

# Science for Environment Policy

## Kerbside waste-collection schemes may need optimisation, highlights Portuguese study

**A new analysis of waste recycling systems in Portugal highlights where kerbside (edge of pavement) collection systems could be optimised, to decrease their environmental impact.** In this case, researchers found that the kerbside system was less favourable economically and environmentally due to more packaging and more fuel consumption per tonne of waste, compared to a system where recyclable materials are deposited by residents in large containers. But the researchers suggest that measures such as re-usable boxes and efficient collection routes could help to mitigate the impact of kerbside collection. While there is an environmental impact from waste collection, processing *and* disposal, this study only focused on the collection phase.

**Separate waste collection is highlighted in the [Waste Framework Directive](#) as a way of promoting better recycling, and is also emphasised in the [Circular Economy Package](#).** Many aspects of separate waste collection have been analysed, but the results tend to be case specific due to the variety of systems used in different countries, note the researchers. They, therefore, set out to investigate the environmental impact and economics of different separate collection systems in Portugal, by analysing three scenarios: exclusive kerbside collection; exclusive container drop-off; and a mixed system, where both kerbside collection and container drop-off takes place.

In Portugal, separate collection of glass [waste](#) began in the 1990s with large containers where people could deposit used glass. This system was then extended to containers for paper, cardboard and lightweight packaging waste. Such systems are the dominant type of separate waste collection in Portugal, but there are some pilot cases of kerbside collection, for example in western Portugal, where a private company operates alongside the container system. The company collects recycling which has been left outside homes in plastic bags.

The study looked at two neighbourhoods that currently use a mixed system; glass waste must be dropped off at containers and kerbside collection takes place weekly for packaging and paper/cardboard only. The residents generate nearly 10 tonnes of recyclable waste per month. Based on data collected in October to November 2015, the researchers determined that this was made up of 3 380 kilograms (kg) of lightweight packaging waste (metal, plastic and cartons); 3 860 kg of paper and cardboard; and 2 400 kg of glass waste. Kerbside bag collections are made by a 3.5 tonne vehicle, and container collections are made by a 19 tonne vehicle for paper/cardboard/packaging and a 26 tonne vehicle for glass.

Despite the kerbside collections, residents also drop off a proportion of other waste in containers, amounting to 840 kg of lightweight packaging and 1 100 kg of paper/cardboard. The researchers compared this mixed system (A) with a scenario in which *all* non-glass waste is collected at kerbside (only glass is taken to containers) (B), and a scenario where all waste is taken to containers (C).

The environmental impact of each scenario was analysed using the life-cycle assessment technique, with impacts in six categories calculated by the researchers (abiotic depletion, acidification, eutrophication, global warming, human toxicity, and photochemical oxidation). Aspects such as electricity used during processing and vehicle emissions during collections were taken into account.

*Continued on next page.*



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**Source:** Pires, A., Sargedas, J., Miguel, M., Pina, J., & Martinho, G. (2017). A case study of packaging waste collection systems in Portugal–Part II: Environmental and economic analysis. *Waste Management*, 61, 108-116.

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## Kerbside waste-collection schemes may need optimisation, highlights Portuguese study (continued)

Results showed that the exclusive container system (C) had the lowest environmental impact in all impact categories. The kerbside system (B) had significant impacts because of the number of plastic bags needed to separate the waste, and vehicle emissions generated during collection. The overall impact of the mixed system (A) was diminished because some waste was dropped off at containers by residents.

Looking at the impacts of the different types of waste collected, the per-tonne impact of collecting and processing packaging was highest due to the low mass per volume collected and electrical energy used during sorting of this waste (e.g. when moved on conveyer belts).

The costs of waste collection were also analysed in an economic assessment, taking data from the private company and academic literature. Capital, operation and maintenance costs were calculated, for example, the costs of collection equipment, processing and expenses due to landfill tax, along with the revenue from selling recyclable material. The researchers were then able to calculate the cost per route based on the economics of collection; the cost per inhabitant and cost per tonne, based on collection and processing; and the break-even point per route.

Results showed that economically, the container system (C) was also most advantageous, while the kerbside system (B) was the most costly, even though the materials collected in this system were the least contaminated and raised most revenue. This is in accordance with national data<sup>1</sup>, according to the researchers. The economic assessment takes into account further steps in the waste-treatment chain, such as landfilling taxes and the revenues of sales of secondary raw materials, but the sensitivity analysis (which is performed using assumptions that differ from those used in the primary analysis) focuses only on parameters related to waste collection. Using this approach the study found that if improvements were made to the distance travelled during kerbside collection and if collection bags were replaced with 50-litre capacity plastic boxes, lasting 10 years, then kerbside collection outperformed the container system (C), in environmental terms.

In addition, the researchers recognise that only life-cycle stages related to collection of waste were modelled; and, that if environmental benefits derived from recycling were included in the assessment, kerbside would be the best collection system in terms of environmental considerations. This is because kerbside collection typically provides more materials that can be recycled, as opposed to landfilling or incineration.

Some studies have found the container scheme more costly than kerbside collection<sup>2</sup>, note the researchers, highlighting how variables, such as the amount of waste recycled and landfilled, can influence their economics. Indeed, the current study indicates where improvements in waste collection could be made, economically and environmentally, and such analysis is important to highlight areas for optimisation to local authorities and waste-collection companies. In conclusion, a good mixture of kerbside-collection and container drop off systems can provide a good environmental outcome at a reasonable price, especially if collection routes and frequency are optimised.



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2. Powell, J.C. (1996). A lifecycle assessment and economic evaluation of recycling. *Journal of Environmental Planning & Management* 39: 97-112