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WEEE MANAGEMENT USING LCA METHODOLOGY: THE FRIDGE CASE STUDY

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Introduction

The quantity of "waste electronic and electrical equipment" (WEEE), comprising computers, hi-fi systems, freezers, fridges, etc., sold and thrown away by an average European inhabitant increases each year. Recovery, treatment and valorization of these waste is only put in practice since few years in many European countries. These operations permit the reuse of materials and the decrease of environmental impacts.

Materials and Methods

This study is based on WEEE life cycle assessment and more particularly on treatment and valorization of fridges and freezers. Two scenarios were envisaged: situation before fridge collect and the Belgian current situation where all national fridges are treated in Liège. Before WEEE treatment, fridges were collected by scrap dealers to recover metals. Other parts were sent to land fill and refrigerant was released to the atmosphere. The current scenario comprises fridges dismantling, grinding, sorting of primary materials, glass plastic and metals recycling, and refrigerant incineration.

The average composition of a fridge [1] taken into account in this study to get the environmental impacts is presented in the Table 1. The study is based on the global mass of recovery fridges in 2009 in Belgium which is about 7000 tons.

Table 1. Average fridge composition

Composition	Al	Cu	Fe	Plastics	PUR	R11-R12	Oil	Compressor	Cables	Glass	Others
Mass percentage	2,42%	0,13%	42,35%	16,84%	11,15%	0,39%	0,30%	21,70%	0,10%	0,50%	0,90%

Steps for the first scenario without any treatment are first the recycling of metals (aluminum, copper and iron), second emissions of refrigerants into the atmosphere and of oil into the soils and last the land filling of the other parts of the fridge. The current scenario considers different steps with the recycling of plastics, glass and metals, energy and material consumptions of the treatment installation and last the incineration of the refrigerants (R11-R12).

Study was made in accordance with ISO standards 14040 [2] and 14044 [3] using the ReCiPe methodology [4] to evaluate environmental impacts. Technical data were provided by Van Gansewinkel [5]; ecoinvent databases [6] and scientific literature were also used to get all necessary data.

Results and Discussion

Main results

Figure 1 shows standardization results of both scenarios for 8 categories of ReCiPe used with the endpoint perspective. The other categories were not used due to the deficiency of data as for land occupation or ionizing radiation. This graph permits to highlight the importance of each category compared with the standard reference. Climate change, ozone depletion and fossil depletion are the three categories with the most important environmental impact for the scenario without any treatment. With treatment and valorization of fridges these impacts can be reduced especially with the capture and incineration of refrigerant which were used to be released to the atmosphere.

Refrigerant (R11 – R12) emissions into the atmosphere led to high impacts in climate change and ozone depletion categories in the old scenario. Controlled incineration and limited landfill can significantly reduce carcinogenic emissions and emissions responsible for the ozone layer decrease and climate change.

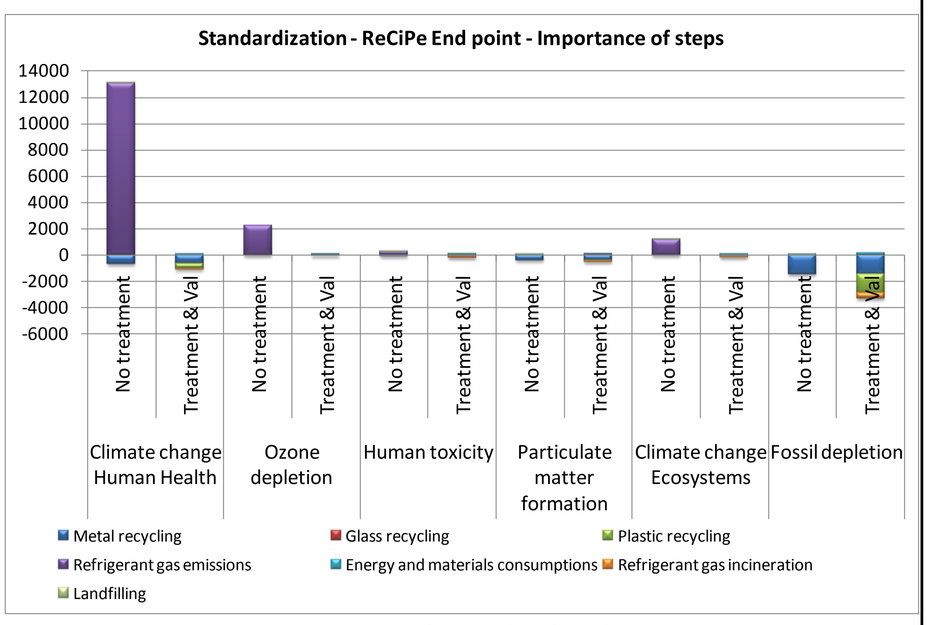

Figure 1. Comparison of standardized environmental impacts with or without treatment of fridges

Important steps

For the old scenario without any treatment the emissions step participates the most to the environmental impact followed by the land filling. The recovery of metals permits an environmental gain and reduces the global score for both scenarios. About the treatment and valorization scenario recycling of vary materials as plastics, glass or metals permits to lead to a negative impact. Incineration of refrigerants reduce their emissions into the air and then reduce their impact on the ozone layer. Energy and material consumptions have a positive impact which is compensated by the others environmental gains.

Conclusions

Results of this study prove the importance of collecting and valorizing fridges especially for old fridges containing refrigerant banned by the Montreal Protocol. Recovery and incineration of the pollutants permit to reduce climate change and ozone depletion impacts.

References

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