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Time series change of municipal waste management flows in Austria

Rokuta Inaba[1*], Tomohiro Tasaki[1], Rieko Kubota[1], Oliver Cencic[2], Helmut Rechberger[2]

1: National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan

2: Technische Universität Wien, Karlsgasse 13/226 1040 Vienna, Austria

*corresponding author: inaba.rokuta@nies.go.jp

ABSTRACT

Among the EU member countries for which efforts at establishing a circular economy are progressing, Austria has the highest levels of material and energy recovery from waste. Its time series change would be suggestive for other countries which intend to catch up. Therefore, we collected the data on municipal waste in Austria for 1990–2015, constructed the unified model to analyze material flows for the period and clarified the time series change of waste flows. The finding shows that gradual introduction of sorting processes resulted in an increase of waste utilization and a decrease of landfilling.

Keywords: Circular economy, European Union, material flow analysis, Waste to Energy, waste hierarchy

INTRODUCTION

In the European Union (EU), the development of circular economies (CEs) have been advocated since 2015. Based on the EU Action Plan, frameworks and efforts at effective waste utilization by all reasonable means have proceeded. The waste hierarchy objective, the basic concept for improved activities, was adopted as the priority of waste utilization. At that time in the EU, Waste-to-Energy (WtE) was progressing even before CE advocacy, but the priority of WtE in the waste hierarchy has remained low. Nevertheless, for cases in which the waste quality as a resource is low, or when energy consumption for recycling is high, WtE represents an effective means of waste treatment. In this way, for advancing CE efforts, it is necessary to position WtE properly from the circumspect viewpoints of energy consumption, cost, CO_2 emissions, and others, and to improve sustainability in a comprehensive manner. Among EU countries, Austria has the highest recycling rate, with aggressive WtE efforts and a high level of energy efficiency.

Examining the municipal waste management system in the country, we collected data for 1990–2015 and clarified the time series change of the flows. Specifically, we extracted municipal waste management flow data from the federal plan for waste management in the country. Then we constructed the unified model by adjusting the names and linkages of the processes and the flows for consistency of comparison. We moreover analyzed the change of municipal waste management flows during a 25 year period.

MATERIALS AND METHODS

First, we obtained the Austrian Federal Waste Management Plan (FWMP) from 1999 to 2015 on the Austrian government web site. We obtained plans that had not been uploaded to the site by consulting with Federal Ministry of Sustainability and Tourism personnel. Next, we extracted and organized the names and values of flows and processes from a diagram of the municipal waste treatment flow in FWMP. The names

and the connections of flows and processes in the flow diagram depend on those plans' year of publication.

Eventually, we constructed a model of municipal waste processing flow common to all years. Specifically, after we extracted all the names of flows and processes appearing in the flow diagrams of all the years we acquired, we integrated those which were apparently equivalent.

Although FWMP has English and German versions, the names in the flow diagram are unified in English. In addition, the treatment flow in each year was expressed by the change in flow amount and the presence or absence of flow and process appearance. In the flow diagram of municipal waste presented in FWMP, some flows do not show values. Also, some flows, such as exhaust gases from incineration, are not shown.

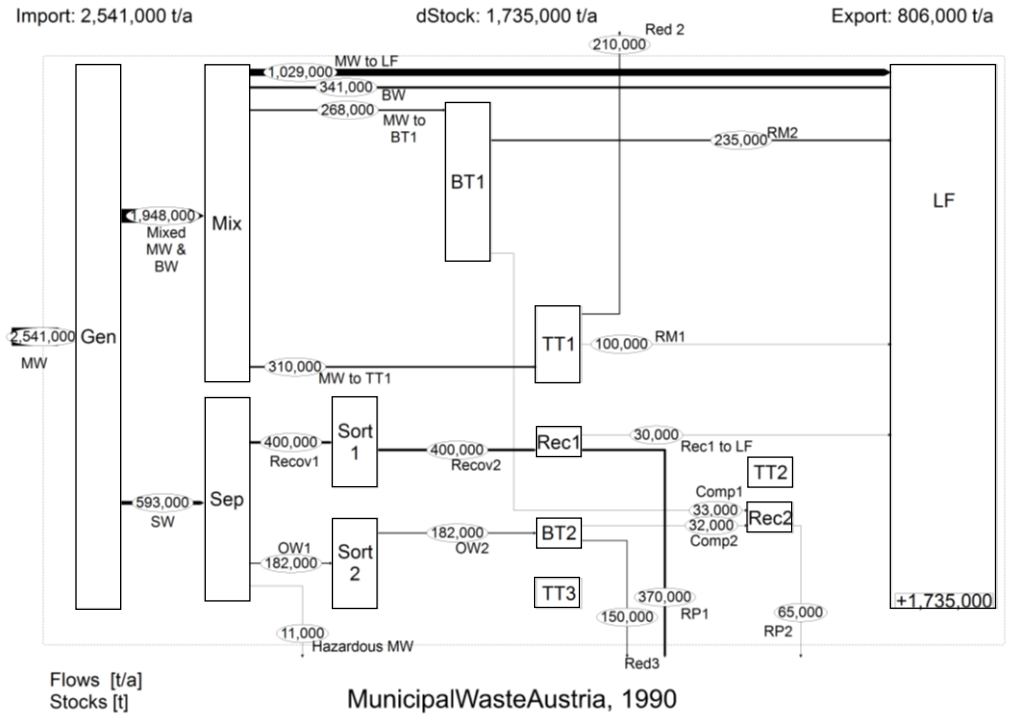
STAN software (Cencic and Rechberger, 2008), which was produced specifically for conducting material flow analyses, was applied to clarify the amounts.

RESULTS AND DISCUSSION

Our information gathering activities yielded FWMPs published in 2001, 2006, 2011, and 2017 (Bundesministerium für Land- und Forstwirtschaft Umwelt und Wasserwirtschaft, 2001, 2006, 2011) (Federal Ministry of Agriculture, Forestry, Environment and Water Management, 2011) (Bundesministerium für Nachhaltigkeit und Tourismus, 2017) (Federal Ministry Sustainability and Tourism, 2017) from the governmental website, and FWMP published in 1992, 1995 and 1998 (Bundesministerium für Umwelt, Jugend und Familie, 1992) (Federal Ministry of the Environment, 1995) (Federal Ministry of Environment, Youth and Family Affairs, 1998) from the personnel of the Federal Ministry mentioned above. We therefore obtained intermittent information about flows for 25 years. The flow diagrams shown in the FWMP are based on data several years before each publication itself.

In order to consistently evaluate the information collected in this manner, we constructed the model to unify the names of the processes and flows and to adjust the flows. Then, the flows of each year in the model described above was output by STAN. As examples, Fig.1 and Fig.2 present flows in 1990 and 2015 respectively. Fig.3 shows the amount of waste generation by collection method. Fig.4 shows the changes in the rate of sorting, recycling, thermal treatment and landfilling for 25 years relative to the amount of waste generated.

As shown in Fig.3, municipal waste generated in Austria has increased year by year. They also reveal that the proportion of separately collected waste has increased steadily. As shown in Fig.4, the recycling rate stopped increasing around 2010, after it had increased for many years. While the proportion of landfill has decreased, the proportion of energy recovery may have increased as the proportion of thermal treatment increased steadily. The structure of the waste management system demonstrates that amount and processes of sorting have increased, and that the proportion of thermal treatment of high-calorific fractions sorted has also increased. Correlation among the sorting rate, the recycling rate, and the thermal treatment rate is significant.



Gen: generation, Mix: mixed collection, Sep: separated collection, Proc: processing, Sort: sorting,
BT: biological treatment, TT: thermal treatment, Rec: recycling, END: end screening, Sum: summation, LF: landfilling,
MW: municipal waste, BW: bulky waste, SW: separated waste, Recov: recoverables, OW: organic waste, cal: calorific,
Frac: fraction, RM: residual materials, Comp: compost, RP: recycled products, Red: reduction

Fig.1 Municipal waste management flow in 1990

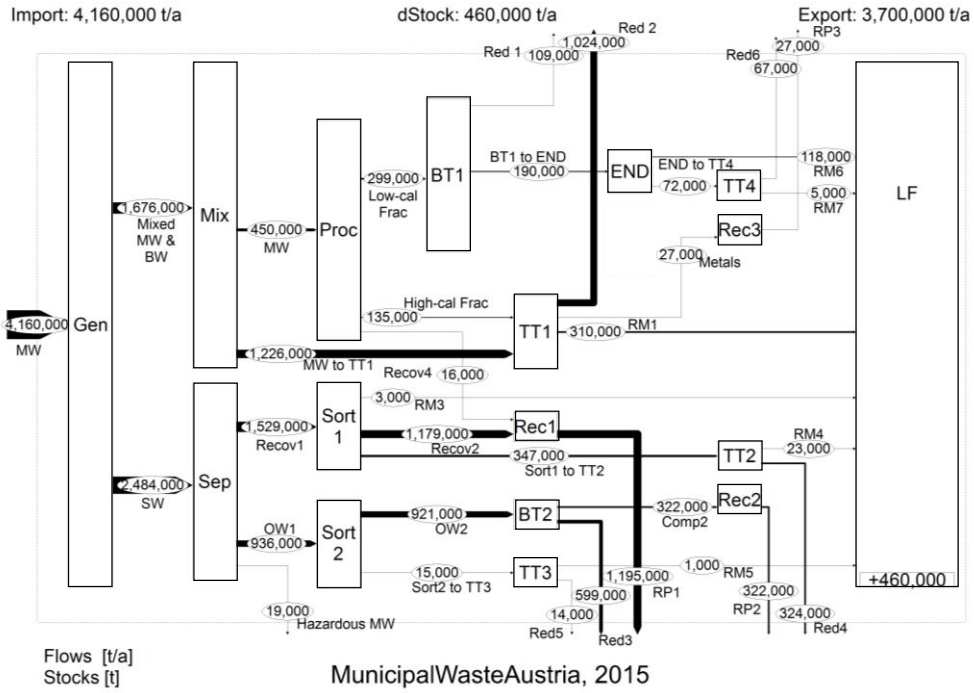


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Fig.2 Municipal waste management flow in 2015

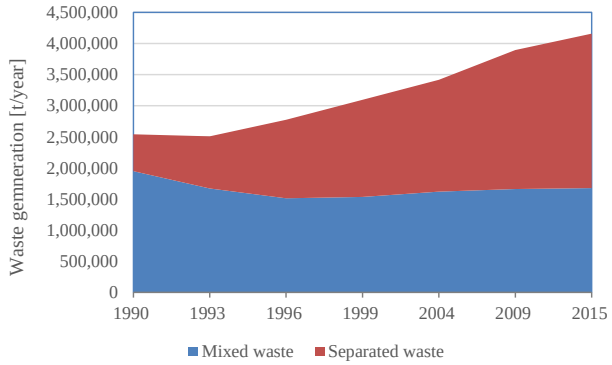

Fig.3 Waste generation amount by collection method

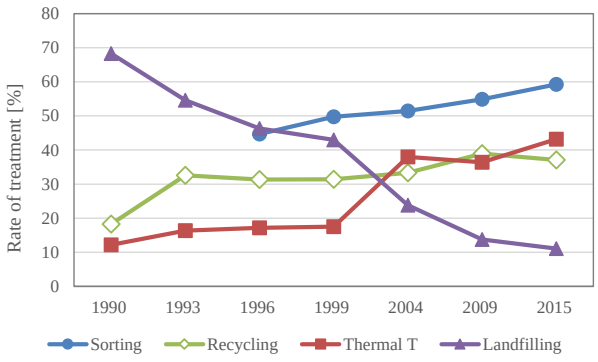

Fig.4 Rate of treatments for waste generation

CONCLUSION

Results show that the amounts of municipal waste generated in Austria have increased year by year. Moreover, the proportion of waste collected separately has increased steadily. The proportion of recycling and thermal treatment increased and the proportion of landfilling decreased as the sorting processing rate increased, indicating the importance of sorting processes in effective waste treatment. Results demonstrated the possibility that effective waste usage has become easier because waste sorting is applied to an increasing degree.

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