Full length article

# Distance and incentives matter: The separation of recyclable municipal waste

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## ARTICLE INFO

## ABSTRACT

The effects of two common systems of waste separation such as drop-off sites collection and kerbside collection, and the addition of an incentive program in small communities of the Czech Republic were investigated. Our findings suggest that the paper and plastics separation rates of total municipal solid waste are 7.7% for drop-off sites and 9.7% for kerbside collection system. If we add an incentive program, the separated paper and plastics rate can reach more than 17%, which represents a significant increase of the separation rate. Additionally, higher density of drop-off sites can also increase separation rate, but the effect is relatively low, and this approach is often not economical.

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## 1. Introduction

Municipal solid waste (MSW) is a constant problem for modern societies. The usual method of dealing with the generated MSW in the past, after learning of negative effects of simply throwing it into the streets, was to dispose of it in an open dump somewhere outside of town (Williams, 2005). While in less developed countries open dumps are still common (Guerrero et al., 2013), western countries mostly departed from this approach and use controlled landfills in designated areas or incinerators. This "out of sight, out of mind" culture may often result in having very little awareness of how much waste is actually produced among the local population. The actual MSW generation per capita in the European Union was in recent years around 500 kg (Eurostat, 2014).

When considering the environmentally friendly strategies of dealing with MSW, there are generally two available approaches: waste reduction and waste recycling. This study focuses on waste recycling, specifically waste separation. The recycling industry has developed significantly over the past decades and today people are often able to generate very little unrecyclable waste. At this point, the availability of infrastructure plays a key role in the willingness to separate (Folz, 1999). Civic amenity (CA) sites today offer the

possibility of separating all kinds of waste, from paper, plastics, and glass through biodegradable waste, metals, WEEE (electronic waste), and wood to oils, bulky waste, and various hazardous waste. Especially in larger municipalities, the possibilities for waste separation are often almost luxurious.

But the sole availability of facilities where people can discard recyclable waste does not mean that people will start separating generated waste. As Williams and Taylor (2004) put it, the public needs to be educated in order to think of waste as a resource rather than as materials that just need to be thrown away. Kirakozian (2015) provides a comprehensive literature review of the factors affecting household waste separation like infrastructure, payment systems, information-based instruments, or incentives, and comments on their utilization in related public policies. Derksen and Gartrell (1993) concluded that probably the most important determinant of recycling behaviour is access to a structured and institutionalized program that makes recycling easy and convenient. The availability of a recycling facility, ease of use, and little effort needed in order to recycle are also indicated as important factors by Chen and Tung (2010), Oskamp et al. (1991), and McCarty and Shrum (1994). Instead of convenience, multiple studies, such as Gonzáles-Torre and Adenso-Díaz (2005), Hage et al. (2009), or Belton et al. (1994) mention distance (proximity) to the waste separation facility, what can be also interpreted as the level of convenience or the effort required. Ayalon et al. (2013) provide a comprehensive study of these factors using international survey data and suggest better targeting of the waste policies to the spe-

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cific household groups (income, education, age, size) once there is sufficient presence and quality of recycling services, and see high potential in unit-charging billing systems (i. e. Pay-as-you-throw).

There are several types of separated waste collection systems, ranging from those far from the waste source and thus less convenient for the people considering waste separation, to those that are right at the waste source and thus providing a much more convenient solution. According to the observations of Williams and Taylor (2004), Gonsáles-Torre and Adenso-Díaz (2005), Domina and Koch (2002), Perrin and Barton (2001), Hage et al. (2009), and Ando and Gosselin (2005), people are more likely to separate if they have a more convenient system available, or if the facility is close to their homes, suggesting that the shorter distance requires less effort.

The available types of waste separation infrastructure can be divided into groups based on the level of separation convenience they provide. Gonsáles-Torre and Adenso-Díaz (2005) have categorized these from to the least convenient to the most convenient (in terms of distance necessary to be covered from waste source such as household to the waste separation site). The least convenient, a drop off at a civic amenity (CA) site, sometimes referred to as Household Waste Recycling Centre (HWRC), is usually also the most expensive collection system for separated waste. The CA site usually consists of a fenced area with multiple containers for various types of recyclables and has one or more attendants who help people separate their waste correctly. Although this system offers a high quality of separation service and requires the least managing from the administrative perspective (Schultz et al., 1995), it is also limited by the high investment costs, spatial demand, and the need for an attendant. Likewise, CA sites are rarely seen in smaller municipalities that are unable to finance such facilities. Even in relatively large municipalities, there is often only one CA site. Moreover, from the household's perspective, this solution requires additional time and effort in transporting recyclables to the collection spot during CA site opening hours.

The second type of infrastructure for waste separation is a drop-off site consisting of a set of large bins for the collection of various recyclables. These sites are usually in public places with easy access for collection trucks. Compared to CA sites they are much cheaper, smaller, more common, and are on average closer to the waste sources like households. In the Czech Republic, the drop-off site is familiarly called a collection or a separation "nest".

The third type is kerbside collection of recyclables, representing a separation of the waste at the household source. This is the most convenient type of separated waste collection system. Examples of practical implementation can be found in many countries like Australia (Gillespie and Bennett, 2011), Canada (Derksen and Gartrell, 1993), Japan (Zheng et al., 2016), UK (Wilson and Williams, 2007), or USA (Saphores and Nixon, 2014). This collection system involves the provision of plastic bins that are usually positioned at the edge of the property, and are used for collecting various recyclables such as paper, plastics, glass.

In any waste separation system, consumer collaboration is crucial to achieving a higher separation rate. With kerbside collection, the consumer directly carries out the primary separation and thus reduces the increasing costs of separation later in the process of collection.

In the Czech Republic the kerbside collection system for recyclables has primarily form of a scheduled collection of coloured sacks filled with recyclables from the kerbside, and is usually called a sack collection. Compared to the kerbside collection using bins, plastic sacks are for one-time use only, do not require as high initial investment, and can be easily manipulated with. On the other hand, given the nature of the sack, limited types of recyclables can be collected with this method, with paper (including cardboard) and plastics being the most common. Separated glass is in municipalities using kerbside collection usually collected through the exclusively glass drop-off sites.

In addition to the distance and convenience factor Schultz et al. (1995), mention several studies showing that introducing any kind of reward for waste separation significantly increases the amount of material that people will separate and concludes that basically any kind of reward for the separation is effective, be it a large or small in absolute terms. Even better results were observed if the rewards were distributed through a lottery, in which bigger rewards were provided to a small group of winners. Such behaviour was also observed by Williams and Taylor (2004).

Introducing a reward related to the amount of separated waste thus generally effect significant increases in the amount of separated waste. In the Czech Republic, several municipalities have introduced an incentive program as a next step of the kerbside collection system. According to municipal representatives we have contacted, these rewards go as high as 70% discount of the regular yearly flat fee for each person in the household in the year following the year when household actively participates in the waste separation. We would describe this incentive program as a "reversed" PAYT scheme (Pay-as-you-throw). The actual level of discount from the usual fee is determined by the amount of separated waste that a household prepares for pick up and the amount separated by other households participating in the scheme. In order to correctly assign the amount of separated waste to each household, people attach a sticker with a unique barcode for each dwelling to the sack, which is then scanned either when the sack is being collected, if the collection truck is equipped with a scale, or at the collection company facility where the sacks are weighed and then emptied (Šauer et al., 2008 and Slavík and Pavel 2013). Bring-in to the designated spot with an attendee is sometimes also available. In contrast, with the usual PAYT scheme households (units that generate waste) are charged based on the amount of waste they produce – each additional generated residual waste unit is charged with an additional fee. For more detail on PAYT scheme see Bilitewski (2008) or Dijkgraaf and Gradus (2004). Although this charging method is generally perceived as more just, it has also drawbacks. As multiple studies like Fullerton and Kinnaman (1996) or Bucciol et al. (2015) add, such scheme can lead to the unwanted behaviour like waste stomping, illegal dumping, waste burning, etc. "Reversed" PAYT overcomes such issues and households are less likely to exhibit mentioned unwanted behaviour – only separated waste matters. We have found evidence of comparable incentive program only in Shaw and Maynard (2008), where it was mentioned as one of the possibilities that municipality was offering to the citizens when designing waste management system.

Our research goal was to evaluate whether kerbside collection, higher density of drop-off sites, and having an incentive program would result in higher separation rates for paper and plastics in a sample of municipalities from the South Moravian Region in the Czech Republic.

## 2. Material and methods

Municipal solid waste management 2012 data of 455 municipalities in the South Moravian Region in the Czech Republic were used in this study. The municipalities were selected based on the data that were accessible via email survey or phone call. Sizes of the municipalities ranged from population of less than 200 to over 3000. Fig. 1 shows frequency distribution of these municipalities based on population size. Compared to the whole Czech Republic, municipalities sampled in our study are a bit larger, but otherwise follow the same distribution. However, municipalities with significantly large populations were not included in this study, as they usually have much more complex municipal solid waste manage-