01 July 2016
Issue 461
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Source: Hoogmartens, R., Eyckmans, J. & Van Passel, S. (2016). Landfill taxes and Enhanced Waste Management: Combining valuable practices with respect to future waste streams. *Waste Management*. DOI: 10.1016/j.wasman.2016.03.052.

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European Commission

Science for Environment Policy

Enhanced waste-management practices reduce carbon emissions and support lower landfill taxes

Landfill taxes and 'enhanced waste management' practices have been introduced to reduce the amount of waste that goes to landfill and to convert waste into useful products. This study investigated the interplay of these two policy options in Belgium, generating findings that could help Europe move towards a resource-efficient, circular economy.

Landfills are the oldest form of waste management, but have a large environmental impact. In the EU, landfilling is now a last resort for waste management and strictly limited, and any waste that has to be landfilled must be sent to sites that comply with the Directive on the landfill of waste[1].

One way to reduce the environmental effects of landfills is to impose a tax on their use. Landfill taxes are a form of sustainable materials management — which is a component of the EU's flagship initiative to achieve resource efficiency by 2020. Another form of sustainable materials management is 'Enhanced Waste Management' (EWM), which aims to process waste into useful products. This is a relatively new concept in Europe and not yet part of the Waste Framework Directive.

Both mechanisms could provide environmental and economic benefits, but they can be difficult to balance. This is because high landfill taxes can reduce the incentive for EWM, as taxation reduces the amount of landfilled material available for conversion into useful products and mitigates the issue of scarce landfill space — thus making EWM less necessary. Likewise, as EWM reduces the amount of waste that is permanently landfilled, it also reduces the landfill scarcity issue, making landfill taxes more 'redundant' (because it postpones the point of landfill capacity exhaustion), the researchers assert. EWM could thus reduce the necessity of landfill taxes, contribute to a circular economy and have environmental benefits.

This study used data from Flanders, Belgium to investigate how the two methods can reinforce each other. The landfill tax was introduced to Flanders in 1990 and is currently set at €42 per tonne (for category two landfills, which contain inorganic non-hazardous industrial waste, household waste and industrial waste that is comparable to household waste). EWM is a more recent addition, and has been under development in Flanders since 2008.

To assess how taxation can encourage sustainable methods of waste processing while generating revenue for public benefit, the researchers applied 'dynamic optimisation techniques' — a method of modelling real-world problems. They simulated three scenarios: one without EWM and with the current average landfill tax; one with the current average landfill tax and with EWM; and a third scenario, which investigated EWM alongside various levels of taxation (all scenarios were focused on *future* waste streams).

In the scenarios where EWM was applied, metals (1.9 percentage by weight, wt%, of the overall waste), glass (2.61 wt%) and aggregates (coarse particles used in construction, such as gravel and crushed stone) (37.86%) were re-used. Just 4.45% of waste was landfilled, 33% was temporarily stored in landfill, and 20% was converted to fuel. These percentages are based on a study performed for the Flemish REMO landfill site, and therefore generated corresponding simulation results. The input parameters of the model can however be adapted, allowing for simulations to be made based on conditions anywhere. The model maps demand for waste disposal, based on willingness to pay for waste disposal and the price per tonne of waste. EWM operators are assumed to generate profit by performing waste-to-material and waste-to-energy conversions, creating metals, glasses and refuse-derived fuel (which can be used to generate electricity).

Continued on next page.

1. Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31999L0031

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Enhanced waste-management practices reduce carbon emissions and support lower landfill taxes *(continued)*

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The model calculates how EWM operators will maximise their profits using an equation that considers processing costs, treatment costs, material and energy revenues, landfilling costs (which apply to the waste fractions that have to be permanently landfilled) and storage costs (which apply to waste that has to be temporarily stored until it can be converted). Using modelling software, the researchers identified the optimal waste volumes for EWM (considering the remaining landfill capacity in Flanders).

To compare the scenarios in terms of their economic, environmental and social impacts, they also devised a 'welfare function', which considers the profit generated by EWM, tax revenues (transfer payments), consumer surplus, green tax-reform benefits, and externalities — including environmental impacts (e.g. negative impacts of landfilling, such as water pollution, and positive impacts of EWM, such as the reduced use of fossil fuels). This function was used to investigate which level of landfill tax maximises welfare, and is 'optimal' for society.

In the first scenario — without EWM — it was estimated to take 14 years for Flanders' remaining landfill capacity to be exhausted. In the second — when EWM practices were applied — only 4% of future waste is landfilled and it would take over eight times as long (123 years) for remaining landfill capacity to be exhausted.

The benefits of EWM, such as an improved net carbon balance, also generate positive external effects that justify lower taxation levels, say the authors. In other words, the optimal tax was higher when EWM is not used. In the no EWM scenario, the optimal landfill tax was €93/tonne. When EWM was applied alongside taxation, the level dropped to €50/tonne (due to the positive social and environmental impacts of EWM). Under this scenario, it would take 128 years for landfills to become full. As the current average landfill tax is below the optimal level, the authors recommend that the tax be raised, or a greater commitment be made to EWM.

Although these simulations are specific to Flanders, the researchers say their findings could help policymakers worldwide to develop sustainable waste-management practices, and provide some general recommendations. For instance, they suggest that higher landfill taxes do not necessarily lead to more effective waste-management practices because, as their simulations show, after a certain level of taxation, profit levels and welfare decline. The researchers also support policymakers incentivising EWM and new technologies to improve waste processing (as not all types of waste can currently be recycled).

Overall, this study shows that it is possible to achieve a complementary combination of landfill taxation and EWM, in which landfill capacity is saved and both the environment and society benefit, and provides a tool (dynamic optimisation) to help achieve this. The approach can account for evolving prices, costs, capacities and technologies, allowing policy to be continuously adapted to market conditions. The findings of this study are relevant to the transition to a more resource-efficient, circular economy in Europe, and waste-management policies worldwide.