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COMPARISON OF THE ORGANIC WASTE MANAGEMENT SYSTEMS IN THE DANISH-GERMAN BORDER REGION USING LIFE CYCLE ASSESSMENT

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ABSTRACT. The treatment of organic waste from household in the Danish-German border region is very diverse, the Danish area only uses incineration for the treatment while the German system includes combined biogas and composting, mechanical and biological treatment and incineration. Data on all parts of the organic waste treatment has been collected including waste composition data and data from treatment facilities and their respective energy systems. Based on that the organic waste management systems in the border region were modelled using the EASETECH waste management LCA-model. The main output is a life cycle assessment showing large differences in the environmental performance of the two different regions.

Keywords: organic waste; LCA; conference; Hong Kong

Introduction

The European waste framework directive sets targets for recycling of household waste of minimum 50 % in 2020 [1]. With regards to the organic waste the EU-member states must take measures to promote (a) separate collection of organic waste in preparation for composting and biogasification of the organic waste (b) treatment of organic waste in such a way that it fulfils a high level of environmental protection and (c) use of environmentally friendly materials produced by organic waste [1].

The waste management system in the Danish-German border region is relatively different on each side of the border. In the German system a high level of source separation of the organic household waste already exists and this waste is treated at different biological treatment plants. In the Danish system no source separation is currently taking place, but there is a wish for starting source separation mainly due to the European waste framework directive and guidelines from the Danish Environmental Protection Agency [2].

The goal of this study is to investigate the management of the organic household waste in the Danish-German border region more specifically the municipalities: “Aabenraa (DK), Sønderborg (DK), Haderslev (DK), Tønder (DK), Rendsburg-Eckernförde (D), Sleswig-Flensburg (D) and Flensburg (D)” and point out major differences between the systems and their potential effects on the environment using life cycle assessment (LCA).

Material and Methods

Data collection

The treatment of organic waste from households in the Danish-German border region consists of incineration, combined biogas production and composting, and mechanical and biological treatment (MBT). In the Danish region only incineration is used, while the German region uses all three treatment options.

Existing data on waste composition, collection and transportation, treatment plants and final disposal were all collected and scrutinized. Where gaps in knowledge about the systems were found data were measured to the extent it was possible. This included a waste composition measurement campaign [3], and communication with all waste treatment facilities managing organic household waste in the region, both as source separated organic waste and as organic waste found in the residual waste.

Waste compositions, i.e. the relative distribution of material fractions in the waste, from Tønder [4] and Rendsburg-Eckernförde [5] were available from previously waste sampling campaigns. The household waste from the three municipalities of Aabenraa, Sønderborg and Haderslev were sampled to determine (amongst other parameters) the content of organic waste [3]. The remaining waste compositions from Sleswig-Flensburg and Flensburg were assumed to be similar to the waste composition in Rendsburg-Eckernförde. The chemical composition of the waste fractions was taken from Riber & Christensen [6].

Each waste treatment facility was contacted in order to provide the required data for modelling. The incineration plants were modelled using material and substance flow analysis with data provided on all outputs of the plants. The energy efficiencies, both for electricity and heat production, of incinerators were taken into account along with the different surrounding energy systems (heating systems) that were substituted by heat from the incinerators.

Methods

All collected data were modelled using the EASETECH waste management LCA-model developed at the Technical University of Denmark [7].

The results are shown for five impact categories: “Global warming, acidification, marine eutrophication, resource depletion – fossil fuels, and resource depletion – elements”, all of which are included in the ILCD recommended impact categories [8] and presented as person equivalents (PE).

Results and Discussion

The results are three-fold. First of all the composition of the organic waste has been determined through three waste sorting campaigns one of which was done as part of this paper, the other two were done previously. Table 1 shows the composition of the organic waste in the different municipalities of the border region. It can be seen that there are differences between the municipalities ranging up to a factor of five (animal excrements and bedding). However the four largest fractions only differ with a factor of maximum 2.

Table 1. Composition of the organic waste collected in the Danish-German border region.

Material fractions	Aabenraa	Sønderborg	Haderslev	Tønder	Rendsburg-Eckernförde Sleswig-Flensburg Flensburg
Vegetable food waste [%]	67.2	68.9	70.8	73.9	63.5
Animal food waste [%]	15.9	16.2	16.5	12.6	20.1
Kitchen towels [%]	7.6	7.8	8.1	6.0	7.0
Yard waste, flowers [%]	8.3	6.4	4.2	6.6	6.1
Animal excrements and bedding [%]	0.9	0.8	0.4	0.8	2.0
Wood [%]	n/a	n/a	n/a	n/a	1.3

The amounts of organic waste in the region are shown in figure 1. Waste generation is divided by area and each arrow represents the amount of organic waste in either the residual waste stream (R) or as source separated organic waste (SSO). The waste streams go to their respective treatment facilities. In the Danish region 100 % of the organic waste goes to incineration (together with the residual waste) and 0 % to separate organic treatment while in the German region 52 % goes to combined biogas and composting, 31 % to incineration and 17 % to mechanical and biological treatment.

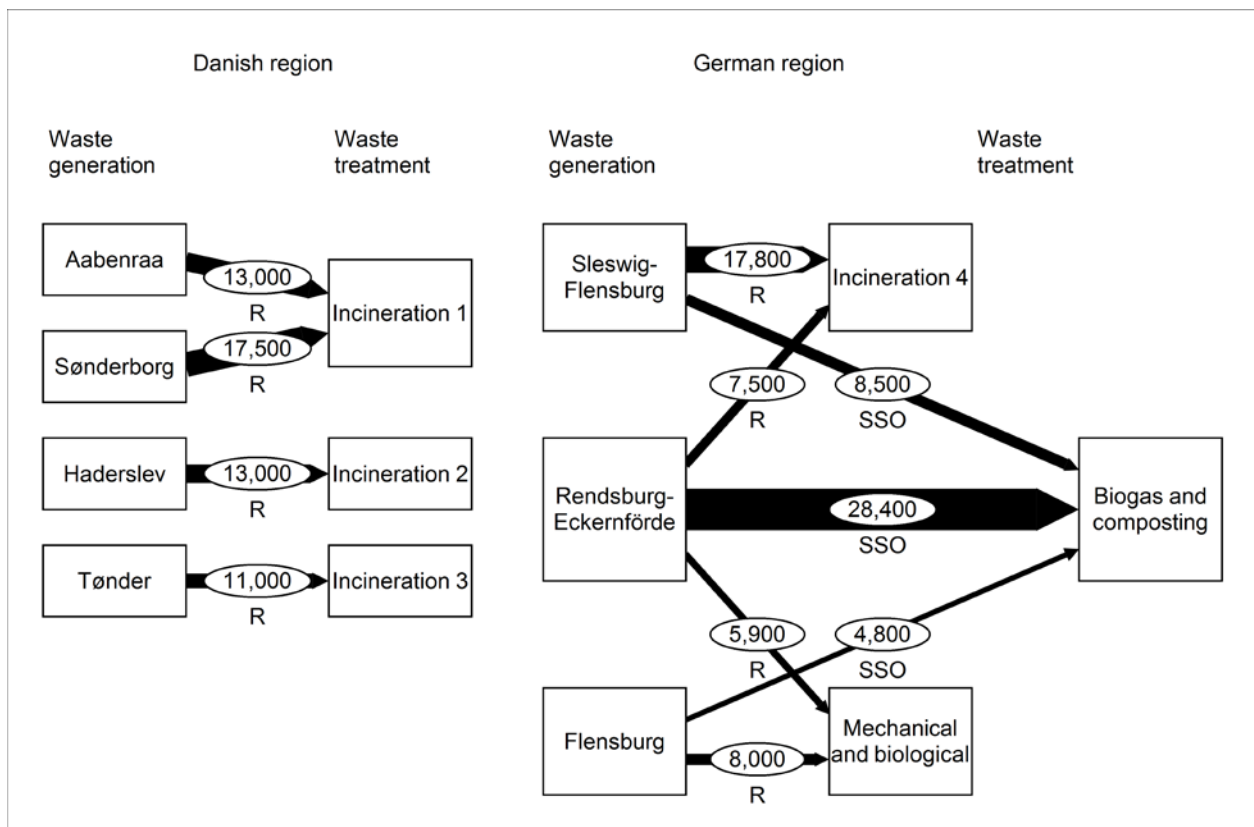


Fig.1. Organic waste flows from households in the Danish-German border region. Amounts are displayed in Mg/year. R: organic waste in the residual waste stream. SSO: organic waste in the source separation.

The waste composition and amounts together with data from the different treatment facilities across the border in the Danish-German border region have been used to model the potential environmental impacts of organic waste treatment using the EASETECH-model. The results are shown in figure 2. The five impact categories show large differences in all cases especially the categories “marine eutrophication” and “acidification”. For “marine eutrophication” the main impact in the German region is due to the use of compost on land and the related leaching of nutrients and the impact in acidification is coming from ammonia emissions from the combined biogas and composting facility. The only category where the result has opposite operational sign is “resource – elements”, the Danish region show a net impact and the German a net saving this is due to the substitution of conventional fertilizers which only happens in the German case.

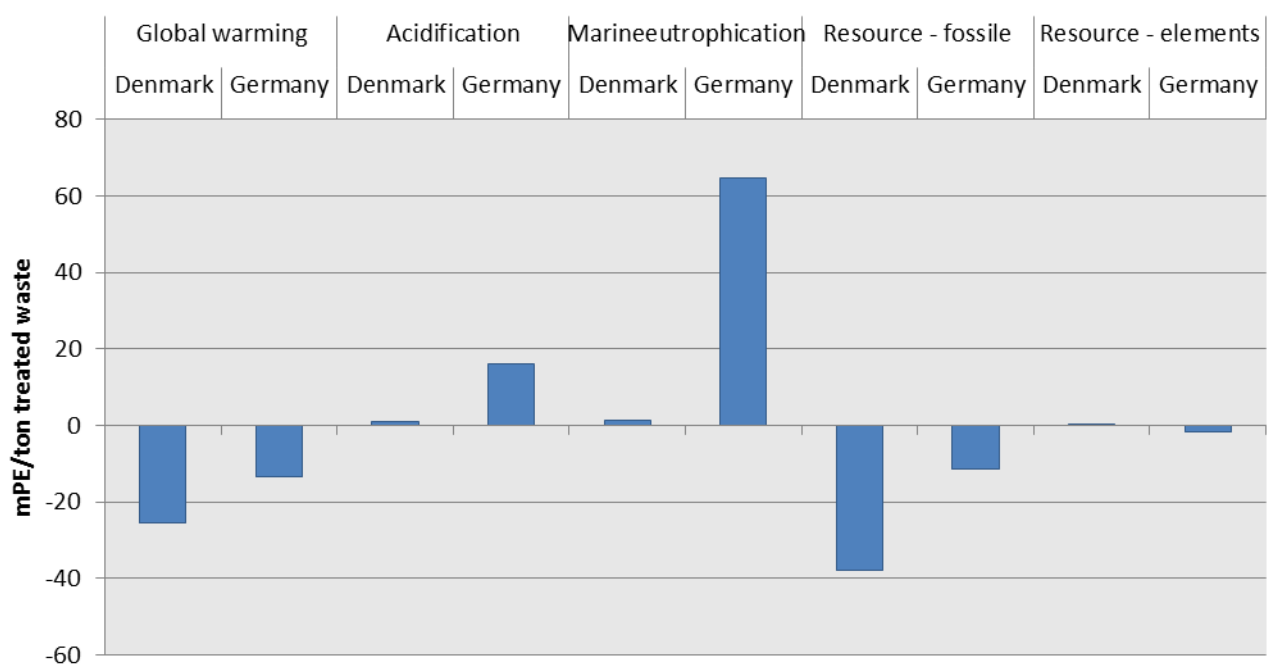


Fig. 2. Comparison of the organic waste treatment from households in the Danish-German border region. Results are displayed as mPE (milli-person equivalents) per Mg of waste treated in each region.

Conclusions

The Danish and German treatment system for organic waste from households in the Danish-German border region show significant differences in their environmental performance as shown in the LCA. In the Danish system incineration is the only treatment technology used while the German system uses incineration, combined biogas and composting, and MBT. The Danish system shows a better environmental performance in four of the five impact categories assessed and only in the category “resource – elements” does the German system outperform the Danish system.

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