Decentralised waste collection and separation in city districts and neighbourhoods

A. van Timmeren\textsuperscript{1,2,3} & L.C. Röling\textsuperscript{2,4}

\textsuperscript{1} Department Building- & Sustainable Technology and -Design (MTO)
\textsuperscript{2} Delft Interdisciplinary Research Centre 'Ecological city' (DIOC/ DGO)
\textsuperscript{3} DOSIS Research; Sustainable Development of City and InfraStructure
\textsuperscript{4} Department Architecture, 'Architectonisch Ontwerpen' (A) Delft
University of Technology, Faculty of Architecture, The Netherlands

Abstract

Waste collection and separation rests with the involvement, participation and consciousness-raising of its supporters. In the Netherlands separate collection of the ‘flows’ of paper, glass and batteries is relatively accepted and well functioning. Depending on district differences percentages up to 80% of the paper and glass amount are being collected. Today’s problem is to further increase these three flows (paper, glass and batteries). Even more important, however, is the need to start separating the waste flow in other raw material flows, such as plastics, metals, clothing, ‘tetra packages’, shoes, cork and etceteras. To achieve this goal in several cities and villages in the Netherlands local governments and private entities have introduced concepts of decentralised waste separation and – collection, mostly in little buildings within city districts. These buildings often are combined with supermarkets, shopping centres or other public buildings. They are mostly named ‘Retourette’ or ‘Recycle shop’. Inside these Retourettes people can separate items into 16 different fractions of waste. Some of these fractions or ‘flows’ are connoted to deposit money, most of them, however, still are not. The background of these new buildings is the belief that it will be easier to realise and maintain further going waste separation and the pursued replacement of the existing (centralised) technologies by introducing decentralised solutions like the Retourette. The introduction nearer to the people inside a well-designed building tries to support the needed shift in acting and thinking: Waste needs to be treated as ‘raw material’. To achieve this goal the final step in this process should be the
introduction of governments or private entities that pay for separated offering of waste fractions instead of people paying for their waste. Of course this should be combined with the full-scale introduction of deposit money for use of raw materials in product prices. In 2001 a study has been carried out by the Delft University of Technology concerning the effectiveness of these introduced decentralised waste collection buildings in the Netherlands. Comparisons have been made in the introduction of these concepts in city districts and villages with high densities versus low densities, cities in which waste collection is free of offered weight and cities where people have to pay for the amount (or weight) of offered waste for (centralised) collection by garbage trucks. Secondary effects of the formerly stated differences also have been investigated. Other factors that have been analysed are the suitability within a social acceptable form (integration), possible educational meaning and the cost factor in relation to energy, water and material efficiency of the concepts. This paper focuses on a case study that compares a ‘Retourette’ in Tynaarlo and a ‘Recycle shop’ in Haarlem, both in the Netherlands.

1 Introduction

1.1 Centralisation of refuse processing

Refuse is business. The total refuse market in a small country like the Netherlands concerns an annual turnover of 3½ billion Euros [1]. Despite several successful green initiatives and public commercials to achieve a reduction of refuse, citizens, trade and industry produce more refuse every year. Comparing studies of collection totals in the Netherlands from ten years ago with the collected refuse totals of today fortunately also show a clear increase of waste separation per person, with an attendant small decrease of the so called ‘rest-refuse’ (after separation of ‘useful’ flows) which are being dumped in incineration furnaces (Avi) or rubbish-tips. Incineration is at this end-of-pipe stage for the general refuse flow a better solution then dumping. At this final stage of processing in the Netherlands still (end 90’s) 11% of the refuse flow is being dumped. For comparison: in England this is 90%.

Figure 1: Dutch preference lists for refuse processing [2].
The Dutch government started to use in the last two decades of the past millennium the ‘Ladder of Lansink’ (after its originator, Ad Lansink, a Dutch MP from 1977 until 1998). Lansink invented a preference list for refuse processing: prevention, element re-use, material re-use, useful application, incineration with energy recovery, incineration without energy recovery, and finally refuse-tipping or landfill [2]. In 2000 the ladder has been completed for the built environment by Kristinsson (et al) into the ‘Delft ladder’ [fig.1]. Waste management should be characterised by the three ‘R’ concept: ‘Reduce – Reuse – Recycle’. The main strategies for managing solid waste streams are: land filling, incineration, recycling and reduction in waste generations. Until recently most solid wastes are disposed of in landfill sites, which are becoming scarcer, leading to increased costs of waste disposal. Therefore waste recycling to reduce costs and save the environment becomes imperative. Disposal should be the last option selected when dealing with solid waste. Only after attempts have been made to reduce, reuse and recycle, should it be disposed of. The term ‘solid waste’ means any rubbish, refuse and other discarded solid material, including those resulting from industrial operations and from community activities, but does not include solids or dissolved materials in domestic sewerage or other significant pollutants in water sources [3]. In the Netherlands, since 1996 a law is operative which prohibits tipping refuse that can be re-used or incinerated in Avi’s.

Apart from the rules the environment has exerted quiet immensely the administrative side of refuse policy: who is responsible for what? Taken by itself every environmental affair lead to ongoing scaling up. Regulating the over one thousand rubbish tips in the late seventies financially seemed quiet difficult, therefore local governments were obliged to co-operate with their ‘neighbours’ to organise these final steps of the ‘Ladder of Lansink’, the rubbish tips. Every local government (city, village, etc.) stayed responsible for the refuse collection, but from 1977 on the refuse policy was being arranged by the regional government. In the ‘refuse-consultation-organ’ (‘Afval Overleg Orgaan’, or AOO) local, regional and national governments worked together responding several questions like, who is responsible for what, where will be situated new or enlarged capacities of incineration furnaces (Avi) and/or rubbish-tips or landfill and who processes which refuse. This ‘concession system’ flourishes up to today. Therefore the incineration furnaces are ensured of supply, thanks to contracts with local governments and arrangements with the AOO [1]. From ‘outside’ the district (region) no refuse may be accepted, but inside every province or region an acceptance duty holds good. This means: every region it’s own service area with attendant prices. The main goal of the introduction of these AOO’s was to keep some force on prevention and re-use and therefore to plan the incineration capacities relatively tight. This resulted in a surplus of combustible refuse (in 1999 2 Mton) that is being tipped by exemption. Today however market influences get stronger and stronger, resulting in a call for removal of the before stated district borders. In the Netherlands now exists an Avi-capacity from more or less 5 Mton while countrywide about 7 Mton combustible refuse is being
collected. Therefore people stated (in 1996) that the AOO arrangements were not needed anymore, for the Avi’s (incineration furnaces) would get filled anyhow without a distribution plan [1]. Apart from that too many responsibilities (policy, execution and maintenance) came in control of just one party: the regional (provincial) government. These regional governments will have to yield part of their power, and therefore also part of their income (via taxes). This process is difficult. Apart from that, behind all this lies possible improvement of Dutch enterprises in the coming international competition. Therefore preparations were made to free the national refuse market and to get rid of the district borders (provinces). The bill is now in the parliament. Problem however is the interest of the local governments. A strange duality exists as the interests of local governments, who mostly are the main shareholder or own (about 72% of) the Avi’s, are opposite to that from the more and more privatised Avi’s. Main reason is the fear for financial catastrophes now that main shareholders in the field seem to be put aside. Especially the local governments in places with relatively high rates and/or nearby bigger incineration furnaces are afraid of a decrease of the refuse flow with growing costs for their furnaces. They fear ongoing price competition resulting in inoccupation of expensive Avi’s. Under the existing AOO system local governments entered into risky contracts with (‘their’) Avi’s, in which they –some more than others- obliged themselves to fixed quantities of refuse and fixed (high) prices, while they –for they are main shareholders- also are responsible for possible losses in exploitation. The differences are enormous: some local governments earn money with their incineration of refuse while others groan under heavy taxation contracts. This last category of city governments has got a double risk: they are not able to offer ‘their’ refuse without restraint in the market, while they also are responsible for possible losses of ‘their’ Avi’s. To avoid this problem of Avi’s without sufficient supply in 1996 a law was approved which discourages tipping by imposing it. The idea was to raise this imposition in the next four years in such a way that tipping would cost the same as incineration (about 100 Euro per tonne). The former Dutch minister Pronk supposed in 2002 that this imposition will function as a minimum fares for incineration [1].

1.2 Modernisation of the refuse market

Dutch trade and industry however are afraid for higher tariffs because of the lack of incineration capacity. This problem is being solved by a concept bill, which makes it possible for the Dutch minister to intervene when tariffs get to high. A second problem is the modernisation of some of the older Avi’s. The sector says they can solve this problem by taking them over by other Avi’s, but they state that it is necessary to work on a bigger scale. A third problem of the existing system is the possibility of exportation of refuse to other countries. In accordance with the regulations this is only possible when ‘the refuse gets a useful application’. But the term ‘useful’ in this case always stays a subject of discussion. Officially refuse only can be exported to foreign countries when it is used for as fuel, when generating electricity is the main goal. Incineration of refuse in foreign countries
however is not possible within these regulations, for the main goal stays wiping out the refuse. The ever-continuing centralisation, or even globalisation of refuse processing seems a way of no return [4]. The higher tipping tariffs provoke possible raise of exportation of refuse to other countries (with softer rules), which in turn provokes empty Avi’s in the Netherlands with coming lower tax incomes for the local, regional and even national government. Opening the market in fact could lead to more competition resulting in lower prices for consumers. The local governments however want to get rid of their venture risks by privatising their Avi’s. This would lead to price increases due to needed external capital and higher profits [5]. The expectation is however that the European borders for transportation of refuse will open the next decade. The earlier stated Dutch regulations, which make international transport of refuse only possible when it will be applied useful already means a possible transportation of 75% of the Dutch, refuse totals [1]. This means possibilities for profitable trade, especially when refuse is being offered separately. Several fusions of smaller refuse businesses run ahead of this expectation. Apart from that the opening of the (Dutch) energy market introduces new proprietors. The possibilities of ‘green’ electricity through incineration of refuse already made them buy up to about one third of the Dutch incineration capacity. What results are big recycling companies with a wide spread range of services. Some decades ago the companies in the field were horizontally organised. The market consisted of collectors, Avi’s, transporters and companies or specialised in a certain flow (part) of refuse. Nowadays these bigger ‘recycling companies’ control the whole refuse chain for all fractions (and scales).

2 Refuse collection and separation in city-districts

2.1 Domestic waste

One of the changing aspects due to the ongoing modernisation and liberalisation of the refuse market are the new initiatives concerning collection and separation of ‘useful’ waste. Sorting waste on a household level is a good starting point for sustainable waste management. The scale and efficiency of waste sorting is encouraged by favourable conditions, like local authority, type of housing, age group, income and level of education.

A survey carried out by Ademe in France [6] showed that 75% of people living in detached houses recycled glass compared with only 46% of people living in flats. The separated flows of refuse still mainly concern glass, ‘green’ refuse (gft), paper and so-called small chemical waste (batteries, paint and etceteras). Each year in the Netherlands for instance 25 kilogram/ person of glass waste is separated. Via magnets 80% of the metal packing is separated, although this is done without separation of this ‘flow’ apart from the collected main refuses flow.
2.2 Pay-per-weight (Diftar)

In 22% of the Dutch municipalities (for about 12,6% of the Dutch population) refuse is being collected via a new system in which citizens pay per weight of offered refuse [fig. 3].

Most of these municipalities impose money depending on the amount of times the container is being emptied. In the other municipalities, representing about 2,7% of the Dutch population, people pay for their refuse per offered kilogram. This system of collection, called Diftar ("differentiated tariffs"), still is disputed but a recent investigation [10] shows the positive effects of this system of refuse
collection. In the municipality Oostzaan the introduction of the system lead to a permanent reduction of refuse with about 30%. The municipality has controlled the changes and possible side effects detailed. They even sampled the sewers. Illegal dumping of refuse ‘wasn’t as worse as expected’ while only for about 5% of the refuse was being fenced with offering it at people’s employers or family. Oostzaan however obtains an a-typical municipality (political ‘green’ parties are bigger than in the rest of the Netherlands). In the other municipalities that introduced the Diftar system the refuse totals also decreased. The amount of reduction depends on the price per kilogram (in Oostzaan about 20 Eurocent per kilogram). When the price per kilogram refuse is too low, the necessary prickle for people misses to be(come) economical with ones waste [10]. But a relative high price per kilogram evokes easier evasion or dumping. In the municipality of Haren in which 40% less green refuse and 23% less ‘general’ refuse was being collected, up to 70% of the people in the beginning exposed certain behaviour of evasion. These people didn’t take all their refuse to other places but only a small part of it [4]. This kind of behaviour however decreases some time after implementation. Important in this case is the need for people to see that the system not only reduces the collected totals, but also results to lower prices for themselves. Therefore the Diftar system (in general) needs certain ‘social control’. So most of the municipalities, which operationised the diftar system, also introduced extra supervisors. It is because of this need for social control that up to now the 22 municipalities mainly concern small ones [10]. In 2004 two bigger municipalities in the Netherlands (Apeldoorn and Nijmegen) also will introduce the system.

2.3 Decentralising recycling and integrating collection/separation in buildings

Solid household waste in the Netherlands in 2000 amounted to 546 kg/p/year, including coarse solid waste and an average of 92 kg/p/year green/organic waste (27 kg/p/year in urban areas and 145 kg/p/year in rural areas)[11][12]. Recycling of useful parts of refuse, especially glass (~ 20 kg/p/year), paper (~ 70 kg/p/year) and small chemicals (batteries), in the Netherlands is organised relatively well and therefore also relatively successful. Glass for instance is being collected in 25.000 glass containers through out the country. Nevertheless the Dutch government wants to increase the collected flows. Apart from that they want to start collecting other flows. Up to now the Dutch government distinguished the following 'fractions' of waste (organic and non-organic): (small) green refuse, green garden waste, coarse waste, wood, building-rubble, cooling equipment, ‘white waste' (kitchen equipment, etc.),'brown-waste' (i.e. radios, etc.), green/brown/white glass, beverage cardboards (tetris packs), plastic flasks, paper & cardboard, textiles, shoes, metals, batteries (rechargeable / non-rechargeable), ink cartridges (etc.), asbestos, plastics (permanent, re-usable, recyclable, co-recyclable, bio-disintegratable, bio- degradable, bio-regenerative and bio-enhancing) and remaining waste [13][14]. In several cities and municipalities
national, regional and local governments therefore subsidise new concepts in which people can bring several of these different ‘fractions’ near to their houses. These concepts, known under the names ‘Retourette’ or ‘Recycle Shop’, mostly are combined with supermarkets to initiate win-win situations. In Germany, in Hannover-Nordstadt [16] several projects were initiated which are not combined with supermarkets but with individual housing blocks in an area with relative high densities (about 80 houses/hectare). In a so-called ‘Abfall Hof’, situated in a glasshouse in a court, the waste of 47 houses (in 4 buildings), a day-care centre and some shops is separately collected. In this ‘Abfall Hof’ apart from the (separate) collection of glass, paper, clothes, shoes and metals especially the organic waste is being collected and composted decentrally. The residual waste here is reduced by 35% up to 50%. The remainder separated waste flows are being processed in the Recyclinghof Nordstadt, which works like a central division- / collection station for the city district [15]. In an other German city, Bremen, this principle of neighbourhood and city district bound waste separation /-management is organised a little more centrally with five decentral ‘Recyclings-Höfe’ [16]. In the time of the introduction the central goal of the municipality was a societal re-orientation from waste disposal towards waste management. The municipality did realise that recycling projects with such a concept “can never make enough profit in order to become independent from public funding”. Due to extensive work in informing, motivating and consulting the public, expenses will always outrun whatever income is made in the other enterprises of the project, which are managed according to business principles. In these projects an average reduction of ‘general waste’ by about 50% has been realised [16]. The former participants of the project have accepted separate garbage collection as part of their household routines.

Inside the Dutch concepts like the ‘Recycle-shop’ and ‘Retourette’, people can deliver up to 16 different fractions of refuse. Some of these fractions or ‘flows’ are connected to deposit money, most of them however still aren’t. The idea is to combine transportation from these decentralised collection buildings towards the regional division- and collection points that are, due to ongoing centralisation, situated at ever increasing distances. Apart from that the possibility to bring more and different fragments gives people the opportunity to walk some steps ahead of regulations concerning the environment in municipalities where the Diftar system still isn’t introduced. In municipalities in which the Diftar system has been introduced the concept generally works anyhow [4]. People can by separating more and different flows save some weight in their deposit containers and therefore save money. Special emphasis is being given to the design of these ‘Recycle Shops’. Most of them are designed in such a way that they address especially to children. The background of these new buildings is the belief that it will be easier to realise and maintain further going refuse separation and the pursued replacement of the existing (centralised) technologies by introducing decentralised solutions like the Retourette. The introduction nearer to the people inside a well-designed building tries to support the needed shift in acting and thinking: Waste needs to be treated as ‘raw material’. To achieve this goal the
final step in this process should be the introduction of governments or privates that pay for separately offered refuse fractions instead of people paying for their waste. Of course this should be combined with the full-scale introduction of deposit money for use of raw materials in (all) product prices.

3 Effects of decentralised refuse collection concepts

3.1 Concept of decentralised collection

In 2001 a research has been carried out concerning the effects of the introduction of the formerly stated decentralised waste collection concepts like the ‘Retourette’ and the ‘Recycle shop’. The research focussed on concepts in the village Tynaarlo and the city Haarlem, both in the Netherlands. The research represents an inquiry among almost 2000 persons [4]. Comparisons have been made in the introduction of these concepts in city districts with high-densities versus low-densities, cities in which waste collection is free of offered weight and cities where people have to pay for the amount of offered waste for (centralised) collection by garbage trucks (Diftar). Secondary effects of the formerly stated differences also have been investigated. Other factors that have been analysed are the suitability within a social acceptable form (integration), possible educational meaning and the cost factor in relation to energy-, water- and material efficiency of the concepts.

3.2 Diftar vs. non-Diftar municipalities

In the investigated cases in which there wasn’t a Diftar-system operative in the municipality the introduction of a Recycle Shop or Retourette did show interesting collection totals. After the collection of more or less ‘usual fractions like paper and glass (69% and 56% of the people brought these fractions) people mostly brought tetra cardboards (28%), plastic flasks (22%), tin (19%), small chemicals (10%), textiles (6%) and shoes (4%). About 70% of the people newly started to bring- and separate different fractions of refuse since the Recycle Shop gives them a possibility to turn it in. Especially the collection of tetra cardboards, plastic flasks and tin/metals increases (respectively 49%, 48% and 38%). But even the collection totals of small chemicals (33%), textiles (28%) and shoes (25%) increase significantly. The collection totals of the more usual fractions paper and glass increase with a small 5%. The collection of all 8 investigated fragments of refuse in municipalities in which the Diftar system was introduced increased even more significantly. Especially the collection of tetra cardboards (72% of the people who came to the Retourette), plastic flasks (63%) and tin (52%) increased enormously. But it is not just the amount (or weight) that changes. People also turn in more (different) fractions and more weight at once (taking boxes in stead of bags). Most of the times this results in the need to transport it by car (two times as many people) or by bicycle (20% more people)
instead of going by foot. At the same time people are willing to cover a longer
distance to bring their separated refuse (with high-flyers up to over 10 km). The
biggest group of people comes from a distance below the 3 kilometres from the
collection site. Apart from that the frequency of bringing separated refuse
increases too. About two third of the people comes in between one or two times a
week. Since the investigated buildings were clustered to commercial activities (in
the investigated cases supermarkets), who most of the times own and therefore
supervise these buildings, more clients came to visit these businesses. Only in
between 7 to 13% of the people didn’t combine their visit of the Recycle Shop
with a visit to the business of its owner. More than 10% of the people however
say not having visited the attending business before, but after the introduction of
the Recycle Shop do visit it regularly. This facet is interesting for the initiators for
they see these concepts as part of their businesses. For them it is just another way
of offering services to attract more people and therefore make higher profits. In
the case of the Recycle Shop in the non-Diftar city of Haarlem the proprietor has
invested Euro 320,000 (including the purchase of the –existing- building). The
project was subsidised by the local government a/o. (overall Euro 220,000). Apart
from that a local Recycle Business, who is responsible for the transportation of some of the collected flows from this Recycle Shop, pays for
half the wage of a person (about Euro 5500) every year for personnel costs. In the
case of the Diftar municipality of Tynaarlo the total investments were much less
for the collection was being arranged inside the new built supermarket. The
overall investment in this case was only Euro 100,000. The collection totals are
better in the Diftar municipalities, but even in the case of the Recycle Shop in
Haarlem quite surprising amounts are being collected: paper average 23 m³/week;
tetra cardboards 2,8 m³/week; plastic flasks 1,4 m³/week; glass 11m³/week; tin/
small metals 1,2 m³/week; textiles 10m³/week. In this case it is important to notify
that in the neighbourhood in 4 other places the ‘usual’ glass and paper is being
collected. The majority of people combine their visit to the Recycle Shop with
their everyday shopping (supermarket). In cases in which the Recycle Shop is
being located strategically, for instance at an in- or exit route of a city more
people (up to 31%) bring their separated refuse without any direct connected visit
to the commercial shop that owns the Recycle Shop. Almost all these Recycle Shops have been designed with extra emphasis at the
target group of children. The idea is to educate these ‘new’ citizens at an early
stage. An interesting outcome of the research however is that a big majority of the
people that bring their separated refuse isn’t being attracted to the concept for this
reason. Moreover they even don’t like this childish stigma “for such a serious
matter as recycling” as several people stated. They do however underscore the
need for a good and aesthetic design, not only for a better control, maintenance
and use but most of all to show the need and seriousness of recycling [4].
4 Conclusions

The introduction of decentralised concepts of (voluntary) waste collection into far-reaching separated fractions in city-districts in the Netherlands is relatively successful. Relatively because of the recognition that in the actual situation recycling projects with such a concept can never make enough profit in order to become independent from public or private funding. The introduction of pay-per-weight systems (differentiated tariff’s) of the residue-waste collected by the authorities improve significantly the collected totals. However they also raise the amount of ‘unsustainable’ transportation kilometres by the people bringing their separated waste. This applies especially for low-density communities and residential districts, due to the availability of more space to accumulate more waste in or near peoples houses. In case of pay-per-weight communities some illegal dumping of refuse ‘wasn’t as worse as expected’ while only for about 5% of the refuse was being fenced with offering it at people’s employers or family. The hygiene, integration and special design of these collecting buildings were indicated by its users to be of significance. To educational aspects applied design however wasn’t mentioned to be of importance (or even was judged negatively).

References

954 Sustainable Planning and Development


