continuous logistic process through which shipped products move from the consumer back to the producer for possible reuse, recycling, remanufacturing or disposal" (Oom do Valle et al., 2009, p. 2; Gonul Kochan et al., 2016). Research done by Pohlen & Farris (1992) on reverse logistics in plastic recycling concluded that there are six types of channel members: Municipalities, joint ventures, material recovery facilities, brokers, intermediate processors, and end user. These six reverse logistic channels

have eight functions: 1. Collection, 2. Sorting, 3. Storage, 4. Transportation, 5. Compaction, shredding or densification, 6. Communication with buyers, 7. Processing or filtration, and 8. Retro-manufacturing (Pohlen & Farris, 1992).

The way to prioritise different measures on the road to the circular economy goes through the waste hierarchy. As it is defined in EU Directive 2008/98/EC, there are five different levels, starting with the most important measure. We should first strive to prevent (reduce) waste from being generated in the first place. Then comes preparation for reuse before recycling is to be considered. These three first measures are also commonly known under the abbreviation 3R or "reduce", "reuse" and "recycle". The last two measures are different sorts of energy recovery before the final and most least desirable step of the hierarchy is disposal or landfilling.

In the circular economy, recycling is the main source of economic value to the focal firm. Recycling is normally associated with the CE, and waste policies have mainly been concerned with increasing recycling rates (Ranta et al., 2018). On the other hand, considering resource efficiency and the ability to keep materials in circulation, recycling might not be the most efficient of the 3R framework. The reason for this is because of the law of entropy, complexity of materials and the potential for abuse (Stahel, 2013). Recycling is still a dominant factor, but Ranta et al. (2018) and Stahel (2013) argued that more effort should be led in the direction of "reuse" and "reduce" to close the gap towards the CE. For instance, through different take-back solutions that were researched. This view is also supported by Zacho et al. (2018) who argued that this would store more value locally and create more jobs, even though the economic potential was limited.

Milios et al. (2018) defined the barriers against use of recycled plastic as low demand, both from producers and end consumers, limited communication, and coordination as well as technical and legislative barriers. The share of plastics that are sent to recycling depends, among others, on consumer decisions. Waste handlers can strengthen the connection to the consumers by communicating to the public what is appropriate sorting behaviour, to increase the amount and quality that is recycled.

Another problem is how manufacturers tend to produce products with mixed polymers. Much plastic is discarded at the sorting facility due to mixed polymers and a lack of sorting technology, as well as being too dirty (Milios et al., 2018). Continuing this, Pohlen & Farris in 1992 three obstacles to establish an efficient reverse channel for recyclable commodities the first one also being differing product characteristics, and the last two are extensive handling and low-density shipments. Further, Zink et al. (2015) found that when the quality of the secondary material is higher, then the primary producer's willingness to substitute virgin material input with recycled materials increases. There is low risk of quality breaches when using virgin material opposed to secondary, therefore recycled plastics usually have a lower price, which is its main asset. This is though very volatile, due to a strong dependency on oil prices (Milios et al., 2018).

2.2 Municipal Solid Waste (MSW)

Municipal solid waste (MSW) can be defined in several ways. Generally, MSW is regarded as all materials that are discarded from residential and commercial sources or as materials that have ceased to have value to the holder (Vergara & Tchobanoglous, 2012). Usually, industrial waste, radioactive waste etc is not included in the definitions. The contents vary with the region and culture but are normally built up by different compositions of packaging waste, food waste and residual waste. Packaging waste tends to include plastic, paper/cardboard, and metal containers, as well as glass bottles and jars. These are considered recyclable, meaning they can be recovered and reprocessed into new materials for use in new products (Britannica, 1998). Food waste or bio waste refers to leftover food and any waste that is biodegradable and can be recovered as biogas. What is left when removing packaging and food waste is considered residual and is either energy-recovered through incineration or left as landfill.

A Danish study found that the collected fractions that were most appropriate for collection and recycling/reuse were cardboard, plastics, waste wood and reuse items. Cardboard was the only fraction that was economically profitable both to collect and to recycle, but considering the triple bottom line concept, no social value was created in terms of job creation (Zacho et al., 2018).

In this thesis we mainly want to focus on plastic packaging waste. Sweden was early out with EPR schemes and sorting of plastic packaging. In fact, the "founder" of the EPR term was a swede (Lindhqvist, 2000). Based on data from 2002, a study was done on the determinants of collection rates for household plastic waste in Sweden (Hage & Söderholm, 2008). They regressed Kg of plastic per inhabitant on different factors such as local policies, geographic, demographic, socio-economic, environmental preferences, and political preferences. The average amount collected at the time was 1.33kg. Not all the tested variables were statistically significant, but among the main results they found that municipalities with a weight-based fee instead of volume-based fee collected on average 0.37kg more.

They also found that in large cities, meaning more than 800 people per square km, people collected on average 0.53kg less than in smaller cities. People living in private housing was also significant, but only increased sorting with 16g. Other findings include that newly arrived immigrants sort less than the average while experienced immigrants (4+ years) sorted more. Also, higher unemployment rate came with a positive sorting effect. Presence of green party in local authorities was insignificant but share of green party voters nationally increased sorting. It should be noted that at the time it was less usual to have bins for packaging waste at home (curb-side).

A similar study as above was done on data from 2005 (Hage et al., 2018). They controlled for joint ventures (spatial dependencies), curb-side collection and number of drop off points. They found that curb-side collection and a high number of drop off points help explain why some municipalities perform better than others. About 46% of the population had curb-side collection of packaging waste at the time, and they sorted an average of 0.5kg more. In this study they found that the factor on big cities was insignificant, as were the factors on demographics and geographics. Also, both factors on green party voters was insignificant while the factors on immigrants was similar as before. An explanation for some of the differences is that the Swedish EPR schemes offer regionally differentiated monetary compensation for collection.

2.3 Waste management

Most literature on waste management concerns cost savings and efficiency, especially in the trade-offs between public and private organising. To reach the goals stated by EU Directive 2008/98/EC, waste management must overcome several challenges. This was something Bing et al. (2016) wanted to understand. They identified three groups of challenges when it comes to decision making in MSWM. Mainly strategic and tactical/operational level challenges, but also external challenges such as taxation, recycling targets and the valorisation of recycled waste. Strategic challenges refer to facilities and the ability to manage waste, such as variability in network configuration, facilitating for multi-commodity and multi-modality, capacity, and location choices. Tactical challenges refer to the collection, in terms of method, coordination, scheduling, capacity planning, vehicle routing and sustainability.

Different municipalities or other governing bodies often organise waste management through intermunicipal collaborations/partnerships. Foster (1997) was interested in this and identified 10 different regional impulses that could impact whether a regional collaboration was fitting. Natural resources, macroeconomic, centrality, growth, social, fiscal equity, political, legal, and historical impulses were chosen. Examples of pro regional impulses were a united political front, history of successful regional collaborations and high central city dominance. Examples of anti-regional impulses were natural barriers, such as mountains and rivers, dissimilar social status, and uneven growth expectations. On the other hand, a study from Flanders, Belgium found that municipalities collaborating in joint ventures for waste management were significantly more efficient than those not organised as such, keeping in mind that was only the case for five out of 299 municipalities (De Jaeger et al., 2011). Similarly, Tobin & Zaman (2022) experienced that challenges with recycling markets are better faced as a region, allowing for more actors and technical expertise. Participants in the study agreed that regional cooperation was necessary to achieve sustainability in waste management.

Villalba Ferreira et al. (2020) proposed a framework to understand inter-municipal collaborations. They researched waste management in Ecuador and divided

collaborations into indirect, transactional, and collaborative. Indirect collaboration means that only knowledge and information is exchanged, and there are no other shared functions. Transactional is a formal channel of cooperation based on contracts and implies that a municipality buys or sells services to/from another municipality. There is a medium level of governance, where one might hire a manager to take care of the relationship. Lastly, "collaborative" is the same as a partnership, where municipalities structure themselves together in longer term joint ventures where risks, responsibilities and gains are shared.

Previous research in England looked at the development of MSWM partnerships. Trust was found to be vital in the development process. Trust is easily eroded if partners pursue their own interests ahead of the partnerships. Other factors such as communication, openness, respect, and fairness were also found as key factors (Slater et al., 2007). Partnerships evolve from one state to another, towards longer contracts and united collaborations. The last stage in this process they call the "single waste authority" stage, and here the partnership resembles a separate organisation where all partners are represented. The partnership is no longer about drawing on independent organisations to develop synergies but acts as one organisation with statutory control.

In 2017, Chifari et al. (2017) analysed the cost effects of separating recyclables before treatment on the Japanese MSWM. One result was that for an average municipality, increasing the recycling rate by one percent should cause a 0.4% increase in total MSWM costs. Separation would improve efficiency in intermediate treatment facilities, but not the overall efficiency of the waste management services. They also found that there were economies of scale through all stages of the process, collection, treatment, and disposal. Another major finding was that costs could be reduced by about 26% if nearby municipalities were to form a management association (Chifari et al., 2017), like the Norwegian IKS.

One of the main issues in waste management is incorrect sorting of household waste. In the NRK article mentioned above they found that much of the waste sorted as residual actually was plastic (Nordvåg & Alisubh, 2021). Similarly, a

study in Sweden by Rousta & Ekström (2013) also found severe sorting errors in a medium sized city. In the residual fraction 43% of the content was packaging waste (which should be delivered at a collection point) and 22% was food waste (should be collected in a separate bag). For the food waste fraction, 71% of the content was correctly sorted, while the rest was a mix of combustibles and packaging waste. In other words, only about 53% of waste was sorted correctly (Rousta & Ekström, 2013). This is a problem that contributes to reducing the quality of the recycled fractions.

2.4 Systems and resources

With systems we refer to the different practices of how waste is collected, transported, and processed before it reaches its final destination or is recycled. This includes different collection methods and treatment facilities. The collection method is determined by what must be collected, and by what treatment facilities that are available. Some fractions are collected curb side (source separation), while others are to be delivered to centralised collection points (bring-in solutions). These practices differ from country to country and municipality to municipality. Lately also CS facilities or in other words material recovery facilities (MRF) have become more common. This means more fractions can be combined leading to less separation at the source, making it easier for the households to sort. Other systems include solutions with coloured bags, where different fractions are colour coded and placed in the same bin. These are separated at another type of sorting facility.

When the fractions are collected and sorted, they are delivered to the next step in the process. Packaging waste like plastic, cardboard, glass, and metal can be delivered for recycling, while food waste can be sent to a biogas facility. The residual fraction is usually delivered for incineration and energy recovery. But also, these practices differ. Not all countries or regions have facilities for recycling and energy recovery, and the waste is often disposed of as landfill or openly burned without energy recovery (Maalouf & Mavropoulos, 2022).

It has long been a belief that source separation and separate collection is the preferred option when it comes to recycling. This was a belief that Cimpan et al.

(2015) wanted to challenge. They researched different practices to look at how the quantities and quality of the sorted materials differed. They concluded that central sorting will be important in the time to come, as a complementary measure, and specially in urban areas where source separation for reasons is harder to exploit.

A dissertation by de Sadeleer (2018) set out to investigate the environmental impact from a CS facility. More specifically, compare the different environmental impacts of a waste management system where plastic waste is sorted out from the residual waste in a CS facility compared to a system where the plastic fraction is sorted out at the household level. De Sadeleer (2018) found that the plastic recycling rates would double when sorting the fraction out in a CS facility, but the target set by the EU was still only reached in an ideal scenario.

Jantz et al. (2011) also wanted to bring focus to the discussion surrounding CS or source separation. They investigated consequences of different mixes of residual household waste together with dry recyclables, and how this would impact expenditures. This was compared to the current situation where residual waste, biowaste, plastic and metal packaging was collected curb side while cardboard and glass had to be delivered to a collection point. The result was that the current solution was the most expensive one from a day-to-day perspective, and that the optimal solution would be to mix light packaging (plastics and metal) with residual. Biowaste could also be included, but due to its wet nature, it could implicate the sorting process and reduce the quality of the output. Cardboard and glass could be included as well but it is not because the current situation works well and is cheaper. Generally, there is no economic support for this solution, as the investments in facilities would be too large now. Another finding was that the number of fractions picked up curb-side instead of at a collection point has a significant impact on collection costs.

Source separation might not be that good for all fractions though. Janz et al. (2011) explained that biowaste could implicate the central sorting, something Lederer et al., (2022) agrees with. They meant that separate collections do not necessarily mean better performance, because the number of undesirable fragments in specially plastics and light packaging might increase over-proportionally. More plastic and other stuff that is considered plastic but not as packaging waste might be included and then shipped almost directly to recycling,

while in a CS facility, these would be sorted out. Lederer et al. (2022) also found that studies agree that MRF sorting efficiencies generally are higher for facilities that are fed with residual waste as well as lightweight packaging and metals. This would also increase the quality. On the other hand, they also found that when systems include deposit-refund systems (DRS) for PET bottles etc., the separate collection rates were higher.

2.5 Recycling behaviour

In 2018, Anderson and Stage concluded that introducing separate food waste bins indirectly signals to households that recycling is important and desirable, implying that less options for recycling will lead to worse recycling behaviour. Removing the food waste will also reduce the contamination of the other fractions, increasing the quality. Furthermore, in the study by Czajkowski et al. (2014) they found that participants, even though informed that the waste would be sorted anyways - if not at the household level, then at a sorting facility - a large group of people were still willing to sort waste at a household level.

One issue is how differences in living situations affect the people's recycling behaviour. People who live in smaller apartments have less space in their households and kitchens for sorting waste before bringing it to their bins or collection points. Centralised collection points also tend to be full or located impractically far from the apartments. This can lead to less advantageous sorting behaviour and might have an impact on the results of some cities. Ando and Gosselin (2005) did a study on this and found that perceived availability of sufficient space for processing recyclables as well as the distance between the household and the bins affect recycling rates. Further, people that live in more rural areas normally have their own waste bins, something that perhaps will lead to a feeling of ownership to the recycling. This may also have a positive effect on recycling behaviour.

Another study, Flygansvær et al. (2021) researched how three different nudges would improve consumers recycling behaviour. A social norms nudge, a distance nudge and an availability nudge were all tested against a control group with the

purpose of making it easier for the consumers to recycle. This was done through information letters about neighbours sorting behaviour, reducing the distance to waste collection points, and providing free sorting equipment like waste bags for plastic and food waste. The results revealed that the recycling behaviour was improved for the experimental group while the control group remained unchanged.

2.6 Extended producer responsibility (EPR)

There are several reasons for why extended producer responsibility schemes are important. Their existence help fund the collection and recycling of different waste fractions and should incentivize eco-design. For the moment it is normal with EPR schemes for packaging waste, E-waste, and batteries, but more fractions are continuously added. OECD defines EPR as:

> *"An environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle".* (OECD, n.d.)

OECD characterizes EPR by the shifting of responsibility upstream toward the producer and away from the municipalities, and the provision of incentives for producers to consider environmental implications when designing their products.

The term was first coined by the swede Thomas Lindhqvist in a report to the Swedish ministry of environment in 1990 (Lindhqvist, 2000). Since then, almost all OECD countries now use different types of EPR schemes. There have been several definitions of the subject, but Lindhqvist concluded his doctoral dissertation on the subject with a revised definition:

"Extended Producer Responsibility (EPR) is a policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product, and especially to the take-back, recycling and final disposal of the product."

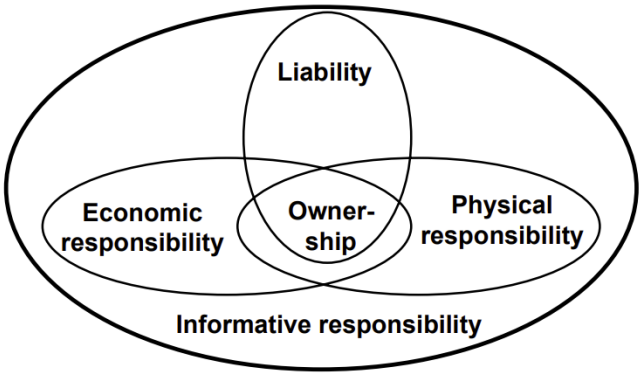

Figure 1: Models for Extended producer responsibility (Lindhqvist, 2000)

The idea is based around the five themes in the figure above (Lindhqvist, 2000). *Liability* refers to the responsibility for environmental damages caused by the given product in any given phase of the life cycle. *Economic responsibility* means the producer should cover all expenses for collection, recycling, or final disposal, either directly or through a special fee. *Physical responsibility* characterizes systems where the manufacturer is involved in the physical management of the products and/or their effects. *Informative responsibility* signifies the possibilities that responsibility can be extended to the producers being required to supply information on the environmental properties of their products. The manufacturers can also retain *ownership* of products and hence bear the environmental problems directly.

There are several ways to take this responsibility. Most commonly through producer responsible organizations (PRO), who either take the responsibility partially or in full (Filho et al., 2019). Full organizational responsibility means the organization is responsible for both collection and recycling. Partial responsibility means the organization, the municipalities are usually responsible for collection while the PROs recycle and sell the given fraction. Another way is to go through direct reimbursement contracts with the municipalities, where the municipality

takes the responsibility (Filho et al., 2019). PROs are usually set up to allow for economies of scale. That way the producers can take on the responsibility in a collective fashion (Maitre-Ekern, 2021).

Since the introduction of EPR schemes, recycling has gone substantially up. That is not to say that the EPR schemes are faultless. Maitre-Ekern (2021) researched and discussed EU law and the CE and how it has failed to promote waste prevention and promote "sustainable circularity". She meant that the 3Rs are not appropriate options for the CE and EPR schemes as the recovery processes requires both energy and resources and the technology might be harmful to the environment. Due to Newtons second law of thermodynamics, the amount of useful energy in matter is constantly declining and new raw natural resources will have to be used to compensate for lost value. Plastic degrades through usage and processing such as thermal stress (Goodship, 2007). To keep the original properties, additive substances such as fillers must be introduced, and the degradation will increase with the number of times the plastic is recycled. Regardless of the efficiency of the processes, value will always be lost, and energy and resources must be added to recover waste (Goodship, 2007).

Maitre-Ekern (2021) criticized the low use of Reuse from the waste hierarchy, and the fact that producers tend to overlook the potential of reuse as they are only financially liable for the products. Furthermore, she mentioned that EPR schemes and recycling targets may have turned the focus from durability to recyclability, with lightweight one-use packaging. Better durability would reduce the need for new raw materials and reduce the degradation with the number of times materials are recycled. Maitre-Ekern (2021) wanted to introduce a pre-market producer responsibility (PPR). The objective is to take measures to limit environmental impact and extend product lifetime in accordance with the CE objectives, prior to market. This means at the product design and production phase. She proposed four ways to do this: no data no market, meaning producers need to provide better data on expected lifetime and other criteria before launch; availability and affordability of spare parts and repairing; take back schemes for repairing and reuse of products and lastly second-hand and reuse sections in stores.

Dubois (2012) was also critical and tried to explain why static collection targets do not internalize all the costs of waste management. He meant the EPR schemes were sub-optimal and reduced the incentives for waste prevention and green product design. He also proposed an additional product tax on the non-collected waste fraction and explained how it would work.

2.7 Business relations (B2B)

Research on business relations in the waste management sector is limited, and mostly focused on how regions (municipalities) collaborate. We found nothing on how the relation between upstream (waste management firms) and downstream (PROs and/or recyclers) plays out. But the business relations literature is on the other side plentiful.

In 2007, Rauyruen and Miller tested how well relationship quality works as a predictor of B2B customer loyalty in the Australian freight courier market. They based their test on the factors trust, commitment, satisfaction, and service quality, both on an interpersonal/employee level and at the organisational/inter-firm level. The factors were checked against both behavioural loyalty (purchase decisions) and attitudinal loyalty (would or would not recommend supplier). The result was that both satisfaction and service quality positively influence purchase decisions, and all four factors have a positive effect on attitudinal loyalty on the organisational level. No hypothesis was supported on the employee level.

Some years later, a similar study was done in Slovenia by Cater & Cater. Product and relationship quality was researched against customer commitment and loyalty in B2B manufacturing relationships (Cater and Cater, 2010). Customer commitment was split into *affective*, which is attachment due to liking and identification, *positively calculative*, which is value-based commitment, *negatively calculative*, where customers stay due to a perceived lack of alternatives also called locked-in commitment, and *normative*, which is attachment due to felt moral obligations. Loyalty was split into behavioural and attitudinal as in Rauyruen and Miller (2007). The dimensions that were tested were product quality, adaptation, knowledge transfers, trust, and cooperation.

Cater & Cater (2010) found that product quality has a positive impact on both loyalty factors directly. Product quality also positively impacts both positive and negative calculative commitment, but only negatively calculative had a further effect on just behavioural loyalty. Further, trust and cooperation positively impact affective commitment, which again had a significant impact on both loyalty dimensions. All other suggested effects on loyalty were insignificant, but adaptation, trust and cooperation positively impact normative commitment.

Sheth & Sharma (1997) studied emerging issues and challenges in supplier relationships. They concluded that organisations would shift their strategies towards developing relationships with suppliers. The main reason for this was that the value creation happening at the supplier was becoming increasingly important. Businesses started to understand the actual value the supplier could provide.

Araujo et al. (1999) wrote about how to manage suppliers through different interfaces, to enhance productivity and innovation. The authors proposed four different interfaces, standardised, specified, translation and interactive. Standardised resembles the classical “arms-length” relationship which is very transactional and has a low cost. Specified means all specifications and production schedule etc. is decided by the buyer. The translation interface relates to the specified, but only the performance and functionality is specified by the buyer, giving the supplier a higher degree of freedom. Interactive interfaces are relational by nature and are when the buyer and supplier jointly design specifications and processes. For productivity, standardised is best for large scale operations, but in other cases productivity increases when we move from specified to translation and to interactive. Innovation comes from learning, and there is little learning happening in the standardised and specified interface. Translation allows for indirect learning between suppliers, while interactive interfaces allow for both direct and indirect learning both ways in the relation.

3.0 Conceptual Framework

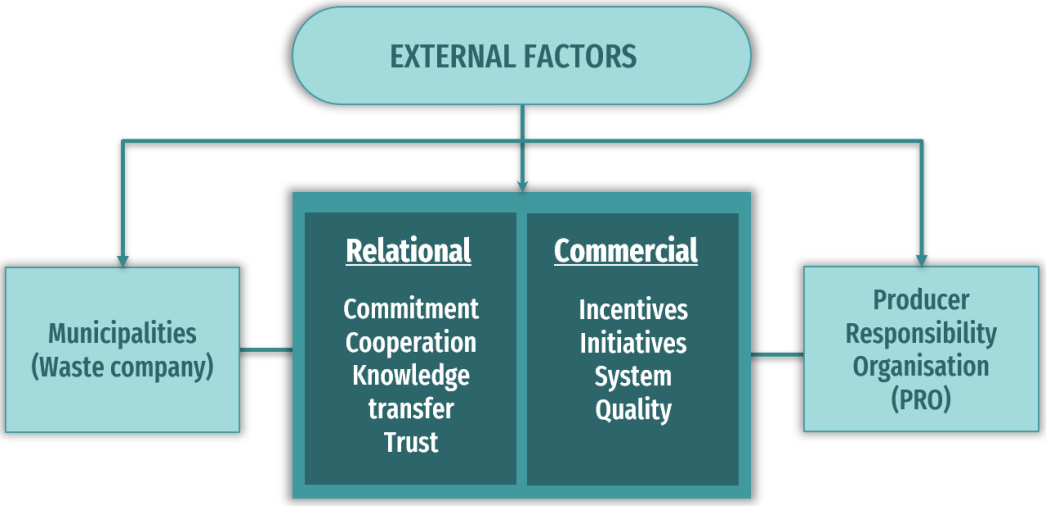

Figure 2: Conceptual framework

The core of our framework allows us to investigate the relation the municipal renovation companies have with their producer responsibility organisation (PRO). It is supposed to help us understand the commercial relationship, where the municipalities act as suppliers and the producer responsibility organisations are the customers. Municipalities collects household waste (MSW) which they supply to their customers, the PROs, against a fee. The PROs then make sure the waste is recycled. For this thesis, we have chosen to focus on the waste stream for plastic waste.

In the middle of the framework, we have the two dimensions we examine, the *relationship* between the two actors and the municipalities observed role as a *commercial* actor in the MSW market. Within the relational dimension we have four factors: Commitment, cooperation, knowledge transfer and trust that are taken from the literature by Cater & Cater (2010) and Villalba Ferreira et al. (2020) mentioned in our literature review. The two different groups of actors are represented on each side as "*Municipalities*" and "*Producer Responsibility Organisations*". When referring to municipalities we think not only of municipalities themselves, but also all municipal and inter-municipal waste companies. External factors are a broad category that represents all factors that cannot be controlled by either the municipalities or the PROs. This includes factors like rules and regulations, demographics, geographics and so on. The

factors influence design of collection system, downstream solutions, information campaigns and much more.

On the right-side of the framework, the PRO companies are represented, there we have investigated the different recycling rates and the *quality* that are achieved for the researched municipalities. It is hard to define what is high quality or not, but we will look at the amount of plastic collected per habitant in each municipality and the percentage of contamination. We will also look at the number of kilos of food waste that is recovered as this is a big source of contamination for the other fractions. On the left side, the municipalities are represented, there we have investigated the different types of collection *systems* being used in Norway and tried to pick municipalities with different types of *systems* to compare them. The type of system directly impacts both the amount and the quality of recyclable goods (Cimpan et al., 2015). These collection systems are fed with MSW or in other words, household waste.

The last two factors of our commercial dimension that we have not mentioned yet is *Incentive* and *Initiative*. Here, we looked for examples from both the PROs and the waste companies on their incentives for improving the waste or if they themselves had taken any initiatives on their own to try to improve the quality of their waste.

The relationship factors are generally about how the actors interact with each other. We have used our B2B literature to choose which factors to include in our framework and in turn our findings and discussion part. The interaction between municipalities and PROs can be either transactional, relational (collaborative) or something in between (indirect) (Villalba Ferreira et al., 2020). The two sides might view the relationship differently and we want to understand how the relationship works from both sides as well as from the outside looking in. There are also different ways a buyer can manage their suppliers. Araujo et al. (1999) mentioned four different interfaces, standardised, specified, translation and interactive. Which of these interfaces is used by the PRO and how the interaction spans out is descriptive to how we understand the relationship and the *cooperation* between PROs and municipalities. There can also be differences in how the PROs

treat the municipalities. We assume that this is generally not the case, but that different treatment does occur for different reasons. Different degrees of effort can be exerted by the PROs towards the municipalities to prevent poor performance and induce investment on the supplier side.

To determine what type of relationship and what interfaces can be found between the two sides we will look at factors such as *knowledge transfer* between them, the degree of *trust*, and how *committed* the municipalities are to the PRO. Cater & Cater (2010) mentioned four types of commitment, normative, affective, positively and negatively calculative which we will use to understand the relationship. They tested among others *knowledge transfer*, *trust*, and *cooperation* on the different types of commitment, and although not all of them influenced commitment we mean that the factors are highly relevant when we want to explain the relationship.

The other main parameter is the degree of commercial involvement from the municipal side. Here we are interested in how the municipalities look at themselves as a commercial actor (supplier). The municipalities have the important and legal responsibility of being the waste administrator for household waste in the given region. However, recently the role as a supplier of waste fractions has emerged, as there is increased interest in recycled material. They must balance the two tasks, and we question whether they direct enough focus towards the commercial role of being a supplier. To understand this, we have looked at what *incentives* there are for the municipalities to put in the effort and what *initiatives* they are taking to deliver waste with as good *quality* as possible. The municipalities may care mostly about their role as an administrative unit and with that take less pride in the product and quality that they deliver downstream.

Choice of collection *system* is integral to how much is being recycled and what quality level that can be reached. Systems perform differently, some perform better when it comes to quality while others are much cheaper (Jantz et al., 2011). Central sorting (CS) facilities implicate quality because of biowaste while source separation might have too much undesired fractions and wrongful sorting (Jantz et al., 2011; Lederer et al., 2022). CS facilities do on the other hand improve sorting

rates (de Sadeleer, 2018), and makes for less effort for the residents. Considering this, choice of collection system directly impacts how much is recycled and should therefore impact the relationship. The reason we place this under the commercial umbrella is because we mean that the choice of *system* tells us something about how the municipalities look at themselves as a commercial actor. It indicates that they invest more and put more resources into a higher degree of recycling and possibly better product quality. We think the choice of system is also influenced by the relationship and this is something we will investigate.

There are an uncountable number of other reasons that surely have an impact. These are represented by the "*external factors*" box. The problem with the external factors is that they are almost endless. But some, we believe, have a bigger impact than others. The external factors impact just about anything, and they influence how the relationship functions as well. Rules and regulations, governance, recycling targets, quality targets are all important and directly impact how the two sides work and how they cooperate, which again translates to recycling results. These can be considered external as they are not decided by the parts themselves, even though they may have a say. We want to know how rules and regulations, recycling targets etc. are reflected in the relationships. To what degree the municipalities are bound by the targets and how the communication is with local authorities on how to reach them.

External factors impacting the sorting at the household could be culture, geographics, demographics, house sizes, political preferences etc. Specially in larger cities, more than 800 people per square km, people tend to be significantly worse at sorting (Hage & Söderholm, 2008). How good residents are at sorting is instrumental to how good the quality is and how much is recycled. The factors are important for choice of system, and we also think they are relevant when it comes to the relationship and the commercial factors. This is because they are instrumental in deciding what initiatives must be taken and how both sides should work with the residents. That way the factors are relevant when designing communication to the residents and to understand the differences inside regions.

Another major externality is how plastic packaging is designed and how much recycled materials is already used in the packaging that is out there. This again is dependent on oil prices and prices on second-hand materials (Milios et al., 2018). Understanding the supply and demand of second-hand materials is important to understand how we can increase the recycling degree. A similar problem is the producer's tendency to use mixed polymers in plastic packaging. This makes sorting and recycling to a challenging and sometimes impossible process (Milios et al., 2018). We think this should be an important topic in the communication between municipalities and PRO's and we wanted to find out how prominent this is in the conversations.

Whether treatment of other fractions like food waste and residual waste is outsourced or done internally is another thing that might be relevant. There can be conflicts of interest where municipalities are less interested in treating a fraction because it is better for them to burn it. Perhaps there is low capacity at the treatment facility for food waste. Then the incentive to try to improve food waste collection is weakened, again weakening the quality of other fractions because food waste is dirty. Food waste also implicates sorting processes (Jantz et al., 2011).

4.0 Research methodology

In this chapter we will present the methodology for the research we have carried out. First, we will discuss our choice of research strategy and design, explaining how we planned to go about the research. Then we will go in depth on data collection, what we have done and then assess the quality and limitations of the actual research and the research design.

4.1 Research strategy

It was our aim to dig into the systems and roles of the different municipalities as well as the relationships that are found between the municipalities and the actors downstream in the supply chain. In practice that would mean the relationships

municipalities has with the two approved EPR actors, Grønt Punkt/Plastretur and Norsirk but also their relationship further down to the recyclers. We wanted to compare how the practices worked considering the relationships downstream and the role of the municipalities.

Therefore, we needed a research strategy that would allow us to examine the roles and relationships to see if we could elaborate on any differences and explore potential causality. To do this we intended to use existing literature on the field of business relations and waste management, and interviews with relevant actors in the market. Originally, we also thought of sending out surveys to all the municipalities, but this was binned because we believed it would not give us the answers we wanted.

Consequently, we chose an approach where we would do semi-structured interviews and collect information from web sites and annual reports etc. This allowed us to analyse and make assumptions based on the data from the interviews and the collected information about systems and recycling rates. Our research is qualitative because we interviewed relevant actors and worked with mostly non-quantitative information. There is also some quantitative information in which is used to support some of the claims in the interviews and in our discussion.

4.2 Research design

There are two main approaches when it comes to making assumptions about the nature of the reality one is researching, the inductive and deductive approaches (Bell et al., 2019, p.17). In addition to this, an abductive logic has been proposed as a third approach which tries to overcome the limitations from the two main approaches. Abductive seeks to explain a perceived puzzle, a puzzle may arise from an empirical phenomenon which existing theory cannot account for (Mantere and Ketokivi, 2013 in Bell et al., 2019, p.24). In our case, there is expansive knowledge about B2B relations, not much on the relationship between waste company and PROs. Our research will fill in the knowledge gap and show that the B2B literature is transferrable in some cases to the municipal solid waste

industry. Although we have our predictions, we will try to find the best explanation and correlations, even though the data might surprise us in the end.

We have chosen to do the research as a multiple case study. A multiple case study is an extension of a normal case study, which allows the researchers to compare the findings in the different cases (Bell et al., 2019, p.67). This allows us to consider what is unique for the different cases as well as what is common for all. That way we can get a greater understanding of how the relationship between municipalities and producer responsibility companies unfolds. It also allows us to investigate whether the different collection systems that municipalities use are relevant for how the relationship and communication unfolds. Case studies tend to be associated with qualitative research but allows for combining research methods that are both qualitative and quantitative. Therefore, we have compared our findings with data on qualities and amounts. This alleviates the weaknesses of both quantitative and qualitative research by exploiting the strengths of both and is what is referred to as the logic of triangulation (Bell et al., 2019, p.574).

4.3 Data collection

Data collection is at the centre of any research. We chose to go with semi-structured interviews and secondary analysis of official statistics and researchers' data. We have used both primary and secondary data in our research to ensure a successful outcome and best possible solution to our research. Primary data analysis is research where the people who have collected the data also are the ones analysing it (Bell, 2019, p.12). Secondary data analysis is then when someone else conducts the analysis of the data. By using secondary data, we avoided time consuming data collection of primary data and have built our dissertation upon previous research.

4.3.1 Data protection

The data controller for all student projects at BI is BI. Some of the data we collected is considered indirectly personal (yellow data) and hence we had to use software that is approved by BI. Interviews were all recorded and stored on the sky-based storage service which is provided by BI international business school

through Microsoft 365. The project was co-written with the use of Microsoft word. Interviews were recorded through the application “Nettskjema/Diktafon”, and all interviewees gave consent for us to record interviews and use the collected data for our research project. The interviewees were informed that all data would be stored and treated in accordance with BI routines for student assignments and that BI is the data controller for the project.

4.3.2 Primary data

To start gathering relevant data we had to assess what we were looking for. We started by mapping all the 356 municipalities by system and waste management company in an excel workbook. This was a lot of work but gave a good insight into how waste management unfolds in Norway.

From what we know, there are 88 different actors which performs waste management for the municipalities. Of the 88, 23 are municipalities that has arranged waste management through the municipality while 55 are companies or inter-municipal companies managing waste for one or more municipalities.

Then we went through all the actors web pages to map what fractions they sort and how they have gone about collecting them. This is what we refer to as system for waste collection. This would help us to see who we were interested in interviewing. There are many differences in waste collection, we have chosen to mainly focus on the plastic fraction. Generally, that makes three fractions relevant for us, namely plastic, residual waste, and food waste. Glass and metal and paper and cardboard is less interesting because they are easier to sort and there are less differences in collection of these fractions.

We have identified three general systems of how plastic is collected:

- No sorting (sorted out mechanically post-collection)
- Curb-side sorting in a separate bin or plastic bag
- Sorted in coloured bags that are optically separated from the residual waste post-collection.

	Municipalities	Share
Mechanical sorting	24	6,74 %
Coloured bags	37	10,39 %
Curbside sorting	291	81,74 %
No solution	3	0,84 %
Bring-ing solution	1	0,28 %

Table 1: Municipalities with collection systems

As you can see, most municipalities engage in standard curb-side sorting with a single bin or plastic bag for collection. 37 municipalities have a system with coloured bags sorted out post-collection and 24 municipalities send their residual waste to a central sorting facility (CSF). The four other municipalities Hvaler, Røst, Værøy and Bardu, we do not consider. Hvaler has a lot of summer houses and few permanent residents, while Røst and Værøy are small islands with less than 1000 residents. Bardu is also a municipality with few residents.

Next in the process we sorted out the different criteria for which municipalities we would like to interview.

1. Municipalities or companies with different systems for collection.
2. Municipalities or companies with more residents.
3. Municipalities or companies located closer to Oslo.

Nr.	**Criteria**	**Reason**
1	Municipalities or companies with different systems for collection	Municipalities with different systems is crucial for our study. Different systems have a lot to do with how much plastic waste is sorted and recycled. The systems might also have a say in how the residents look at sorting and recycling and is an essential part of how sorting should be communicated in the municipalities. Different systems also impose different challenges and different quality of the output.
2	Municipalities or companies	Municipalities with a higher number of residents likely has more challenges communicating with the residents than smaller municipalities. More apartment buildings

	with more residents	make waste collection harder, and people have less space for self-sorting at home. Bigger municipalities probably increase the amount of dialogue with partners and gives them more weight when cooperating with other actors.
3	Municipalities or companies located closer to Oslo.	Municipalities located in the area around Oslo are probably culturally similar, and somewhat equal considering population density. Location near Oslo also allowed us to visit and do interviews face to face and for us to see some of their facilities.

Table 2: Criteria for interview with municipalities

Furthermore, we needed to decide who else we were to interview. The obvious choice was Grønt Punkt or Plastretur who is the main actor for sales and recycling of plastic packaging from municipal waste. There is only one other actor in that market, which is Norsirk, so it was clear we would have to talk to them as well. This would make for an interesting comparison of how the two collaborate with municipalities and recyclers. It is also apparent that we should have talked to some of the sorting and recycling facilities as well. Bearing in mind that they are mostly located abroad, and the representative from Grønt Punkt thought it would be difficult to get in contact with them, we chose to not go down that road.

We chose to go with semi-structured interviews. This allowed us to look broader into some of the themes and follow up with questions to elaborate on interesting aspects. To do this we tried to use open ended questions to get the interviewee to talk more in general and give us a wider understanding of how the dialogue and relationships unfold. That way interviewees could answer in their own words, and it makes it possible for us to change the course of conversation if something unexpected or interesting were to come up. The interviews also allowed us to customize the conversation to fit the different settings. There are different issues for the municipalities than it is for the PRO's, and the municipalities also operates slightly different which means we must adapt to their situations.

Based on the problem statement and framework, two interview guides were prepared before we started interviewing. One for the municipalities and one for the EPR providers/return companies. Some questions were equal for everyone, but

we also customized the guides with a couple of specific questions relating to the relevant company's situation. An example of this is that ROAF is the owner of a unique sorting facility, and because of that operates differently than others. Another example is that Norsirk is very new to the plastic packaging recycling market, and hence has other challenges than what Grønt Punkt/Plastretur has. Similar questions were asked to both return companies and municipalities to see whether they looked at the relationships and dialogues in a similar way.

Our primary data was collected from our semi-structured interviews with relevant private actors. We intend to primarily focus on big renovation companies and EPR providers such as Grønt Punkt and possibly also directly with the recycling companies. The semi-structured interviews made it possible for interviewees to answer in their own words and for us to change the course of conversation whenever anything unexpected and interesting came up in the conversation. The prepared questions coincide to the best of our ability with what we want to research. In essence the questions are based on what we needed to know to make assumptions about the causality between system, recycling grade, quality, and relationship.

4.3.3 Sample

We talked with the guy from Grønt Punkt after he was a guest lecturer at BI. He pointed us in the direction of some people we should talk to. He mentioned Oslo because they are very good at working with their residents, even though they have a challenging population. ROAF was mentioned as they operate in another way than most other municipalities. Further we should talk with a municipality with a curb side source separation solution, where he among others mentioned ØRAS. Avfall Norge and the interest organisation Samfunnsbedriftene was also mentioned, but we left them out. Lastly, he also suggested we should talk with the quality manager at Plastretur, something we did. Then we had one actor with each of the three major collection solutions, but we still wanted one or two more. We also contacted RfD because it said on their web page that they used Norsirk as the supplier for plastic packaging recycling. That would mean we had two actors on each of the return companies, but this info was wrong as they now use Plastretur. Then it was three to one but given the market share of the two companies we believe it is ok. MOVAR was also contacted because they do still not collect food

waste, as they should, but they seemed less interested and left us with no answer. The focus regarding food waste was also turned down with time.

Generally, we did not send out any questions or major information except for the topic and theme of our master thesis. Some of the actors asked and wanted something to help pick the right candidate, so then we sent out some keywords and sentences. Some themes were still left out so we could learn their initial reaction and not get a fabricated answer, eliminating some of the possible bias.

4.3.4 Data collection timeline

Meeting/Interview	Background	Date	Time
Grønt Punkt (PRO)	The person we met with was head of development and was very passionate about his job. He held a quest lecture for the class below us which we attended, and then we had a conversation afterwards.	21.03.23	11:00 – 11:30
ROAF (WMC)	The interviewee is the sales responsible and has held this position for the last 10 years.	11.04.23	10:00 – 11:30
ØRAS (WMC)	We spoke with both the communication responsible and the one responsible for the environment before the CEO joined us after some time.	11.04.23	13:00 – 14:00
Oslo Kommune (REG – Renovasjon og gjenvinningsetaten) (WMC)	The interviewee is a communication advisor for the Renovation and Recycling agency. (REG)	18.04.23	10:00 – 11:00
RfD (WMC)	The interviewee is responsible for recycling	24.04.23	10:30-11:30

	stations but has been in the business for more than 20 years and in praxis worked as an internal advisor. Was among others central when introducing source separation of plastic when that came.		
Plastretur (return company)	The interviewee is the quality manager. The employees at Plastretur share offices with Grønt Punkt.	27.04.23	10:00 – 10:30
Norsirk (PRO)	We interviewed two people, both the communication director who is also the most experienced person at Norsirk and an analyst with multiple responsibilities among others downstream.	22.05.23	10:00 – 11:00

Table 3: Data collection timeline

4.3.5 Secondary data

Our secondary data will be data collected by Statistics Norway (SSB), information gathered from communal websites and existing literature on our topics. Annual reports from the six involved companies will be important to underline our research, as they contain information on quality and collected amounts as well as their practices. This allows for comparison between different municipalities and can provide further insights. We have been looking into existing literature, such as academic articles, research books and reports. Predominantly within the areas of municipal solid waste management and B2B, but also the other areas mentioned in our literature review.

4.4 Quality of research

The three most important standards for assessing business and management research are reliability, replicability and validity (Bell, Bryman & Harley, 2019,

p.46). Reliability is the question of whether the results of the study are repeatable. Replicability concerns to what degree a study can be replicated. This is not so usual inn business study, but it requires that that the procedures are explained in detail. This is also important to ensure that the study is reliable. Validity is all about the integrity of the results you find and can in turn be split into different aspects such as internal and external validity.

We will take all three standards into account when making sure our findings from the research are sound. The findings are based on observed causalities between the different variables measured. We intend to check that the causalities are consistent in all observed similar situations and not just an outlier. The standard of replicability might prove to be a bit harder, as there are big differences in how the municipal solid waste is handled from country to country.

Reliability and replicability

It should be quite easy to replicate this study as we have clearly explained what companies we have worked with and given that we have only held interviews with them. One issue though is that our interview guide is quite limited and that the interviews are semi structured. This means that it is not that easy to replicate the same questions and to get similar results, meaning the reliability is weakened. The quality of the questions asked may also be subject to criticism, which can bias the results also making it less reliable.

Generalisability - external validity

External validity is about whether the results of the study can be generalised beyond the specific context of the study. The findings will probably not be directly generalisable to other settings, but we believe similar results would be found should the study be replicated in similar countries like for instance Sweden. For countries and regions where the MSWM is organised in a similar fashion, the same problems and trade-offs should also exist, meaning the research could be transferred to other contexts. Most countries in the EU for instance uses similar EPR schemes and are bound by the same set of rules and regulations. This indicates that the external validity should be reasonably strong.

As we have mainly focused on the plastic packaging fraction it is somewhat unclear whether the results also can be generalised to other fractions that are also bound by EPR schemes. At least in the Norwegian setting we believe it can be, as the EPR providers tend to provide producer responsibility for multiple fractions and usually have agreements with municipalities for multiple fractions at a time. There is no reason not to believe that they operate similarly for those fractions as well. How this works in context outside of Norway we do not know.

Credibility - internal validity

The internal validity of the research depends on several factors. If not treated rightly, these factors can weaken the validity of the research and prevent us from drawing inference. Small sample sizes and bias in sample selection can be factors that have altered our research. We got in contact with four out of the five municipalities we initially wanted to talk with, and both approved EPR providers making it a strong representation of differences in relationship. The municipalities also represent large and populated regions, making them more relevant than others. In that sense we are safe to say that we got most of the data we wanted, indicating that the results can be trusted. What threatens the internal validity is related to the quality of questions asked and the answers received. We are new to this type of research and might not have asked the best questions. This impacts the results of the study and draws negatively on the validity. But on the other hand, some of the findings matches the literature which at the same time lead to stronger validity and higher trustworthiness.

4.5 Research considerations

As mentioned above, our research will have limitations based on our sample choice and factors related to it. Our sample will only be based in Norway which grants a geographical limitation. Furthermore, there is sample bias because we only interview four different waste management companies. We have tried to work with companies that operate differently, but they are all located in the same geographical region which may cause bias. Concerning the PROs, we have been in touch with both approved companies something that will give us a clear picture of their side of the table. There is also a limitation that we focused mainly on one

fraction, as the PROs do have agreements for multiple fractions and their relationship is wider than just for plastic packaging.

5.0 Research context – MSW management in Norway

Norway is a country of about 5.5 million people (SSB, 2023b). Locally, the country is divided into 11 counties and 356 different municipalities. The capital and highest populated is Oslo with more than 700 000 residents, while Utsira with roughly 200 residents is the smallest. The country is elongated with lots of mountains, fjords and islands making the geography challenging for waste management.

On average, every person in Norway producers about 387 kg of household waste every year (SSB, 2023a), which is more than one kg a day. Although that sounds much, this also includes waste delivered at recycling stations such as garden waste, wooden waste and even building materials. Of the 387 kg, about 169 kg per person was sent for recycling, amounting to 43.6%.

In 2022, approximately 877 000 tonnes were residual waste, 202 000 tonnes were food waste, and 53 000 tonnes were plastic packaging (SSB, 2023a). Given that there is not perfect sorting, a lot of the residual waste can also be considered food waste, plastic etc. This is numbers from the households. The total number of plastic packaging waste for both households and industry was 87 791 tonnes in 2021, of which 20 985 tonnes (23.9%) was sent for recycling. Most of the plastic is lost between purchase and collection (56.7%), meaning it is sorted wrongly or ends up as litter. Then at the next step, which is sorting abroad, a further 8.1% of the plastic packaging waste is lost, before another 11.3% is lost in the recycling step because it cannot be recycled, or it is wrongly sorted. This leaves us at a place where only 23.9% of the original 87 791 tonnes of plastic packaging put on the market that year is recycled. (Daae, 2023)

5.1 Municipalities role

Rules and regulations are essential when it comes to waste management and recycling. There are a lot of different frameworks covering all aspects of the industry, in order to keep the society clean, increase recycling rates and reduce as much emissions as possible. The most important regulation must be that littering is forbidden through the pollution act §28 (Forurensningsloven, 1981).

In Norway, it is the responsibility of the Municipalities to make sure that household waste (MSW) is collected. This is determined in the Norwegian pollution act of 1981 §30 (Forurensningsloven). How the municipalities choose to go about this responsibility is down to the individual municipality. The Pollution act §83 also gives the municipalities the opportunity to outsource the task of waste management to municipal or inter-municipal companies instead of as a part of the administration. Norway is a widespread country with some very small or poorly populated municipalities and many geographical challenges making cooperation advantageous. About 24 municipalities has less than 1000 inhabitants making it hard to fill all responsibilities of the Municipality by themselves. Therefore, there are now 88 different waste management companies for MSW in Norway, who all are collaborations between two or more municipalities. About 20 municipalities arrange waste collection through the municipal administration. Some municipalities even do the renovation for other municipalities, normally smaller places, like what Værøy does for Røst and Steinkjer does for Snåsa.

The waste management solution in each municipality is financed through a waste management fee that the municipality collects. This fee should cover all expenses for legally required waste handling and should not exceed the costs. The municipality are not to make profits from waste management (Forurensningsloven, 1981, §34) (Avfallsforskriften, 2004, §15-1 - §15-3).

The municipalities are responsible for sorting of food waste and plastic packaging waste. For food waste, 55% must be sorted before 2025, 60% before 2030 and 70% before 2035. Similarly, 50% plastic packaging must be sorted before 2028, 60% before 2030 and 70% before 2035. They are then responsible so that these sorted fractions are sent for recycling (Avfallsforskriften, 2004, §10a-4).

5.2 Producer responsibility (EPR) and return companies (PROs)

Waste management in Norway is bound to follow the *principle of polluter pays* which is explained in the pollution act §2 (Forurensningsloven, 1981). The principle states that costs to manage and prevent pollution, waste and following damages to the environment should be borne by those who produce pollution. This is the foundation for producer responsibility.

In Norway, producer responsibility is taken by producers and importers who take responsibility for their products through the entire life cycle, also after it is disposed of. In this chapter we will mainly focus about producer responsibility for packaging waste. Every producer or importer that put more than 1000kg of one type of packaging on the market are obligated to join a return company (PRO) (Avfallsforskriften, 2004, §7-5). The producers and importers pay a fee to an approved return company who then uses the fee to facilitate waste management in such a way that environmental targets for collection and recycling are met. This is generally done through reimbursing the municipalities for collection and then forwarding the sorted fractions to further sorting and recycling. In praxis this means that the cost of disposal is included in the production/shipping cost and is reflected in the final price of the product.

The purpose of the EPR in Norway is to front environmental product design through giving the producer a larger responsibility. Further its purpose is also to secure nationwide waste collection, reduce littering, increase recycling and secure that waste is handled according to regulation (NHO et al., 2023).

The return companies are free to choose their fee to their members/customers and how much they reimburse the municipalities for the waste. They are obligated to collect a fair amount of the waste fraction they are approved for (Avfallsforskriften, 2004, §7-9c), and this needs to be connected to the total amount of waste their members put on the market. Therefore, the fee should match the cost of collecting the same amount of waste as the producers put on the market. Return companies are also obligated to have financial reserves that can cover a minimum of six months of operation (§7-14a) and cover the costs for a

register that shall hold data from and about producers and importers, as well as identify businesses that do not fulfil their producer responsibility (§7-14b).

The requirements the return companies must meet varies from what fraction they work with. For electronic waste and batteries there are other rules and regulations which we will not consider. For packaging on the other hand, it is strongly connected with the household waste regulations. As for the collection targets for the municipalities, there are three increasing thresholds coming up. These are minimum requirements that the return companies must meet running from the given year. For plastic packaging, now it is 30% but increases to 50% in 2030. The percentage is calculated as the fraction of the total weight of the waste the members/customers of the return company put on the market that is recycled.

From year:[1]	**Plastic packaging:[2]**	Metal packaging:[3]	Aluminium packaging:	Glass packaging:	Cartoon packaging:
→2024[4]	**30%**	60%		60%	60%
2025	**47%**	70%	50%	70%	60%
2030	**50%**	80%	60%	75%	60%

Table 4: Recycling requirements for return companies (Avfallsforskriften, 2004, §7-9a)

Return companies must once a year carry out at least one information campaign for each fraction they are approved for (Avfallsforskriften, 2004, §7-10) They can either choose to go about it individually or work together with other return companies on fulfilling this requirement.

Producers are also obligated to work with waste prevention and reporting of prevention measures, results and developments that are happening (Avfallsforskriften, 2004, §7-6 & §7-7). The work with prevention cannot be outsourced to the return companies. Reporting on the other hand can be done in collaboration with the other producers, so this is normally something that is done

[1] Left out brown paper packaging and wooden packaging
[2] Excluding expanded polystyrene
[3] Iron based packaging from 2025
[4] Current requirement through 2024

through the return companies. Doing so also makes it easier for the Norwegian Environment Agency (NEA) to follow developments.

One of the main problems inside the EPR schemes is an issue with freeloaders. Some businesses choose not to take part in the EPR schemes and by doing that they save money and get a competitive advantage. A good example of this is foreign companies delivering to Norway. Companies like Amazon, Alibaba etc. are not covered by the EPR schemes in Norway, and that means more plastic packaging (and other) that is not prepaid to be collected is imported onto the Norwegian waste market. These are not accounted for, but it is still expected that the municipalities shall collect it, and hence the return companies must take it in. It is impossible to separate plastic from freeloaders from other plastic once it is collected. This is the case for about 60 000 tons of plastic every year.

5.2.1 Deposit refund system (DRS)

There also exist parallel return solutions that are excepted and have their own regulations, like deposit refund systems (DRS). Norway has a well-functioning deposit system for PET bottles and aluminium cans. How it works is that when a consumer buys a bottle or can, they pay an extra fee of 2-3 NOK which they are reimbursed if they bring the bottle back to a store that sells the same type of good (infinitum, n.d.). All stores that sell such products are obligated to take them in and pay out the fee. This gives the consumer an incentive to bring it back. Most grocery stores have reverse vending machines that accepts the bottles/cans to make it easier for both consumers and the store to take them in. This is a “closed loop” in the sense that no other waste gets into this stream, but unfortunately not all bottles are returned. The system is funded similarly as the other EPR schemes, with producers and importers paying a set fee for the amount the put on the market. The incentive to join this system is that there is an environmental tax for every unit that is put on the market. However, when in a return system and the return degree gets higher, the tax is reduced until it completely vanishes at a given percentage (Infinitum, n.d.).

5.3 Composition of waste

To provide an example of what the waste looks like we want to present the waste composition of Oslo from 2021. We cannot say it represents the whole country, but we believe the numbers in other municipalities will be similar. The selection is taken from the waste bin in Oslo where residual waste is combined with bags for plastic packaging and food waste. Paper and cardboard are left out of the mix as it is thrown in another bin. There is still paper and cardboard in the mix, but that is due to faulty sorting.

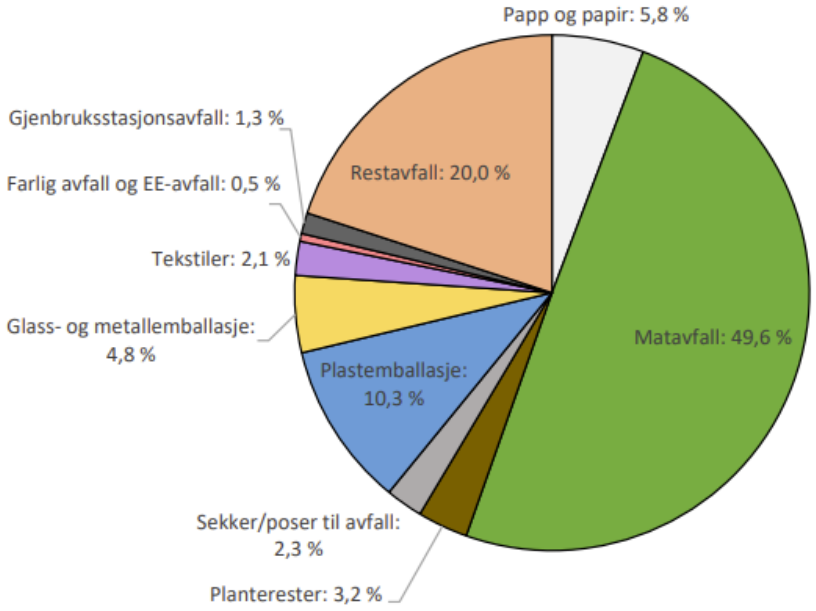

Figure 3: Waste composition in Oslo (residual, plastic, and food waste) (Oslo Kommune, 2021)

As one can see, food waste dominates the waste covering about 50% of the waste. Only 20% is what is considered residual waste, about 10% is plastic packaging and 4.8% is glass and metal. Green waste is 3.2%, waste bags amount to 2.3%, textiles are 2.1%, E-waste and hazardous waste amount to 0.5% while 1.3% should have been brought to the recycling stations.

6.0 Findings

To present our findings from each interview with the waste companies we will use our two main dimensions of the framework, relational and commercial. The two dimensions will be used as head titles, and then we have the four relating factors of each dimension underneath. We will present the PRO Plastretur first, then follow up with their three members ROAF, ØRAS and RfD that we interviewed. Then we will present the PRO Norsirk and follow up lastly with the findings from out interview with their customer the Municipality of Oslo.

6.1 Grønt Punkt / Plastretur

Plastretur, along with Norsirk, is one of the two approved return companies for plastic packaging from municipal waste. Plastretur is strongly tied with Grønt Punkt Norge, and they were previously under the same administration. Plastretur along with four other return companies is the owner of Grønt Punkt Norge AS and, as of January 2023, Plastretur is responsible for collection and recycling of plastic packaging. Grønt Punkt Norge have had this responsibility for Plastretur since 2008, but due to increased efforts around plastic waste they have decided to divide the tasks to facilitate building a sorting facility for plastic in Norway. Grønt Punkt will still be responsible for funding Plastretur through their members, together with the other return companies, among others for Glass and Metal. Plastretur still buy services such as communication, development etc. from Grønt Punkt, and they also share the same office facilities.

> *"We are under the same umbrella, with Grønt Punkt at the top and all the other return companies for glass, metal, paper, plastic etc. below."*
> *(Quality manager, Plastretur)*

Figure 4: Plastic packaging life cycle - Plastretur

Grønt Punkt's foundation are their members, who are companies that put product packaging on the market, normally producers or importers. These products are then bought and consumed by customers before the packaging is considered waste by the majority. It is now the task of the municipalities to collect, separate plastic from the residual waste and press it to bales. When the municipality has collected enough bales to fill a truck (18 tons), then Plastretur is contacted, and they order transportation through a transporter (Bring). Plastretur then coordinates transport by train down to one of three facilities in Germany. One where plastic is sorted and recycled, and two where plastic is sorted and sent further on for recycling. This way they utilize the negative trade balance and achieve a good price. From this moment, Plastretur do not own the packaging, but they are still responsible for the packaging being recycled as best as possible. The packaging is then made into recycled material (granulate) that can be used in new recycled plastic products which in turn will go back out on the market. This is the life cycle of plastic products in the system of Grønt Punkt and Plastretur.

The cash comes in from the members who pay a price per ton of packaging they put on the market. This cash flow is used to pay the municipalities (suppliers) a price per ton for what they have collected. These agreements are called "municipal agreements" (kommuneavtaler) and implies that they get a better price the better the quality is. Contaminations can be either because of wrongful sorting or organic remains, and perfect quality would then be at 100%. There are steps for quality which then determines the price. The quality is checked by having a **picking analysis** that Grønt Punkt performs annually or semi-annually. That along with the choice of collection system determines what the fee will be. Municipalities that have chosen to go with coloured bags and optical sorting receives a worse price than those using transparent bags or bins. The same goes for those that store the bales unsheltered. Water and snow increase the weight of the bales. Bags made of coloured foil, as in the optical solution, have a lower value. Clear foil gives the buyer more possibilities with the granulate. Large batches of coloured plastic give the granulate a distinct colour.

Picking analysis: They remove one or two bales (500kg), opens them and spread them out on the floor. Each object is physically sorted into categories and weighed as a part of the original weight of the bale.

> *"Experience also shows that municipalities supplying optically sorted coloured bags on average has a higher degree of contamination. A much larger share of the bags is used for residual waste. For instance, in the bathroom, the bag fits perfectly in the small garbage bin you have there, so Q-tips and all other sorts of stuff is put there." (Quality manager, Plastretur)*

Next, Plastretur pays for transport and sells the bales to sorting facilities or recyclers abroad at a negative price. This is called a "gate-fee", meaning they pay for the service of sorting and recycling. The plastic waste is not valuable enough to provide a positive price. The recyclers then must deliver the degree of recycling (sorting rate) that Plastretur demands, so that they can fulfil their 30% recycling obligation. Therefore, trust and reliability are important, and they only work with companies that are skilled and traceable.

Communication

Plastretur collaborates well together with Grønt Punkt. Plastretur works together with the municipalities on one side and with recyclers on the other. There is no communication between the municipalities and downstream actors like sorting and recycling facilities. Then Grønt Punkt communicates with their members, among others on design for recycling and trying to improve the processes from the start of the life cycle. This collaboration allows for both municipalities and downstream actors to share challenges so that Grønt Punkt can bring this forward to their members.

Communication towards municipalities is characterized by frequent quality revisions through the picking analysis. Based on the results, Plastretur comes up with improvement ideas in collaboration with the municipalities. The results are reported back with all the different categories. What fractions had most wrong sorted objects, how much was organic remains etc. “They get good insights” (Quality manager, Plastretur).

> *«Sometimes we suggest improvement measures, and other times the municipalities themselves know best how to improve the quality.” (Quality manager, Plastretur)*

> *“It is with close dialogue and physical picking analysis. Only then, when you are in contact with the waste, can you get a good impression of the status and how you can improve.” (Quality manager, Plastretur)*

The frequency of the picking analysis is determined by the performance. They are executed yearly for the municipalities that perform the worst, and for those delivering the largest amounts. For the rest it is normally done every second year, but for some also every third year. This indicates that they distinguish between the efforts they invest in the municipalities. They also have communication in between the analyses, for instance at conferences and other meeting areas.

> *"It is the quality revision, the formal big revision. But we also have dialogue in between as well, amongst others at conferences and so on, and we have other meeting points with the municipalities." (Quality manager, Plastretur)*

The downstream actors also take their own picking analysis and distribute the results to Plastretur. They get monthly sorting reports about what they received and what goes through sorting and recycling, so they get a lot of insight but not on the municipal level.

The downstream actors do not comment on the practices of the municipalities, but they do come with feedback which is aimed at the producers. A lot of plastic will not be sorted and/or is hard or even impossible to recycle, so they give feedback with suggestions to improve the design for recycling. There is a close and frequent dialogue that mostly runs through the development department at Grønt Punkt.

Another example of how they work with recyclers is with Quantafuel. They are a chemical recycling company that has tried to enter the recycling market. The problem with mechanical recycling is that the plastic output cannot be used for food packaging after recycling, (except for closed-loop systems like deposit refund schemes). This is because you do not know what the plastic have been used for or in contact with previously. When using chemical recycling, the recycled material is then raw oil and is considered virgin. They held a close dialogue over time, with frequent information and documentation of output and quality over time. Chemical recycling requires an extremely high degree of cleanliness. To be approved by Grønt Punkt as a recycler Quantafuel had to showcase and document a good output from their process. The same goes for other facilities, every new facility must be approved individually. As of now, only ROAF has good enough quality to use this process, so their foil/laminate, or more specifically all the plastic bags used to contain the waste, is sent to Quantafuel. ROAF also worked with Quantafuel for 4-5 years, as well as on research projects with NTNU to improve and understand this type of recycling.

6.1.1 ROAF – Romerike avfallsforedling IKS

ROAF is an intermunicipal waste management company owned by seven municipalities in the region north-east of Oslo. They serve more than 200 000 residents distributed among about 90 000 households. ROAF is a bit of a special case and cannot be directly compared with the other municipalities. This is because they are along with IVAR one of two waste companies in Norway that operate sorting facilities that can sort different polymers (PP, PET, HDPE and LDPE) out from the residual waste. Because of this they do not ask their residents to separate the plastic from the residual waste, and all sorting of plastic is done in the facility. The facility at IVAR recently burned down, so ROAF is the only one in operation. The sorting facility also sorts mixed plastics, paper, and metals, but for different reasons this is not optimal in itself.

About 75 000 tons of waste runs through the facility each year, of which 55 000 tons is disposed for energy recovery. They are subject to public procurement, so when buying the energy recovery service, they must send it out for tenders. Right now, Norsk Gjenvinning is responsible for energy recovery. Sales on the other hand is not under public procurement, so this is easier, and they can sell on the spot market. For the plastic fraction, it is recyclers that are the customers. Since it is already sorted into different plastics, the recyclers clean, crush and melt the fractions into new pellets.

6.1.1.1 Commercial dimension

System

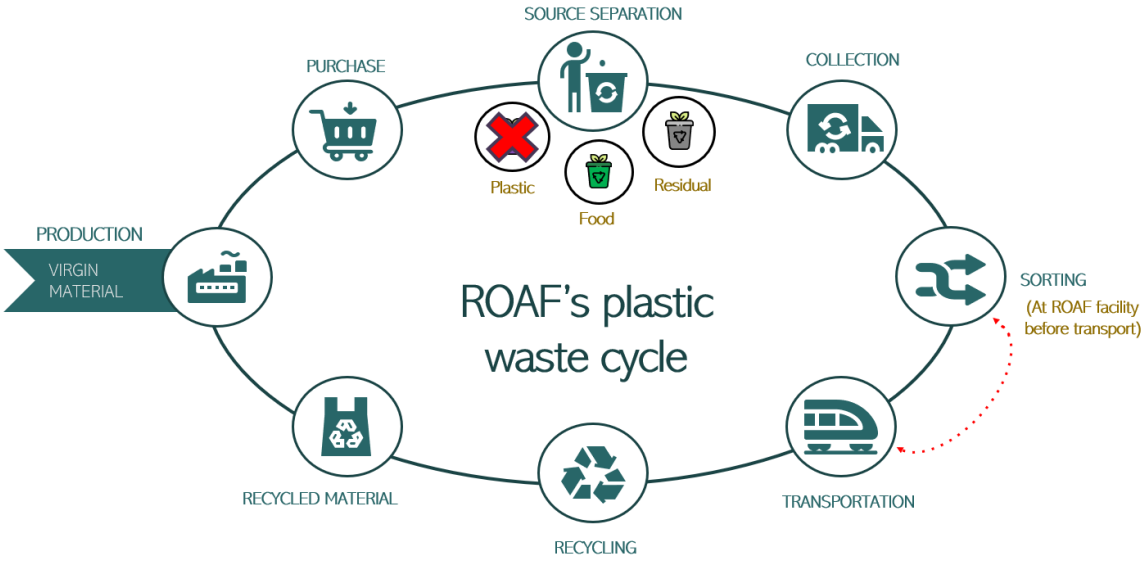

Figure 5: Plastic packaging life cycle - ROAF

As mentioned above, the collection system at ROAF is easier than other municipalities, because they do not ask residents to separate plastic. This means there is one less fraction to collect. The current solution has two bins, one for residual waste and one for paper and cardboard. Food waste is sorted in green bags and placed together with the residual waste. These green bags are read by optical scanners and then shot out of the waste stream when they reach the facility. Glass and metal on the other hand must be delivered to a return point.

Facility has capacity of 75 000 tons, distributed over two shifts. The facility was built with excess capacity because they are the region in Norway that the most people move to. ROAF have more than 40 000 tons themselves, but while they have capacity, they also run the waste from FolloRen, Halden municipality and from ØRAS through the facility. ØRAS has separate plastic sorting as well. FOLLO and Halden do not have separate sorting of plastic.

As mentioned, Norsk Gjenvinning is responsible for the post sorting energy recovery. Food waste is delivered to “den magiske fabrikken” in Tønsberg, while glass and metal is delivered to Sirkel in Fredrikstad. The plastic fraction usually goes through a return company, but for ROAF it is different. Because they have all the polymers sorted, they can sell it directly to recyclers. They still work with

Grønt Punkt and Plastretur, who does picking analysis and determines a compensation fee for them as well. This fee is similarly used as a part of the funding of the facility, but mostly to pay recyclers to recycle the non-profitable polymers.

Quality

The quality is determined through the picking analysis. External consultant Mepex does this for Grønt Punkt. Because the polymers are already sorted, it is done a bit differently than for the other municipalities. They remove 100kg of each polymer and hand sort. If more weight is organic remains than plastic, then it is contaminated, and GP does not want to pay for this.

ROAF has recently experienced less contamination now than previously, which they believe might be connected to poorer financial times. They also see there is less food waste now, so people might be using their resources more carefully. About 100 tons less is going through the facility every week now, which is substantial. For ROAF, sorting out food waste before it goes through the facility is very important. This makes it easier for the machines to sort correctly, and there is also a lot less contamination on the final product. This increases the quality, the price they receive from recyclers, and the compensation they get from Grønt Punkt.

Feedback from buyers/recyclers is also important for how ROAF works with quality. An example of this was in the early days of operation when a recycler (Kedenburg) complained about yellow PET containers that a producer used for chicken. The yellow colour influences the colour of the recycled product making it harder to reuse. Then ROAF's sales representative called the producer and two days later the packaging boss for the producer was sitting in his office trying to sort out the problem. The containers were later changed to a transparent solution to improve recycling performance. Before 2014, none of the producers thought about design for recycling. It was all about shelf life, food safety and visibility.

Initiatives

> *"Our most important task is to ensure that renovation works well in all of our owning municipalities, in an environmentally friendly way." (Sales responsible, ROAF)*

ROAF works on multiple fronts to improve their operations. As mentioned above they work closely with recyclers to improve the final quality. On the other hand, their communication department works hard to try to get people to use the green bag for food waste. Millions have been invested in different campaigns to increase how much food waste is collected. Amongst others they use a bag lottery, where you can write your phone number on the green bag and earn the chance to win a 5000 NOK gift card. One of the problems with this is that those who join are usually the people who already are good at sorting. They are only at about 50% sorting of food waste, which is below the EU target. About 15-20% is also lost in the process, either in the truck, or throughout the facility. One initiative they did was to test out having a separate bin only for food waste. This proved successful and is being introduced further this year. They believe many residents do not believe in the system when it is mixed with residual.

The sales representative himself is working closely on the packaging bit. A large part of his job is to try and influence the market by working with the producers to optimize the packaging for optimal sorting in the facility. Grønt Punkt has also joined in on this and are investing large resources together with "Handelens miljøfond".

> *"Out of 160 people, the sales department consists of me. But we are clearly a supplier of raw materials, and I believe this part of the operation will increase in the coming years." (Sales responsible, ROAF)*

> *"He does such wonderful things, like getting Idun to change the label on the ketchup bottle." (Analyst, Norsirk)*

ROAF works closely with the owning municipalities as well. Lillestrøm is the largest municipality and adds most weight in deciding questions. Together they have agreed on increasing the recycling goal from the EU target of 65% to 70%. They also arrange an owner's day, where they explain and try to communicate what has been done to reach the goals. They try to influence and make it easier to sort and collect waste in apartment buildings etc. Waste management is often not prioritized by the architects, and now ROAF at least has a say before new projects are approved. Being listened to on the problems is not easy though. Renovation fees are kept low while water and sewage have increased fees substantially in recent years. There is not much to go on for the renovation part.
"This year it is also local elections, meaning we will probably not get anything through." (Sales representative, ROAF)

Incentives

Incentives largely circles around prices. Prices are determined by the degree of plastic cleanness, meaning that there is little wrongful sorting. Mixing polymers messes up the recycling process. ROAF guarantees 96% cleanness, but usually deliver 98-99%. Might be some small deductions due to organic remains. They are interested in having the buyers over to visit, so they can see the quality and the actual value themselves, enabling them to give a fair price.

Prices has varied a lot the last years, with a dip during Covid. The last year, new EU rules about using recycled plastic in products is in the making. This increased the prices on PP, HDPE, and similar multiple times. This was gold for ROAF who have these fractions for sale. It has stabilized due to the energy crisis, but the prices are still much stronger.

> *"Normally I have had to call around to see if someone wants to buy a batch, but suddenly I could just sit and answer the phone calls from everyone". (Sales representative, ROAF)*

For LDPE (foil), prices have normally been around zero or they must pay up to 1800 NOK per ton to have it recycled. Had it not been for the compensation from Grønt Punkt, they would have burned it (energy recovery), as burning is less than

1000 NOK. Lately, chemical recyclers such as Quantafuel has entered the market. The LDPE fraction now goes to Quantafuel, and since the product then is considered virgin, ROAF now gets paid for that fraction.

6.1.1.2 Relational dimension

Knowledge Transfer

It was very sad for ROAF that the facility at IVAR burned down. IVAR came some years after ROAF started to operate in 2014. The two facilities are identical in most ways, as they are from the same supplier. ROAF had shared a lot of information with IVAR, and they were hoping to receive more feedback about what is good and what could be better once IVAR was up and running in 2019. Only a couple of years later, IVAR was out of function and the information sharing would stop again. Instead, ROAF now collaborate with SÖRAB (Söderhalls renhållningsverk AB) in Sweden who has a similar facility.

As mentioned previously, they also work a lot on sharing information with the municipalities and help them learn what waste management is about.

Trust

Since ROAF trades the plastic themselves, they need to make sure that the recyclers do what they are supposed to do. The recyclers must be approved by Grønt Punkt, so they should be trusted to some degree. The problem mostly is with plastic foil (LDPE), as this fraction usually cost more to recycle than it is worth. During Covid it was harder to go visit the recycling companies and make sure they do as they are supposed to. This is critical because they pay them extra to recycle this fraction. Usually they visit regularly, and even come on surprise visits. In that period, ROAF tried to limit the number of recyclers they send to, and only send to those they have a lot of communication with and trust a 100%.

> *"Then we tried to limit who we sent the plastic to, and only send to those we have had rich communication with and that we trusted 100%. But 100% it can never be because in the plastic industry and the recycling industry they still act a bit like cowboys" (Sales responsible, ROAF)*

But the dialogue is good, and they have good relations on a very personal level. There is a high degree of credibility and trust among them.

Grønt Punkt was very reluctant to believe in the sorting facility in the start. They did not like the idea that ROAF would ask their residents to stop sorting plastic. They believed what would come out in the other end would be an unsellable mess, but two months later they turned around and are now one of ROAF's best and most important partners. People believed the new facility would be like some previous facilities from the nineties that were far from the same quality.

Communication/cooperation

As ROAF handles the sales of their plastic themselves, rather than using Grønt Punkt's services, the sales representative has direct contact with recycling companies in Germany, Netherlands, and Poland.

> *"Very close communication with our customers (on plastic)" (sales responsible, ROAF)*

They try to visit the recycling facilities at least once a year, either as known visits or as a surprise. Further, good relations are sustained through constant feedback, both when delivering plastic and if something were to come up. Extremely rare that they get any complaints. One example of communication was that they complained about the plastic bales sinking together during storage and transport becoming harder to handle and stack. This was investigated and now they are using multiple straps to secure them. Most communication now goes through Microsoft Teams, while previously phone and WhatsApp was mostly used.

New buyers are also normally invited to come visit the sorting facility before they buy. The quality is technically very good, and few suppliers can deliver the same quality. ROAF believes it is important that the buyers come and see the waste for themselves, because there is some organic remains on it. However, until now there have been very few or no complaints about the organic remains, because the washing processes at the recyclers have become very good. There is a much larger

challenge with all the plastic going in the residual fraction elsewhere. Only the plastic bags people use as waste bags are getting sorted at ROAF and incinerated everywhere else.
As explained earlier also, ROAF has a solid collaboration and communicates frequently with Grønt Punkt and producers. With the help from ROAF, Grønt Punkt can test out new packaging designs etc. in the sorting facility to work with the producers more efficiently on minimizing waste and maximizing recycling.

Commitments

ROAF is committed to Grønt Punkt/Plastretur in multiple ways. One can say they are committed both positively and negatively calculative to Grønt Punkt. Positively means they gain value and advantages from working with Grønt Punkt. This is true because Grønt Punkt pays them compensation for a lot of the work they do and provides a good platform to collaborate with the producer, so that they can get the best out of their product. Negatively means that they have limited options. In Norway there are a limited number of return companies that can pay this compensation. There is only one competitor, and previously there was a monopoly. We may also say they are committed normatively, that they feel a moral obligation to stay with Grønt Punkt.

> *"The obvious is that they have been with us the whole time. They were our biggest opponent but are now our best partner." (Sales responsible, ROAF)*

Towards the recyclers they are less committed. There are more to choose from, even though the recyclers must be approved by Grønt Punkt. Especially recently when the prices of secondary plastics have increased. There are few moral obligations, so the commitment must come from a positively calculative perspective, meaning that the recycler providing the best deal will be preferred.

6.1.2 ØRAS – Øvre Romerike avfallsselskap IKS

ØRAS is an inter-municipal company responsible for the waste management in four municipalities a bit north of Oslo. The region is less urban and made up mostly of farmland, forests, and smaller cities. It houses about 90 000 people in approximately 37 000 households.

> *"Our main purpose is to handle municipal solid waste for our owning municipalities in an environmentally and economically sustainable way." (CEO, ØRAS)*

6.1.2.1 Commercial dimension

System

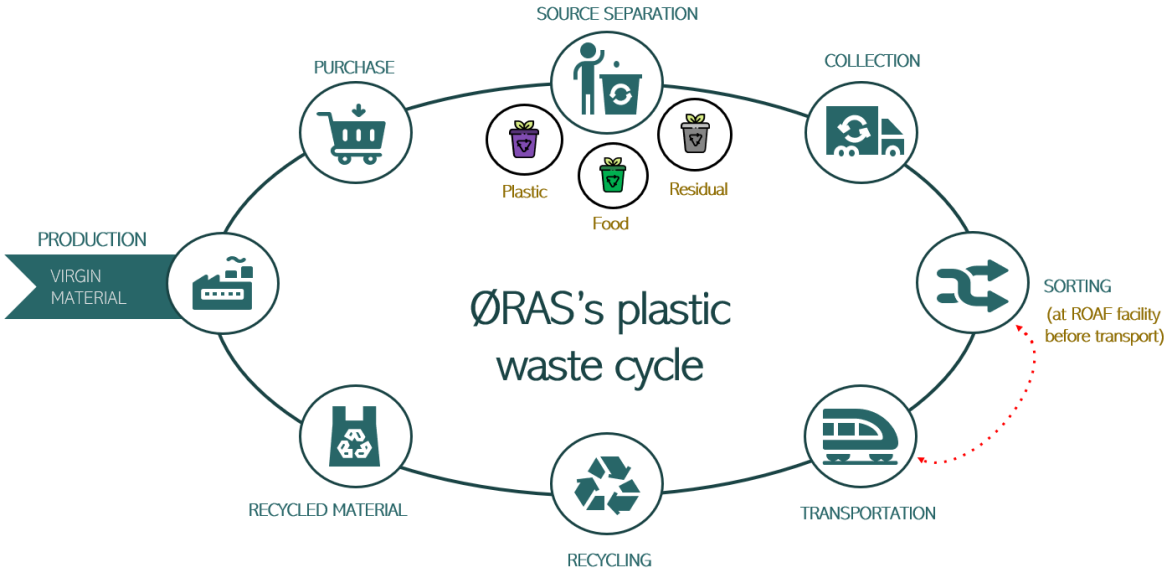

Figure 6: Plastic packaging life cycle - ØRAS

ØRAS carries out their renovation by themselves for glass and metal, the rest is handled by NordRen. The system of waste collection in the region revolves around two bins and one plastic bag. One bin is mixed for food waste and residual waste, while the other is for paper and cardboard. Food waste goes in green bag together with the residual waste. The transparent plastic bag is for plastic packaging waste and is supposed to be left along the bins on collection day. Glass and metal must be brought to central collection points. Recently they have also

been trying out and plan to expand a project with another bin for glass and metal as well.

Post collection, paper and cardboard is delivered to the waste company Ragn-Sells. The same is plastic packaging, but only for reloading and baling before Plastretur collects it. The residual fraction is first sent through an optical sorting facility to separate the green bags from the rest. Food waste is then sent to the biogas facility at Nes which is run by the energy recovery agency in Oslo (Energigjenvinningsetaten). Residual waste is finally sent to ROAF to go through their sorting facility. That way, excess plastic can be sorted out before it is sent for incineration.

They talked about an issue that downstream solutions change over time. An example of this was with Styrofoam. Earlier, Styrofoam was supposed to be delivered as plastic packaging, but not anymore. Now it should be sorted as residual waste or delivered to the recycling station. Different downstream solutions make it challenging to keep the residents up to date on how to sort. The same goes for different downstream solutions between regions.

In 2022, ØRAS sent 44% of the waste to incineration, 52% was recycled, 2% was being reused and 2% was landfilled. (*ØRAS IKS*, 2022)

Quality

ØRAS has impressive results with their separate sorting of plastic, collecting about 17kg per resident, which is among the best in the country. But from the picking analysis of the residual waste, there is still about 9% plastic in the residual fraction. In the plastic fraction they are at about 12% contamination now, meaning 12% of the contents are not plastic packaging. But they have previously been so low as 4%. It depends on where the tested fraction comes from.

> *"Those living in detached houses in the countryside are better at sorting than those living in apartment buildings in the city". (CEO, ØRAS)*

They are not that good when it comes to food waste and is only at about 50% sorting of that fraction, so there is a big potential for improvement there.

Initiatives

At ØRAS they are doing several things to improve and increase the sorting and quality. They engage in continuous dialogue through social media and their web pages. Once or twice a year they also release a magazine called "Miljøposten" (The environmental post) with information about packaging and plastic products. Information received from quality tests and picking analysis by Plastretur is considered and used in the communication either in their own channels or in local newspapers, radio, and other advertising. This communication normally includes examples of things that are not supposed to be sorted as plastic packaging. This can be like a net for firewood, which is a type of plastic, but not the same as packaging. The same goes for harder types of plastic.

For the younger residents, ØRAS has this thing they call the ØRAS school. That means 4th and 10th year schoolchildren come by for a visit every year to get an introduction to sorting and why it is important. Then they learn more about what happens to the waste once it is collected from their homes.

> *"We see that the quality is getting better, and that is the feedback we receive from the picking analysis" (Communication advisor, ØRAS)*

Same as for ROAF, ØRAS has also imposed stricter requirements for sorting. The goal for sorting rate is at 70% instead of the EU and national standard target. The regions try to agree on these kinds of things, and work closely with each other on standing united. This is a part of their strategy. They have also discussed collaboration around sorting facilities. As for now they send their residual waste to ROAF for a second round of sorting. External consultants have been mapping regions on who should collaborate and on what they should collaborate on. There is little point in building a facility for each municipality or every company. ØRAS for instance do not cover so many residents, so it would be inefficient.

Incentives

To increase the amounts collected and the quality of the collected fractions, the price is the most important physical incentive. And the most important factor for the price is the quality. ØRAS works with Grønt Punkt/Plastretur, and the cleaner the plastic is, the better they will get paid. This is explained more in depth above.

6.1.2.2 Relational dimension

Knowledge Transfer

ØRAS collaborates and shares experiences through Avfallsforum Øst. Avfallsforum Øst is a forum for waste companies and municipalities in Oslo and some of the regions surrounding Oslo. Here they discuss and collaborate on ideas, projects, and deals and tries to get the best terms. On the other hand, ØRAS was not aware that ROAF was selling plastic by themselves, and not through Plastretur.

ØRAS have also been helping LOOP, which is an ideal foundation that works on getting people to sort more and throw away less. Together with Grønt Punkt, LOOP has been developing new symbols for waste that will help sorting. These symbols are now printed on most products to help people know how it should be sorted. The symbols are colour coded and are equal across the country. Grønt Punkt is also lobbying this abroad in the EU. ØRAS has been sharing input to help the development of the symbols.

Further, ØRAS collaborates with other waste management companies on different tasks. They collaborate with others on knowledge and capacity when it comes to landfilling. ØRAS has more space to operate this, even though they do not want to landfill, some waste is difficult to recycle or energy recover. The same goes for garden waste, which requires more space as well.

Communication/cooperation

The answers we got when asking about the dialogue downstream were very short and gave little insight. About the biogas facility:

> *"Yes, we have conversations about quality with the facility we deliver to" (CEO, ØRAS)*

> *"Yes, we deliver the food there, and then we get fertilizer and biogas back. The renovation vehicles run on biogas." (CEO, ØRAS)*

Towards Plastretur and Grønt Punkt they work closely. Much goes through LOOP which is the main communication channel. When they find examples of where design can be improved, it is easy to take this to LOOP and Grønt Punkt so they can bring it forward to the producers. The process from given feedback to a solution being put in place is long, which can be problematic. It is a big system, and each waste management company is very small, so it is not given that any feedback is considered in the end. They also collaborate through Avfallsforum Øst as previously mentioned.

Plastretur comes and does picking analysis regularly. Based on the results they give feedback on contamination and wrongful sorting that ØRAS can use in their communication with the residents. Grønt Punkt also sends out newsletters once a week, with more information about sorting and packaging in general. In-between the picking analysis' it does not seem ØRAS has any contact with Grønt Punkt or Plastretur, as neither the CEO nor the communication advisor had any contact with them in-between. Sirkel who are the return company for glass and metal also gives feedback when the fractions are contaminated.

There is a communication problem because there are different systems of collection in nearby municipalities. The residents have a hard time understanding why they must sort plastic when in the neighbouring municipalities (ROAF) they do not have to. Similar problems concern the recycling stations as well. Some municipalities combine the fee for the recycling stations and the renovation fee, meaning the station is free, while others ask you to pay for what you deliver.

People then drive between municipalities to deliver where it is free. Therefore, they mentioned that it is an advantage when there are concrete demands coming from the government.

> *"Then you cannot sit on your own hill and have your own solution. You are forced to cooperate and find a solution together." (Communication advisor, ØRAS)*

The dialogue with the owning municipalities could have been better. They have a frequent dialogue with the administration and politicians, but they have a low understanding of what ØRAS do because of the complexity of their business. The dialogue usually concerns economy and provision from sales. For example, the municipalities do not understand that the prices are volatile. Metal prices can range between 500 and 3000 NOK per ton which is a major difference. The politicians want to keep the fees down, and instead of increasing the renovation fee they increase taxes, while ØRAS must save. This inflicts ØRAS's opportunity to invest in their operations. Another problem is that the municipalities often do not agree with each other. It is easier to set goals and manage them for municipalities that do their own renovation, like Oslo.

> *"The municipalities, our owners, have worked out a strategy for the company towards 2030 with recycling goals. But when things start to cost money, then the strategy and the goals are not that important anymore." (CEO, ØRAS)*

Commitments

ØRAS also uses Grønt Punkt as their return company for plastic packaging. It had recently been out on tender, in collaboration with "samfunnsbedriftene" which is an interest organisation for municipal companies. Grønt Punkt or now Plastretur delivered the best deal, so they chose them. This points to ØRAS having a positively calculative commitment towards Plastretur, because it is based on them getting the most value from the deal. Since it has been on tender, we can also say that they are not morally (normative) or affective committed. But as for most

others, they are to a degree negatively calculative committed, due to there being only two return companies for plastic packaging.

6.1.3 RfD – Renovasjonsselskapet for Drammensregionen (IKS)

RfD is the municipal waste management company responsible for waste collection in Drammen and four other municipalities in that region. The region house about 169 000 people distributed among about 75 000 households (RfD, n.d.).

How RfD looks at themselves as a business:

> *"Really good, we are one of the best companies in the country, not as good as ROAF, but we collaborate with them. The waste industry is not so big, we know each other." (Advisor, RfD)*

> *"We all try to be the company the furthest ahead when it comes to sorting and recycling. That is where we compete and benchmark us" (Advisor, RfD)*

> *"The goal is to be best in the country at material recovery, and I am not talking in percentage, I am talking about being the best!" (Advisor, RfD)*

RfD consider themselves a client in most trades. They buy all the services from different suppliers, except the people working at the recycling stations. They are employees of RfD. The missions are passed onto different suppliers who solves them. RfD is mostly an office that organizes everything. But on the other hand, they have recently opened a new reloading facility which they also own.

> *"We are a client."*

> *"We were originally rigged as an ordering organization."*

> *"We are concerned with being clients, and to perfect the role as clients." (Advisor, RfD)*

6.1.3.1 Commercial dimension

System

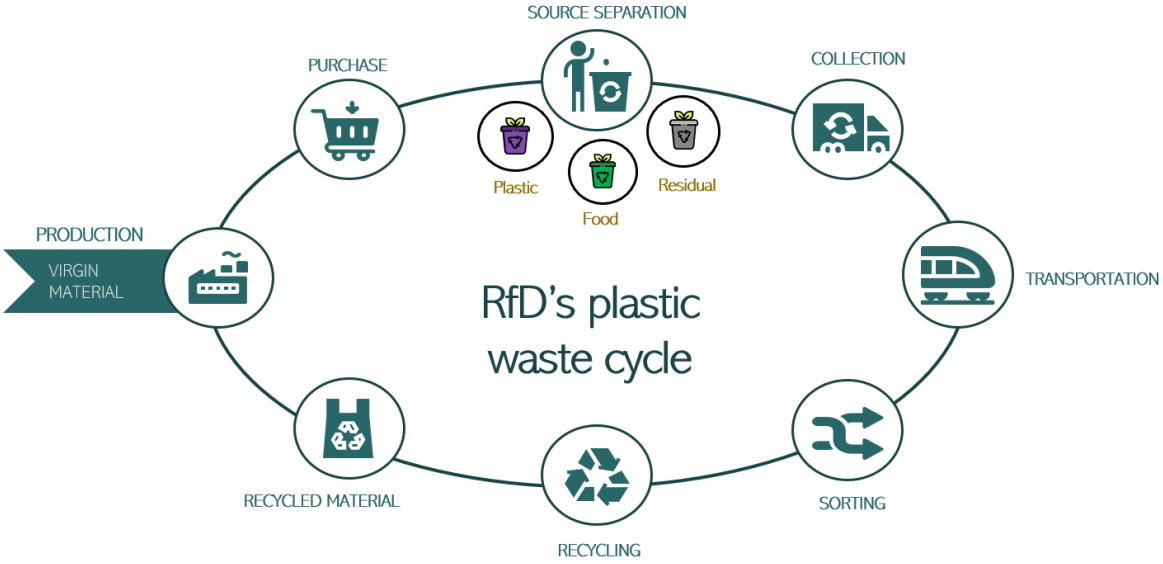

Figure 7: Plastic packaging life cycle - RfD

At RfD, five fractions are collected from the households. None of the five major fractions are supposed to be brought to collection points. There are separate bins for glass and metal, paper, and cardboard, and one for food waste and residual waste. There are two chambers in the residual waste bin, where one is for food waste, unlike ROAF as explained above. This eliminates the need for the optical separation of the food waste bags. Plastic waste is collected in a separate bag.

They have one reloading facility where everything collected from households is delivered before it is distributed to the right actors. Plastic packaging is reloaded and baled into bales at around 500kg. When they have enough to fill a truck, they contact Plastretur, and they come and pick it up. Food waste is delivered to Greve ("den magiske fabrikken") for biogas production. Glass and metal are delivered to Sirkel in Fredrikstad. Residual waste is traded through Geminor. Geminor buys capacity at different energy recovery facilities, and now it is delivered to two facilities in Østfold, as well as to Klemetsrud in Oslo.

Quality

From the picking analysis, there is about 30-33% of the residual waste which is food waste.

> *"This is sad, because it should have been at Greve so it could become biogas." (Advisor, RfD)*

> *"There is a demand that we shall be at 65% recycling or reuse before 2025. We will almost make it, and if we had invested more resources into sorting of food waste, we would have made it elegantly." (Advisor, RfD)*

The plastic fraction is normally good, with about 10% missorting. This includes other types of plastic that are not considered plastic packaging. An example that was mentioned was pipes for pulling cables in houses, which is supposed to go in the residual waste. RfD works with quality management in a quality management system called QM+. There they can enter deviations into the system to have better insight and control of different deviations.

> *"They do as well as they can, but there will always be a small percentage missorting. This I have always said, we will never make it to zero percent missorting." (Advisor, RfD)*

> *"We have very good service and a good word out to the public".*

> *"We receive a good score from our customers (residents)." (Advisor, RfD)*

Between 2021 and 2022, the amount of waste went down. RfD thinks this was due to Covid, with more people traveling, interest rates and prices increasing etc. Recycling rates also went down because there was less waste. There was less waste of the types that was easily recycled, making it harder to maintain good recycling rates.

"To reach our goals, we need more waste, at least of the right type." (Advisor, RfD)

"We are not able to get all our waste fractions clean. That is something we struggle immensely with." (Advisor, RfD)

"Wrongful sorting will always be present. As mentioned, the goal is to reach a level that one normally must count with in the society. About 3% is how I look at it, you can't go any lower than that. The goal must be zero, but in practice you are unable to reach that." (Advisor, RfD)

"We focus both on quality and our mission. The quality is implemented in our contracts. (…) The hard part is to describe the quality when you know that there is wrongful sorting." (Advisor, RfD)

Initiatives

They use the quality management system to report deviations and other things that are less than optimal. Then these things are checked up on at the end of the year. Environmental status is made up with the suppliers, and they check what the suppliers have achieved with the waste. If there is a need, then they go after the suppliers to sort out eventual problems.

Further, RfD communicates a lot upstream, towards the residents. Communication mainly goes through social media like Facebook, tv-commercials and sometimes they even send out flyers. One on one communication at the recycling stations is also an important meeting area with the residents.

"What maybe is most challenging is what we collect at the households. Getting people to sort right, then it goes to our communication from us and out there." (Advisor, RfD)

"I believe people don't give a shit about us because we are a publicly owned company. They have many problems with public management." (Advisor, RfD)

"As long as people can fit their waste in the bin and not feel any responsibility, then it ends up in the bin." (Advisor, RfD)

When people first have put something in the bin, RfD cannot see if there is wrongful sorting taking place. It is about communication to each individual household. The most important thing RfD can do to help is to raise awareness about the whole system; how you are supposed to sort, why, and what happens to the waste in the long run. They have also communicated that if the packaging is too contaminated, it is better to place it in the residual fraction, to keep the sorted fractions cleaner and at a higher level. RfD believes that people lose the will to sort when we communicate that all plastic must be thoroughly washed. They do not believe in "cardboard lotteries" etc., because people in Norway in general are too rich, they are not interested in such incentives.

"Maybe better to act on the plastic that is easy to clean and return to the system, than for people to clean packaging that is not easily cleaned."
"I am afraid that if we start forcing them, then we will lose more than we gain." (Advisor, RfD)

Incentives

There is not too much different to say about incentives. It is still heavily dependent on the price received for the plastic. If there is a lot of wrongful sorting in the plastic fraction, then Plastretur deducts an amount from what they are paid, as for the other companies that work with Plastretur.

"We lean a bit on the return companies and the job they do. They must create the value, while we only provide the raw material. Then we get some compensation for that." (Advisor, RfD)

6.1.3.2 Relational dimension

Knowledge Transfer

RfD has total insight into documentation, bookkeeping etc as a part of the agreements. But for companies like Plastretur, which are approved by the directorate of environment, they do not use too much energy. The same if the suppliers use facilities that they trust, like Norsk Gjenvinning for paper and cardboard. They report what facilities they collaborate with on a yearly basis.

Trust

> *"We lean a bit on the return companies and the job they do. They must create the value, while we only provide the raw material. Then we get some compensation for that."* (Advisor, RfD)

When it comes to trusting the suppliers of the downstream solutions, RfD seems very active. They have made sure to have complete insight in the operations of their suppliers, with full documentation, bookkeeping etc. But as explained earlier, they trust known suppliers and facilities more than those they are less familiar with. Similar to Plastretur, which is approved by the Norwegian Environment Agency (NEA) and works closely to make sure that their partners are compliant.

Communication/cooperation

Communication towards Plastretur is centred around the regular picking analysis. How much communication there is depends on whether things arise, and if there are things that need to be taken care of. However, this is rarely the case, as RfD does everything they are supposed to. They collect and bale the plastic, and contacts Plastretur to schedule a pickup once they have about 18 tons, which is their demand. Plastretur cannot interfere with what they do at RfD if they are compliant, and it is not something Plastretur usually do either.

> *"We have signed an agreement, and we relate to that agreement."* *(Advisor, RfD)*

"We have not had any dialogue with them since last fall. For us, not having any dialogue, is actually something positive, it means things are going well." (Advisor, RfD)

Sometimes there is also some unformal communication, there is one employee at Grønt Punkt that lives in Drammen and comes by on visits from time to time. The downstream communication is quite easy, it is the upstream (residents) that is the hard part.

Communication with the municipality is less problematic according to RfD. They are maybe the only waste management company in the country that has been delegated all powers from the municipalities. The municipalities only want information from them when the municipalities are supposed to write their environmental reports. However, they do of course expect RfD to deliver what the government expects from the municipalities. They are very aware of the targets, but acknowledge that it is hard, especially considering food waste.
On reflecting the EU targets:

"It doesn't have to go from the EU via the government and the municipality to us. We catch the targets directly." (Advisor, RfD)

Commitments

RfD previously worked with Norsirk, but this stopped in 2021. They currently have an agreement with Plastretur running through 2024. There was not much to this other than some talk about prices and other minor things. The system is generally the same, and the waste is handled the same way. Though there were some internal problems. The person we interviewed was sick most of 2021, and it slipped a bit through their fingers. The deal with Norsirk ran out, so they were left without a return agreement for plastic packaging. Plastretur then stepped in to help and provided a good solution for RfD.

"Generally, one of the worst things that could happen for us is to be without agreements for disposal of waste." (Advisor, RfD)

Then for this commitment we could say they are slightly affectively and normatively committed, because Plastretur came in and helped them when they had a problem. This can have obligated them morally and increased the affection for Plastretur. Furthermore, they are even more negatively calculative committed as it seems Norsirk was not on their toes trying to retain their customer.

6.2 Norsirk

Norsirk is the second of the two approved return companies for plastic packaging. They have been in the producer responsibility and return industry for many years but have only recently started working with plastic packaging. They were approved in 2019 and started collecting plastic from 2020. Previously they have worked with producer responsibility for batteries and E-waste and have about 2000 customers on those fractions (Norsirk, 2023). By the middle of 2020 they had about 220 customers on plastic packaging, and today most of their customers on E-waste and batteries are also plastic packaging customers. Now they are at about 10% market share but are aiming towards 25% in a few years. They also emphasized that they have been compliant with the 30% recycling grade that is required for all three operating years, and that Grønt Punkt only recently had reached that threshold. Many are aware that Norsirk is a challenger, and some maybe want to try something new.

As with Plastretur, Norsirk is also a non-profit organisation that is owned by the industry, different return companies, and interest organisations. They operate very similarly but they highlighted that one of the differences was that Norsirk has customers and that Grønt Punkt has members. The customers put goods on the market and pay a small fee for the amount of plastic they put on the Norwegian market. This money Norsirk uses to facilitate collection, transport, sorting, treatment, salaries for the administration etc. The fee is decided by the amount of money needed to do the job, regardless of what fraction they represent. The E-waste and battery fraction is typically more valuable than the plastic fraction, so those fees are normally a bit lower.

The customers are the upstream in the cash flow, as they provide the funding through the fees. Operationally on the other hand, upstream is the waste management companies and consumers. Norsirk pays the waste handlers for collection and the effort of separating plastic from residual waste. There are different steps for this compensation based on quality, moisture etc, but almost everyone stays in the same step. “I have never seen anyone move a step.” (Analyst, Norsirk) Downstream is the sorting and recycling facility, and as for Plastretur, Norsirk pays a similar “gate-fee” for them to recycle the plastic. The plastic is acquired from the waste handlers, reloaded, and shipped by train to the treatment facility in Sweden. Norsirk as with Plastretur is still responsible to make sure that the plastic is being recycled.

For quality control, Norsirk also performs picking analysis of the waste. It is done once quarterly, so four times a year. Unlike Plastretur, the analysis is performed at the treatment facility when the truck arrives from the municipality. It is done by hand and sorted into many categories. The frequency of the analysis determines how often they can adjust and optimize the sorting machines at the facility based on the input. That way they can maximize how well the facility runs and minimize the amount that is not recycled.

When asked what they thought of Grønt Punkt/Plastretur not wanting to work with municipalities that uses the coloured bag optical sorting approach, they replied:

> *“We get them recycled, and then let’s leave it at that.” (Communication director, Norsirk)*

Communication

Norsirk meets formally two times a year with each of the municipalities. Preferably physically both times, but because of long distances one of the meetings tend to be digital. It is easier to visit Oslo twice a year than it is to visit ØFAS (Øst-Finnmark avfallsselskap). In the meetings, general things about challenges for both sides are discussed. What works well and what could be better, ongoing issues. They talk about operational issues, how things are going at

the treatment facility, quality of the plastic, how to communicate to the residents etc. Norsirk emphasizes to call everything dialogue. We asked about constructive criticism, but they did not like to use those words. They have a good collaboration, understand each other's situations, and want to talk positively about source separation because that is what it is all about.

> *"We have the same goals. Both for Norsirk, the producers and the municipalities. It is super important to have a good system for collection and recycling of plastic packaging." (Communication director, Norsirk)*

The content of the dialogue is very varied. Some municipalities want to change the colour of the collection bags to purple, as that is the colour of the general labelling of plastic packaging. Oslo, on one hand, have strong opinions about the system and politics concerning producer responsibility. They are also a big and important player with coinciding goals. On the other hand, the municipalities have little to no input regarding the design of the packaging etc.

Norsirk tries to treat the municipalities equally, regardless of how well they perform. They do not distinguish between municipalities with different systems either. They have their own challenges. There is maybe a bit more communication with Oslo, as Oslo is very active on social media and have more questions about how to communicate with the residents. Though this is very natural as Oslo is a big city with more resources and can afford to put more resources into this. They also have a challenging population with very different people and living arrangements. So, there are different initiatives from the municipalities and different initiatives from Norsirk as well.

> *"We know them well, and it is about how you meet people too. We collaborate with the municipalities because we have common goals, and it is important for us that the municipalities get feedback on the good numbers. We have a high degree of recycling, and the municipalities need to know and be proud of that and become even better." (Communication director, Norsirk)*

On the other side, Norsirk works with Swerec (bought by Stena Recycling) who washes, sorts, and recycles the plastic. They have a lot of communication with them where they work on finding better solutions and solving existing problems. Norsirk frequently visits them, and they sporadically visit Norsirk as well. A lot of dialogue on how to find the best solutions and get the best and highest degree of recycling.
The recycler comes with input about types of plastic, how the facility works, design ideas etc. that Norsirk can convey to the producers, but not too often. The industry largely agrees on what is the problem with the plastic. Optimally it should be mostly mono-material, minimum amount of laminate and foils etc. New things do occur, but it is the same challenges we are working on all the time. But the recyclers do come with strong opinions and good examples.

> *"Same messages all the time. Do not produce shitty plastic, produce plastic that can be recycled." (Communication director, Norsirk)*

> *"The recyclers are good to have on the team when Norsirk want to communicate things." (Analyst, Norsirk)*

> *"Do not tape paper labels on the products making them harder to sort" (Analyst, Norsirk)*

The same week we interviewed them Norsirk also held a one-day course on packaging and recycling. We were invited to come along, and one of us did. This is not the responsibility of Norsirk, and not a part of the EPR scheme, but it is important that the different responsibilities are communicated. The typical customers of Norsirk are electronics companies and importers, as most already were customers. This makes it harder for Norsirk to influence the producers, as most are international brands with international production. There is limited potential for a Norwegian sales team to influence production abroad. However, the producers or importers are still obligated to work with optimizing packaging and report what they do. This is something Norsirk helps them with as the directorate prefers to get a collective report. There are new regulations coming from the EU, so we want to help them prepare.

We also asked them how they reflected the EU and national goals for recycling.

> *"Luckily still some years to go, but as for now, the goal is only 30%, which we have managed with ease." (Communication director, Norsirk)*

New regulations for recycling are coming, and at the same time, new bans for using non-recyclable materials are coming. It will become more expensive. The fees to return companies will increase, and it will also be in the interest of the producers to produce recyclable plastic. The principle of Polluter pays will become even more important. The only problem is that the system is a bit slow, so things take time.

> *"To say it in an ugly way, it will hurt for the producers." (Communication director, Norsirk)*

6.2.1 Municipality of Oslo – Renovasjon og gjenvinningsetaten (REG)

The municipality of Oslo houses about 700 000 people and is by far the biggest municipality in Norway.
Oslo REG had this to say about their most important tasks:

> *"It is about a maintenance responsibility, with collection, cleaning up and doing that job. But it has developed from earlier where we uncritically collected and burnt almost everything." (Communication advisor, Oslo REG)*

They have gotten a greener mandate, where they talk about reducing consumption and reducing the amount of waste. They want to collect less waste.

> *"I am not saying we make a living of collecting waste, but that is what we do, but we do want to collect less waste." (Communication advisor, Oslo REG)*

6.2.1.1 Commercial dimension

System

Figure 8: Plastic packaging life cycle - Oslo

Their waste collection system is a combination of bring-in solutions and curb-side collection. Four fractions are collected from the households, while all other fractions must be delivered at collection points or at one of several smaller or larger recycling stations. Plastic packaging (purple) and food waste (green) must be self-sorted in coloured bags and put in the same bin as residual waste, before it is sorted out at an optical sorting facility post collection. Paper and carboard is collected in a separate bin curb-side, while glass and metal must be delivered to centralized collection points. These collection points should never be more than 200-300m from any housing.

Paper is then delivered to Norsk Gjenvinning who sorts and makes sure it gets recycled. Glass and metal are delivered to Sirkel in Fredrikstad, while plastic is baled and delivered to Swerec in Sweden for sorting and recycling with help from the return company Norsirk. Previously they used Grønt Punkt for the plastic fraction, however they cancelled all agreements with municipalities using optical sorting with coloured bags for plastic packaging, including Oslo in 2020. Food waste is treated in Oslo REG's (renovation and recycling agency) own biogas facility at Romerike. This is the only fraction they treat by themselves. Residual waste is energy recovered by Hafslund Oslo Celsio who runs two facilities in Oslo (Klemetsrud and Haraldsrud) which provides district heating.

Quality

Oslo municipality collects between 3 and 4 kg of plastic packaging per resident. There is about 15% contamination in this fraction, meaning that 15% of what goes in the purple bags is not meant to be there. This is not unusual as there are many misunderstandings regarding plastic sorting. A lot of things in the bags are not considered packaging, and some people even use the purple bags for residual waste which heavily impacts the quality. About 31% of the plastic waste that is thrown away finds its way to the purple bag, the rest is wrongfully sorted as residual or food waste. The same number for food waste is about 50% which is quite good. The contamination in the green bag is about 5%.

Quality is on the mind of Oslo municipality, even though the results are not too good. They see themselves somewhat as a supplier, but also as a customer of different services.

> *"Partly. We are an intermediary for almost all fractions, and we are concerned about it having good quality, because then we can sell more." (Communication advisor, Oslo REG)*

> *"We are both a customer and a supplier, in different contexts". (Communication advisor, Oslo REG)*

Initiatives

Oslo is very good at working with the communication towards the citizens, even though the population is diverse and challenging. This is usually done as a mass communication, as they do not have the budget to run too much targeted communication. There are no easy ways to dig through the waste of different groups of people to assess what type of communication is suited and to analyse the effect afterwards. However, they do carry out picking analysis every other year on a more general city level. These are also divided into different regions to see regionally how they perform, which can be used as an input for further communication.

Oslo started using the optical sorting system for waste collection in 2009. In the start, the communication towards the residents was very different than what it is now. Back then it was more like:

> *"Blue and green bag, blue and green bag, blue and green bag! It was all about what and how the sorting should be done". (Communication advisor, Oslo REG)*

Now, people want to know more about why they should sort, and they are also more concerned about the climate and how the system works. Knowledge about the system is important in the communication out to the public. However, knowledge on how to sort is still more important, and there are continuously moving new people to Oslo, like students, immigrants etc. There is much information for them to take in when moving to a new city, and it might not be that waste sorting is the most important things for the municipality to communicate. They must be careful not to hammer them with information.

Oslo recently changed colour for the bags for plastic. They went from blue to purple, which is in line with the colour of the national symbol for plastic packaging mentioned earlier. In the same time frame, the collected plastic per resident went from 3.4-3.5 to 3.9-4kg. Oslo believes this is due to increased communication about the colour change, something that might prove how important communication is. Since then, the sorting facility has been adjusted to sort out both blue and purple bags to not miss anything.

> *"For us, the question is, how can we sort out more? We believe that we must have a new facility that sort out plastics from the residual waste. And then someone must grant funds in some way. Oslo municipality must decide that we are going for it." (Communication advisor, Oslo REG)*

> ***"**If everyone had sorted out as little plastic as Oslo, then you would not stand a chance, you have to deliver more." (Communication advisor, Oslo REG)*

Incentives

Incentives are mostly centred around the price and how well they are compensated for the plastic fraction.

> *"But in the end, it is in our interest to do our best. If the quality is bad, then we get paid less for the plastic." (Communication advisor, Oslo REG)*

Amount collected (kg/resident) is irrelevant to the unit price received. However, the total amount collected will increase the total amount of units that you are compensated for, so increasing the collected amount is absolutely in the interest of Oslo. It is only quality and cleanliness that determines the level of compensation. For the return company, Norsirk, a sudden increase in collection would not serve them well, as they are still small and have less capacity to handle more waste than they do now. This is because they do not have as many customers and cannot increase their resources overnight to meet an eventual increase in demand.

6.2.1.2 Relational dimension

Knowledge Transfer

Regular meetings between contract managers, with quality follow-up and price negotiation. Oslo receives reports on the plastic as well as what happens with it further in the process.

Trust

There is not much to say about trust. Normally, the contracts Oslo has downstream are 2-4 years long and often with extension options making them even 6-8 years long. Norsirk only wants one-year contracts because they are very new in the business, and they are negotiated year by year without any big changes. Oslo do not work directly with the recyclers and only need to trust that Norsirk does what they say they are doing. Thus, they receive reports on Norsirk's recycling process. Norsirk must then trust that Oslo tries their best to achieve good results, something that they are incentivized to do.

Communication/cooperation

Oslo works with Norsirk as their return company for plastic packaging. They also work with Norsirk for fractions, like electrical waste and batteries. They mainly work through standard follow-up of contract, there are regular meetings between contract managers, following up quality and negotiation of prices. Norsirk then provides reports on the quality of the plastic and what happens with it further in the process. This is the normal way they work with these kinds of contracts, as they have a lot of them. Every six months they have formal meetings, and in between there are regular dialogue through e-mail when needed and in conjunction with reports etc. On how they perceive the relationship:

> *"Yes, it is very good today. There is nothing. We have a good collaboration with them." (Communication advisor, Oslo REG)*

> *"If there is something we want to know, then they let us know. There are no closed doors or anything. They are very open. It is a very good collaboration." (Communication advisor, Oslo REG)*

> *"Communication takes place in different ways, but business wise, it is the follow-up of contracts". (Communication advisor, Oslo REG)*

The communication department has very good communication with the communication department at Norsirk. This is beneficial when collaborating on messages regarding plastic and it is very nice for Oslo to be able to talk to them before they communicate anything to the public. Norsirk has better control and knowledge regarding different types of plastic and communication with the producers. Oslo on the other hand best know what their population looks like and how they should communicate with them. Not too much communication between Norsirk and Oslo on that part, but it is nice to be able to ask each other when there is a need. This type of communication was not usual in earlier years. There is also some communication among the leader groups.

"But previously, some years back we never thought of asking Grønt Punkt about these things, so there has been some development." (Communication advisor, Oslo REG)

Norsirk is aware that the system with coloured bags is flawed and not optimal. Most of what they can influence is on the communication with the public on how to sort etc. Oslo cannot change their system overnight. Even though Norsirk might be critical about something, like poor quality etc., there is no bad tension. Both Oslo and Norsirk are concerned with delivering as good as possible.

Oslo also communicates with the government and their agencies. They are keen to come with input in different hearings etc.

"Everyone can give input on these hearings about new regulations etc., and we do that." (Communication advisor, Oslo REG)

They get a lot of input, and it is a lot to consider for them. However, considering that Oslo is the capital, they believe that adds weight when they voice their opinions.

"I do not have an impression that there are huge changes from a draft to the final product, but I believe they take it (the input) seriously." (Communication advisor, Oslo REG)

There are also other challenges when communicating with the municipality. The municipality does not want cars in the city, which makes for unfavourable solutions for waste collection. This is something Oslo REG tries to influence, but they are rarely prioritized. Examples of this include planning of waste rooms in buildings. They also mentioned bike paths coming up where they usually collect waste. Bike paths are great, but they make the renovation job harder. There are lot of unintended consequences that arise from these kinds of decisions.

Commitments

In 2020, Grønt Punkt cancelled the contract with all municipalities using a collection system based on coloured bags and optical sorting. This meant Oslo lost their contract, and it is the main reason why they work with Norsirk today. This indicates that they are more or less locked-in to Norsirk as long as they use the same system, and that the commitment is negatively calculative. There is little indicating a moral of affective commitment. The commitment would be slightly positively calculative, as the relationship between them provides certain advantages for Oslo.

7. Discussion

Throughout the interviews it became apparent that there is no direct communication between the municipal waste companies and the recyclers, apart from at ROAF. All communication downstream goes through the return companies Plastretur and Norsirk. Generally, this seems like a good way to go, to limit wide communication and centre it around the return companies. That way it is easier to transfer knowledge and engage in learning between the municipalities, which in turn can lead to innovation. When a municipality comes up with a new idea for their system and communication, it can be discussed with the return company which can bring it with them to other municipalities in other areas of the country. The return company can forward messages from the recyclers to all municipalities and tailor information to each company because they know them better.

Generally, the relationships seem quite transactional, and they remind us of the Translation interface that Araujo et al. (1999) was mentioning. The translation interface means that only performance and functionality is defined by the buyer, which is the producer responsibility organisations. They determine how they want the plastic to be picked up, in specified bales and the level for the fee is determined by the quality. How the municipalities go about collection is up to themselves. However, it can also be argued that it resembles the specified interface. That is because the product itself is not very complicated, and the relationships seem somewhat at “arms-length”. In the translation interface there is

not much direct learning, which we also experienced, and is also the case for the specified interface. The room for indirect learning however is bigger, as there is more freedom for the supplier in their processes. This is something that can be communicated to the return companies which they can forward to other municipalities.

At ROAF, which was the exception, they sell plastic themselves and get compensated by Plastretur. There they have strong communication towards the recyclers and collaborate well with Plastretur and Grønt Punkt. This relationship is still quite like the translation interface, but edges towards the interactive interface. The interactive interface allows for buyer and supplier to discuss solutions and trade-offs to improve productivity and create benefits also for third party actors like the producers themselves (Arajuo et al., 1999). The sorting facility allows them to test more and work with a higher degree of specificity. As they are a part of the Plastretur and Grønt Punkt universe, the knowledge learnt about what is important to increase the quality can be shared with producers and other municipalities, even though they do not have the same kind of facility. This shows the advantage of centralized information, good communication and knowledge transfer.

7.1 Central sorting facilities

In the start Grønt Punkt was very sceptical to the sorting facility at ROAF. They did not like that ROAF was telling their residents to no longer sort plastic at home. The new facility was confused with previous attempts to make efficient sorting facilities, and that the outcome would be unsellable. Since then, Grønt Punkt has turned around and are even working for building a national sorting facility for plastic here in Norway. Which is one of the main reasons they separated Plastretur from the operations of Grønt Punkt. Hence it seems that the beliefs of Cimpan et al. (2015) was right, that central sorting facilities will become more important. Such a facility is still not confirmed but is something that is being planned carefully. Though, as we understand, this planned facility would be fed with sorted plastic and not with the residual fraction. This means that no more plastic would be separated from the residual fraction. The difference would be that

the sorting of the different polymers is done in Norway, and that we would be less dependent on sorting facilities abroad like we are today.

The development manager at Grønt Punkt said the optimal solution would be that the municipalities still ask their residents to sort plastic at home, but that the residual fraction then was sent through a sorting facility to maximize the outcome. The quality would be even better because more plastic is washed and cleaned beforehand. This is the practice at ØRAS. There the residents sort plastic at home, before ØRAS delivers the residual fraction to ROAF for a secondary round of sorting. About 5 more kg per resident, compared to ROAF, is then sorted out and can be sent to recycling. At RFD they also talked about having a reception where the plastic is washed before the final sorting, that the residents would be better at home sorting if the need to wash it was removed. If this was to be installed in Norway also, it would decrease the problem of sending organic remains across the border.

The municipalities who uses central sorting facilities sorts out more plastic than the others. This was also the case for IVAR before their facility burned down. Some municipalities using curb-side sorting follows closely but municipalities using coloured bag systems like Oslo is generally worse off with Oslo being among the worst. Hage & Söderholm (2008) found that the sorting of plastic packaging generally was worse in large cities which was defined as more than 800 people per square km. Oslo stood in 2022 at 3 855 people per square km (SSB, 2022), meaning they should invest in a central sorting facility according to Cimpan et al. (2015). They argued that sorting facilities would be especially important in larger cities.

Now, there are more sorting facilities like the one at ROAF in the planning phase, in line with Cimpan et al. (2015). One in Østfold (ØAS) and one in the Trondheim region (SESAM). These facilities have a much larger effect on the degree of plastic that is sorted out, as they also sort out all the plastic that is sorted wrong (de Sadeleer, 2018). If plastic is also washed and sorted by the residents, then the quality will become even better, and we believe this was what the guy from Grønt Punkt was thinking about. Of course, this is more expensive as it requires using

resources for picking up an extra fraction when collecting. This hints at the renovation fees perhaps being a bit low and that the municipalities do not understand and give waste management enough thought and resources.

7.2 The issue with food waste

Another thing that would increase the quality of the plastic would be increased separation of food waste. Jantz et al. (2011) explained that biowaste implicates the sorting process in sorting facilities and therefore separating biowaste before sorting is beneficial. This year, a new regulation requiring all municipalities to collect food waste was introduced. But at the same time, there are still municipalities that do not collect food waste yet. The municipalities that we interviewed seemed to hover at around 50% sorting of food waste, indicating that there is still a huge potential for improvement. Given that we should soon be at 70% (65% EU target) sorting of food waste, they are tracking behind. The more food waste that is sorted out, the cleaner would the sorted plastic be and the same for the residual fraction that is run through a sorting facility. It would also keep the sorting facility cleaner and reduce the need for maintenance. Better sorting of food waste is essential to improve the quality of the plastic and is something all four interviewed municipalities agreed on. The guy at Grønt Punkt also argued that at ROAF, the plastic has been together with the residual fraction, and hence is more contaminated. Improved sorting of food waste would reduce this problem. We believe food waste is among the biggest problems trying to reach the targets for reuse and recycling of waste.

> *"We will almost make it, and if we had invested more resources into sorting of food waste, we would have made it elegantly." (Advisor, RFD)*

From Grønt Punkt Norge (2023), it seems that the municipalities that have had the most stable solutions with the least changes have the best results. This seems sensible as changes tend to upset people and it takes time to change their behaviour. A good example of this is the contamination degree of municipalities with an agreement with Grønt Punkt / Plastretur. In January they published a list, where Steinkjer municipality stood out as the single best municipality. They had a

contamination degree of only 2.9%. In comparison, RFD was at 13.8% and ØRAS at 14.6%. Trondheim Renholdsverk (TRV) was down at 24.5%. The main reason for the big difference is that Steinkjer has been collecting food waste since 1998, while Trondheim only started now in 2023. Trondheim is at the same time making multiple changes, changing from a bin for plastic to a plastic bag and starting with collection of glass and metal.

7.3 Increasing the quality by centralising decision making

ØRAS discussed the problem with being the neighbouring region of ROAF. It is harder to tell the residents they must sort plastic waste when neighbouring municipalities are not supposed to. Some people do not understand why and get demotivated. Communicating is a challenge for both parties, as they have different messages to send out. Similar problems are found nationwide. There are many different systems for collection depending on where you are. This was the foundation of our initial motivation for the thesis. We have focused on three branches of solutions where plastic is the main character. Those are source separation in bin or plastic bag, source separation in coloured bags and central sorting post collection.

Different systems perform differently and call for different communication. Of course, the systems have their own advantages, and there is not necessarily one correct solution for each municipality. For instance, even though the coloured bags generally perform worst, the system makes collection easier and less costly. That is because they need less separation when collecting and can use the same trucks for more fractions. There is also less need for bins at the residents. What we would like to argue is that it should be the same system nationwide. It should not be up to each and one of the municipalities how they are supposed to perform waste collection.

There are plenty advantages of having a unified waste system. Communication to the public could be generalized and there would be no differences when visiting other cities. It should also apply to the recycling stations and the renovation fees, so everyone pays the same for waste management services regardless of region. If

everything where to be decided centrally, costs could be reduced locally. Less decisions were to be made by the municipalities and waste companies. This would make the dialogue between companies and the municipalities less problematic and facilitate for better waste management solutions. All the three inter-municipal companies we spoke with acknowledged the communication with the municipality as a problem. The municipalities do not understand how waste management works and what it costs. There are also multiple municipalities involved, and they are not necessarily united in questions about waste management. ØRAS meant it was easier for municipalities that arrange waste management themselves, because then there are fewer stakeholders and easier to communicate. Another issue was in conjunction with local elections. In the year before an election, the politicians are reluctant to do anything, specially increasing the renovation fees as they risk losing the support of the people.

The main problem with this would be cost. The price of operating waste management services in rural areas versus in urban areas are significantly different. We will not go further into how the costs should be distributed, but it largely depends on whether the prices should be equal across borders or not.

7.4 Relationship & Commitment

By using four of the five antecedents of commitment mentioned in Cater & Cater (2010) we have constructed an overview based on our findings above, which illustrates the differences between the waste companies. In their research Cater & Cater discuss how the four antecedents of commitment simultaneously, and customer loyalty, depend on product and relationship quality. Their hypothesis that product quality will positively influence both the degree of positive (value-based) and negative (locked-in) calculative commitment, will also be correct in the case of B2B in MSW management. Essentially this means that product quality will be the leading rational reason for continuing the relationship (Cater & Cater, 2010). As discussed in our findings for all four waste companies the main content of their agreements with the PRO's was that the quality of the plastic waste would determine how much they would get as compensation.

Cater & Cater (2010) discovered their two hypotheses about *knowledge transfer* to be too weak to be significant, however their main reasons for why it was so could also be applied in our MSW setting. First, knowledge transfer is defined as information given from the supplier that will improve the customers' products, processes, and procedures (Kuenzel & Krolikowska, 2008). Thus, it is reasonable they hypothesised it would positively influence both positive and negative commitment, the two rational dimensions, as it implies improved product and by such increased profit. However, the two reasons for it not being of significance are that the customers do not expect to receive any other rational relationship benefits, and secondly that the customers cannot differentiate between their main and second supplier in terms of flexibility and knowledge received (Cater & Cater, 2010). From our findings several of the waste companies mentioned how the communication has increased in the last few years, and that they use the information services provided from the PROs more. This can indicate that there might be a higher significance level now, than when the research paper was published. However, we also found that all waste companies in fact did not communicate that often outside of their regular contract meetings, and that their level of increased communication seems to still be significantly low. The second reason can in our case be explained by there only being two PROs on the Norwegian market, and that they both are certified by the Norwegian Environment Agency (NEA).

Secondly, we have *trust*, which can be divided into two components: credibility and benevolence (Moorman et al., 1992). Credibility concerns whether the customer believes the supplier has sufficient expertise, and benevolence is the belief that the supplier's intentions and motives are beneficial to the customer even when new conditions arise about which a commitment has not been made (Ganesan, 1994; Cater & Cater, 2010). Cater & Cater (2010) found trust to be very positively connected with customers' commitment and reinforces the notion that they enjoy relationships where they regard their suppliers as benevolent and trustworthy. As for the Norwegian MSW companies, they seem to have a high level of credibility and benevolence in their relationships. Some expressed how the lack of communication is a good thing because then everything is running smoothly, how they in uncertain times prioritised a few suppliers due to their trust

in them, and how they spend less energy following up the PROs as they trust the approval of the NEA.

Thirdly, we have *adaptation* which Cater & Cater (2010) defines as "when one party in the relationship adapt its processes, procedures or products to another party". In our findings we both provide examples of initiatives the waste companies do for the PROs and vice versa, some of these can be characterised as adaptations. The PROs are adapting by collecting complaints about packaging, and ideas about redesign and educating the producers of the plastic packaging. The finding from our interview with ROAF is a great example of how the waste companies have adapted to their PROs, here they complained that the plastic bales did not stack well due to them falling over when the plastic shrunk. There was a lack of sufficient binding, and ROAF started to cross-bind their bales going forward. There also seems to be a general agreement that as long as it is reasonable and it helps with their main goal of reaching circularity, there is little in the way of adapting to other partners. Another finding from Cater & Cater is that due to one party's adaptation the other might stay in the relationship because it feels a sense of moral obligation to the supplier. In our research RfD switched PRO company, not because of any reason, rather that due to unforeseen circumstances. The man in charge of the agreement was on sick leave when the deal was up for re-negotiation, and then it slipped through, and they were left with no PRO deal at all. Then Plastretur stepped up and said they would help them, and since they have had a nice relationship.

Last antecedent to commitment is *cooperation*, which is when firms in interdependent relationships take coordinated actions to achieve mutual outcomes or singular outcomes with expected reciprocation over time (Anderson & Narus, 1990). Cater & Cater (2010) discovered that cooperation positively influenced the two "emotional" commitment dimensions, affective and normative. This hypothesis is harder to confirm if it fits in the MSW setting or not. To help we will try using the inter-municipal collaboration (IMC) framework by Villalba Ferraira (2020) introduced in our literature review chapter on waste management. Although their research was only concerning relationships between municipals and without ERP/recyclers. The indirect and transactional type of collaboration

are easy to confirm exists from our findings. Indirectly all the waste companies and PROs share openly information either online, during arranged events or by facilitating for visitors to come see their waste management systems directly. This confirms that they all have the lowest presence of IMC spectrum, which in this case probably should be called just collaboration, as it is not necessarily between two municipalities. Transactionally, all waste companies share a contract between one of the PROs. One company even mentioned that a lack of one would be detrimental to their operations. The highest level of governance complexity is the collaborative one, it would require the parties to formalise a shared structure of long-term cooperation (Villalba Ferreira, 2020). Here, the only observation we can argue for that fits this description somewhat is how ROAF have internalised some of what Plastretur does by sorting and directly selling their waste to recyclers and still getting compensated for it by Plastretur.

7.5 Internalizing EU targets

We were very interested in how the EU targets are reflected in the different actors. We did not speak with either the government or the local authorities, but EPR providers were very concerned about meeting the targets. Two of the companies (ØRAS and ROAF) mentioned that their municipalities even had upped the long-term target for recycling to 70%. At the same time, they were reluctant to increase investments that are needed to reach the goals. RfD on the other hand was an interesting case. They were very proud that they had been dealt all powers to perform waste management. What this means is a bit unclear, but the point was that the municipalities did not care about how they tried to fulfil the targets. They tried to reflect the goals themselves. The last case was in Oslo, not saying they were not concerned with doing a good job, however they mentioned that it was the return companies that were responsible for reaching the target.

The current target for the return companies is only 30% recycling. There seems to be a misalignment of the goals here, as the targets are not aligned with the national and EU targets for recycling. It is up to each return company to finance the collection through the EPR scheme. There should not be anything standing in the way of doubling the collection target, or even make it 100%. The last one is

not that difficult to understand, as it would be practically impossible. Waste ends up as litter, it is delivered at the recycling stations, and ends up in the waste stream of the industry instead of the municipalities. That is if it is 100% of the total plastic waste distributed, and not the amount collected at each municipality.

This again is linked to another problem concerning at what point in the value chain the recycling degree is measured. There is a large difference if the recycling degree is measured as what is sorted out at the municipality, if it is measured after the sorting facility or after final recycling. Some of the waste is lost in each of the steps because it is not recyclable or difficult to sort. We must separate between what is sent for recycling and what is recycled. When we have mentioned kg/resident we are talking about what is sent for recycling.

Further, the EPR schemes seems to be unfulfilling as they are, something which was argued by both Maitre-Ekern (2021) and Dubois (2012). Oslo was especially concerned about this and generally interested in improving the scheme.

> *"We only receive a few million in compensation yearly, but we have 80 renovation cars and double the employees to drive them, where large parts of the work consider plastic. So, there is something that doesn't add up." (Communication advisor, Oslo REG)*

> *"Ideally, the producers should pay more, their fees should increase when they put plastic on the market, unless they would have to use less plastic." (Communication advisor, Oslo REG)*

Dubois (2012) argued that the EPR schemes did not internalize all the costs of waste management, which matches well with the experiences from Oslo. It may not be an acute problem, but it may become. The return companies cannot just collect and recycle as much as they would like. They must have the funding to back up the amount. The money they receive in fees from the producers is what they have at hand to use for collection and all administrative purposes. This was mentioned regarding Norsirk who has a small market share compared to Grønt Punkt and hence lower budget to collect and recycle plastic. If Oslo were to

collect significantly more the next year than they already do, Norsirk wouldn't have the capacity to recycle it all, which would be a problem. Norsirk already collects more than their customers put on the market at 105% (Husby, 2021). This brings up the issue whether the market should be limited to one return company, or if there should be an opening for even more. On one hand having only one would lead to a monopoly, like what it has been previously. The return companies are non-profit as of today, so this may not be a bad thing. It could give complete freedom to set the prices necessary to collect as much plastic as possible. It also makes it easier to coordinate collection to fulfil the budget, as everyone must address to one company. On the other hand, having several return companies makes matching the budgets a large challenge.

Let us say there are five return companies instead of two. Producers and importers must choose producer responsibility company, and they will have to compete on fees for covering the responsibility. This potentially makes for poorer collection and may result in less plastic being recycled. Matching ingoing cash flows with outgoing cash flows is a challenge. The supply capacity of return companies must match the recycling demand in the municipalities. The municipalities have varying amounts of plastic they want recycled, and with multiple return companies, it would be harder to coordinate this for maximum recycling.

7.6 Design for recycling

Generally, the municipalities experience challenges when communicating correct sorting behaviour to their residents. Nearby municipalities have different systems being one of the challenges. The other challenge is that products are not designed to be easily sorted and recycled. This was a recurring theme in all the interviews, but also very expected. Design for recycling is an emergent theme. One of the main problems is the tendency of producers to use mixed polymers, something that ROAF stated was a problem in the sorting facility. The infra-red scanners in the facility then cannot read the polymer correctly and errors occur in the sorting process. Products may have etiquettes made from foil on the outside of other polymers making it harder to sort correctly. This is also in line with Milios et al. (2018) who mentioned that mixed polymers are a challenge for sorting. This also could dampen the demand for recycled plastic as it affects the quality of new products.

8. Conclusion

To understand the results better, lets recap the initial research question:

How do municipalities and inter-municipal companies as commercial actors collaborate with recyclers and extended producer responsibility (EPR) providers on achieving recycling targets and increasing the quality of recyclable materials?

We set out to investigate how municipalities act as businesses when supplying waste to the recycling market. As there already existed literature on inter-municipal cooperation and the more general B2B relations. We wanted to try fill in the literature gap on the relationship and roles between waste companies and ERP providers in the Norwegian municipal solid waste market.

We compared our findings with existing B2B literature and could confirm that the frameworks easily could be applied for the most part to our MSW setting. Based on this we can say that the leading rational reason for continuing a relationship is the quality of the waste. We observed a high level of trust in the field, and that when continuing the relationship trust was an important factor. Since the actors on the MSW market all have a general common goal, there is less resistance to adaptation. We also observed that one PROs adaptation might make a waste company have increased sense of moral obligation to that PRO. Although the hypothesis seems likely, only one observation is not enough to say that for sure, especially since we are dealing with the case of a duopoly. Lastly, we observed that applying the collaboration framework introduced by Villalba Ferreira (2020) could easily be done in a MSW setting for relationships between PROs and waste companies, and not only inter-municipal relationships. The highest level of collaboration was not really observed in our study, however the lowest two levels of collaboration was easily applicable to all observed relationships.

Based on the findings there is not enough evidence to state that the relationship and roles has a significant impact on reaching recycling targets. The choice of collection system still seems to be the most important factor in reaching recycling targets. What we found is that the relationship with PROs do not influence the choice of system, which indicates that the impact is low. Though, at ROAF there was a stronger relationship, and there was also a greater focus on how they could

improve recycling by working on design for recycling. Their system also seems to be the best, both in terms of collected quantities as well as the perceived quality. Designing rules and regulations that promotes the most effective systems seems to be the way to go.

From what we experienced, it seems that external factors such as rules and regulations are very important when it comes to increasing the degree of recycling. There are misalignments when it comes to the demands the PROs face and the actual recycling targets, which do not quite add up. The second important takeaway that was mentioned frequently was better sorting of food waste. Food waste and contaminations implicates sorting processes (Jantz et al., 2011) which in turn limits the potential of recycling.

8.1 Limitations

The main limitation to our study is related to our ability to ask good questions and elaborate on the information received. There is some doubt whether the questions in the interview guide were good enough and covered enough for us to sufficiently answer our research question. This is due to inexperience regarding the interview situation.

We also chose not to speak with the Norwegian Environmental Agency nor any producers. This could have given us a wider perspective on the waste management practices, how the producer responsibility schemes work and how responsibility is distributed. We also left out talking with any of the final recyclers as all of them operates outside Norway. This would have increased our understanding of the recycling process and more of what could be done to improve it.

8.2 Further research:

At the moment there are no producer responsibility schemes for Food waste. We argue this could help incentivize better collection of food waste, because it would mean more money could be channelled into the collection practices and information campaigns regarding food waste. This is something we believe is not researched yet and which it could be interesting to learn the outcomes of.

Another theme that could be of interest would be to do similar research but switching the focus towards the producers. That way we can learn more about how EPR actors work on promoting design for recycling based on the knowledge they have about municipal solid waste and contact with recyclers.

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10. Appendix

The following section provides the two interview guides, first in English and then the original in Norwegian following.

Appendix A: Interview guide municipalities (English)

What do you do, what is your position?

How does your collection system for waste work?

- What fractions do you collect and how is the waste collected?
- Do you collect the waste yourself or is the service bought externally?
    - Do you think this has an impact on amount of waste collected and the quality?

Can you describe the process from the moment the waste arrives from the households for plastic, food waste and residual waste?

- Who owns and runs the facilities?
    - Are there any conflicts of interest? Food waste versus residual waste to energy recovery?

What EPR provider / PRO do you use?

- Why did you choose them and not their competitor?
- Are there any demands you must fulfil?

How are the downstream agreements designed?

- What decides the price, quantity, quality, recycling degree etc?
- What is the time frame?
- Are there any incentives for better collection?

How is the communication downstream? Can you describe how the interaction unfolds?

- How often is there communication?
- What is the content of the communication?

- Do the PROs influence the way you operate? Do they come with suggestions to the operations? Are they constructive bearing in mind how things should be done?
- What do they mean about the quality that is delivered?

How do you look at yourself as a business?

- What are the most important tasks in order to secure sustainable operations?
- Do you look at yourself as a supplier/producer of goods? Or are you more characterised by being a service provider?
- How do you contribute to the circular economy?

From the EU, Norway is obligated to follow certain directives where they are obligated to reach certain goals such as 55% recycling before 2025, 60% before 2030 etc. How is this communicated from the authorities? How do the municipalities and the government work towards you to ensure that the goals are reached?

- To what extent do the municipality or the company feel bound by these demands/targets?

Do you try to improve the waste so that you can deliver "better" fractions?

- What measures are taken to improve the recycling degree?
- Have you received feedback from downstream actors regarding the delivered quality?

Do you have any numbers on how much plastic is collected?

How do you think about the problem regarding fires starting in waste facilities?

Finish off by asking whether we can contact them if something were to come up or need answer to some uncertainties or questions.

Individualized questions:

ROAF:

Why have you chosen not to collect plastic separately? Wouldn't this give an even better degree of recycling?

- What does the PRO mean about this decision? Have they tried to influence it?
- How is the capacity at the sorting facility? Have you considered cooperation or sale of capacity to nearby municipalities?
- We noticed you have collected 9-10 kg plastic for recycling per inhabitant in 2021 (Annual report). In an article in Aftenposten it said that it was more than 17 kg, what is the difference between these numbers?

ØRAS:

What do you mean about sorting facilities like the one at ROAF?

- Is this something you have considered implementing? Have you had any dialogue with ROAF or others if this is something you could have cooperated on, or bought as a service?
- Is it correct that you collect about 9 kg per inhabitant a year?

OSLO:

- There has been an increasing tendency in collection (From approximately 3.5 to 4.0 kg) since the deal with Grønt Punkt was cancelled. Do you notice any differences in how they worked versus now with Norsirk?
- Romerike biogas facility has run with reduced capacity because of low access to food waste.
    - We assume you have tried to buy food waste from nearby municipalities. Does everyone have good solutions and are no one interested?
    - Have you considered contacting municipalities that has not collected food waste previously, like for instance MOVAR?

Appendix B: Interview guide PRO (English)

- What do you do, what is your role about?
- Can you tell me a bit about how the producer responsibility scheme works?

- When do recycling companies take ownership of the waste from the producer responsibility company?
- How long are the contracts between the producer responsibility company and downstream actors?
- How do the agreements/contracts affect the quality?
    - How is the price of the waste determined? Quantity? Quality? Efficiency? Market? Does the region have any influence? Are municipalities with greater difficulty in collecting rewarded more than others?
- How is the competition in the waste market? If one chose to pay more when the amount of waste is higher, would there be a risk of other actors buying the waste directly from municipal actors?
- How do you work with municipalities to improve the quality of the waste you deliver?
    - How often do you have dialogue with municipalities/IKS?
    - How would you characterize the dialogue? Is it extensive or very simple and confirming?
    - Is there a difference in the dialogue with waste companies? For example, based on the quantity and quality delivered?
- How is the communication with sorting facilities and recycling facilities?
    - Do they provide feedback on how you can improve the quality?
    - How is the interaction between GP and Norsirk regarding how much members put on the market?
- What is your view on chemical recycling of plastic packaging?
- How do you think about investments in municipalities/IKS?

Plastretur/Grønt Punkt:

- What is the relationship between Green Dot and Plastretur? How are they connected?
- We spoke to the sales manager at ROAF, who said they sold their plastic themselves. How does their agreement work, and are there others who have similar agreements?
- He also said that their quality was better than others, which contradicted what the Grønt Punkt representative has said when we talked to him.

- They terminated the agreement with Oslo and other municipalities due to economic reasons associated with their system of coloured bags.
    - Why are these bags harder to sell? What is the difference between this plastic and plastic collected in bags or containers?

Appendix C: Interview guide Municipalities (Norwegian)

Hva gjør du, hva er din stilling?

Hvordan fungerer innsamlingsløsningen deres for avfall?

- Hvilke fraksjoner og hvordan hentes avfallet?
- Gjennomfører dere renovasjonen selv?
    - Tror dere dette har noen påvirkning på mengde og kvalitet på avfallet som hentes?

Kan dere beskrive prosessen fra det øyeblikket avfallet ankommer fra husholdningene?

- For plast, mat og restavfall.
- Hvem eier og drifter anleggene?
    - Interessekonflikter? Matavfall versus restavfall til forbrenning?

Hvilken produsentansvarsordning anvender dere?

- Hvorfor valgte dere den og ikke konkurrenten?
- Stiller de noen krav for at dere skal få være med?

Hvordan er nedstrøms avtaler utformet?

- Hva bestemmer prisen, mengde, kvalitet, resirkuleringsgrad osv?
- Hva er tidsperspektivet?
- Insentiver for bedre innsamling.

Hvordan er kommunikasjonen nedstrøms? Kan dere beskrive hvordan samhandlingen foregår?

- Hvor ofte er det kommunikasjon dere imellom?
- Hva går kommunikasjonen ut på? Innholdet?

- Påvirker produsentansvarsselskapene måten dere driver på? Kommer de med forslag, innspill til driften? Er de konstruktive med tanke på hvordan ting bør gjøres?
- Hva mener de om kvaliteten på det som leveres?

Hvordan ser dere på dere selv som bedrift?

- Hva er bedriftens viktigste oppgaver for å sikre bærekraftig drift?
- Ser dere på dere selv som en leverandør/produsent av en vare? Eller er dere mer preget av å være en oppdragsutfører?
- Hvordan bidrar dere til at økonomien blir mer sirkulær?

Fra EU er Norge pålagt å følge visse direktiv der vi forplikter oss til å nå visse mål slik som 55% materialgjenvinning innen 2025, 60% innen 2030 osv. Hvordan kommuniseres dette fra myndighetenes side? Hvordan jobber kommune og myndigheter inn mot dere for å sikre at disse målene nåes?

- Til hvilken grad føler kommunen eller selskapet seg bundet til disse kravene/målene?

Prøver de å forbedre avfallet for å kunne levere 'bedre' avfall?

- Hvilke tiltak gjør de for å bedre resirkuleringsgraden?
- Har dere fått tilbakemelding fra nedstrøms aktører angående kvaliteten på det dere leverer?

Har dere tall på hvor mye plast som blir samlet inn?

Hvordan tenker dere rundt dette med branner i avfallsanlegg?
Avslutte med å høre om vi kan ta kontakt om det skulle dukke opp usikkerheter eller ting vi trenger svar på.

Individualiserte spørsmål:
ROAF:
Hvorfor har dere valgt å ikke samle inn plast separat? Vil ikke dette gi enda bedre gjenvinningsgrad?

- Hvordan stiller produsentasvarsselskapet seg til denne beslutningen? Har de prøvd å påvirke den? (Grønt punkt mener dette er den beste løsningen)
- Hvordan er kapasiteten på ettersorteringsanlegget? Har dere vurdert samarbeid/salg av kapasitet til nærliggende kommuner?
- Så dere hadde samlet inn 9-10 kg plast til materialgjenvinning per hode i 2021 (årsrapporten 2021). I en annen artikkel i aftenposten sto det over 17 kg. Vet du forskjellen på disse tallene?

ØRAS:

Hvordan stiller dere dere til etter sorteringsanlegg, i likhet med ROAF?

- Er dette noe dere har vurdert å innføre? Har dere hatt dialog mot ROAF eller andre om dette er noe dere kunne samarbeidet om? Kjøpt som tjeneste?
- Stemmer det med rundt 9kg plast innsamlet per hode?

OSLO:

- Det har vært en økende tendens siden avtalen med grønt punkt ble sagt opp, har dere merket forskjell på hvordan grønt punkt jobbet mot dere før kontra nå med norsirk?
- 3.9 – 4.0 kg plast i 21 og 22
- Romerike biogassanlegg har kjørt med redusert drift grunnet lav tilgang på matavfall.
    - Regner med dere har forsøkt å kjøpe matavfall fra andre kommuner? Har alle gode løsninger på dette og ikke vært interessert det?
    - Har dere vurdert å kontakte kommuner som ikke har hatt innsamling av matavfall tidligere? Slik som for eksempel Movar?

Appendix D: Interview guide PRO (Norwegian)

- Hva gjør du, hva går din stilling ut på?
- Kan du fortelle litt om hvordan produsentansvarsordningen fungerer?

- Når overtar gjenvinningsselskapene eierskap til avfallet fra produsentansvarsselskapet?
- Hvor lange er kontraktene mellom produsentansvarsselskapet og nedstrøms aktørene?
    - Hvordan påvirkes avtalene/kontraktene kvaliteten?
    - Hvordan fastsettes prisen på avfallet? Kvantum? Kvalitet? Effektivitet? Marked? Har region noe å si? Kompenseres kommuner med større vanskelighet for å samle inn mer enn andre?
- Hvordan er markedet for konkurranse om avfallet? Om man ville valgt å betale bedre når mengden avfall er større, risikerer man da at andre aktører vil kjøpe avfallet direkte fra de kommunale aktørene?
- Hvordan arbeider dere mot kommunene for å bedre kvaliteten på avfallet dere leverer videre?
        - Hvor ofte har dere dialog med Kommunene/IKS?
        - Hvordan vil dere karakterisere dialogen? Er den omfattende eller veldig enkel og bekreftende?
            - Skilles det på hvordan dialogen er mot avfallsselskapene? For eksempel basert på mengde og kvalitet som leveres?
- Hvordan er kommunikasjonen mot sorteringsanlegg og gjenvinningsanlegg?
    - Kommer de med tilbakemeldinger på hvordan dere kan bedre kvaliteten?
    - Hvordan er spillet mellom GP og Norsirk rundt hvor mye medlemmene setter på markedet
- Hva er deres syn på kjemisk gjenvinning av plastemballasje?
- Hvordan tenker dere rundt investeringer hos kommunene/IKS?

Plastretur/Grønt Punkt:

- Hvordan er slektskapet til Grønt Punkt? Hvordan henger Plastretur sammen med Grønt Punkt?

- Vi snakket med salgssjefen hos ROAF, som sa at de solgte plasten sin selv. Hvordan fungerer avtalen deres og er det flere som har lignende avtaler?
- Han sa også at kvaliteten deres var bedre enn hos andre, noe som ikke stemte overens med hva representanten fra Grønt Punkt sa da vi pratet med han.
- Sa opp avtalen med Oslo og andre kommuner grunnet økonomiske grunner forbundet med deres system med fargede poser.
    - Hvorfor er disse posene vanskeligere å få solgt? Hva er forskjellen på denne plasten og plast som samles i sekker eller beholdere?