

The value of high-resolution MFA data for LCA of waste management systems:

Considering waste compositions and material efficiencies.

Emile VAN EYGEN, David LANER, Johann FELLNER

Case study: Plastics packaging waste in Austria

The environmental performance of the waste management system of plastic packaging in Austria was assessed using a combination of (1) **high-resolution material flows** and (2) **input-dependent life cycle inventory data**:

- The waste flows of plastic packaging were quantified with respect to polymers as well as product types. The elemental composition of each of the polymers was characterized with respect to 23 elements (Figure 2).
- These material flow data were subsequently connected to input-dependent life-cycle inventory data for each of the treatment processes (Figure 1).

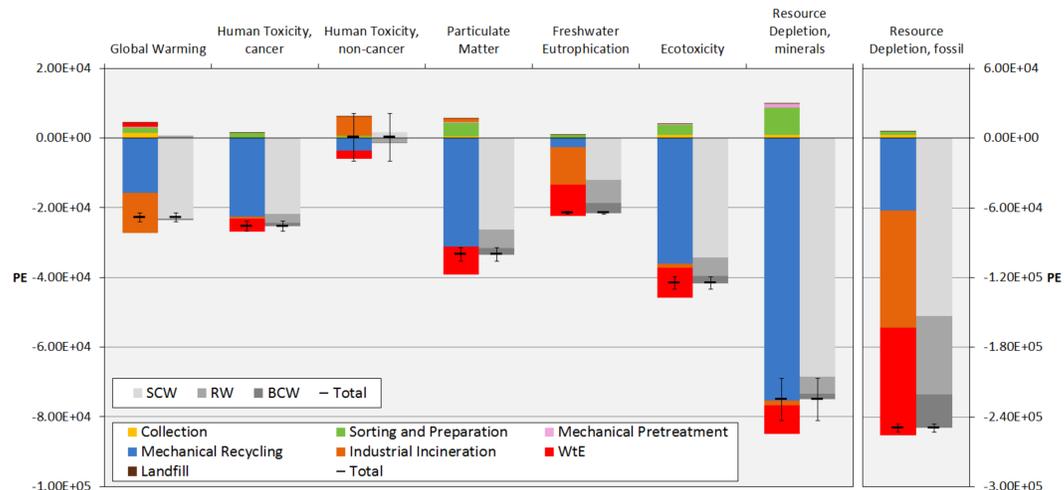


Figure 1: Environmental performance of the waste management system of plastic packaging for eight selected impact categories, subdivided by treatment process and collection route.

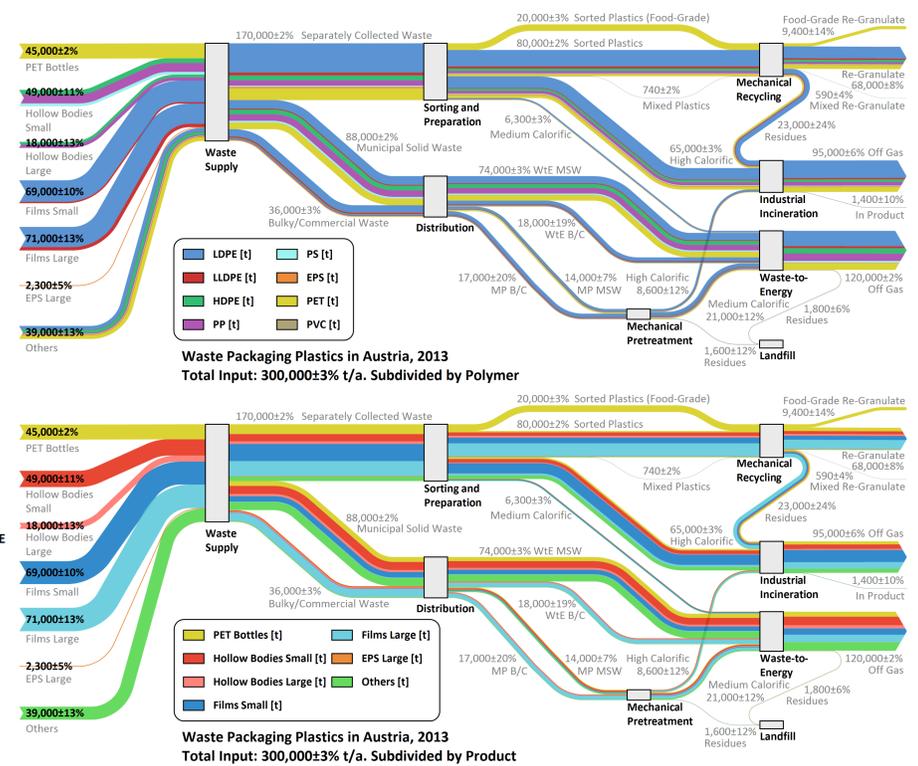


Figure 2: Waste flows of plastic packaging in Austria, 2013, subdivided by polymer and product type.

What if less detailed MFA data were available ?

The mechanical recycling yields **very different results for each of the different polymers** (Figure 3), but the same is the case for incineration processes (Figure 4).

The differences for mechanical recycling are mainly caused by the differences in the substituted material, and less by differences in the actual operation. For the incineration processes, the differences are mostly linked to the heating value and depend to a lesser extent on the elemental composition.

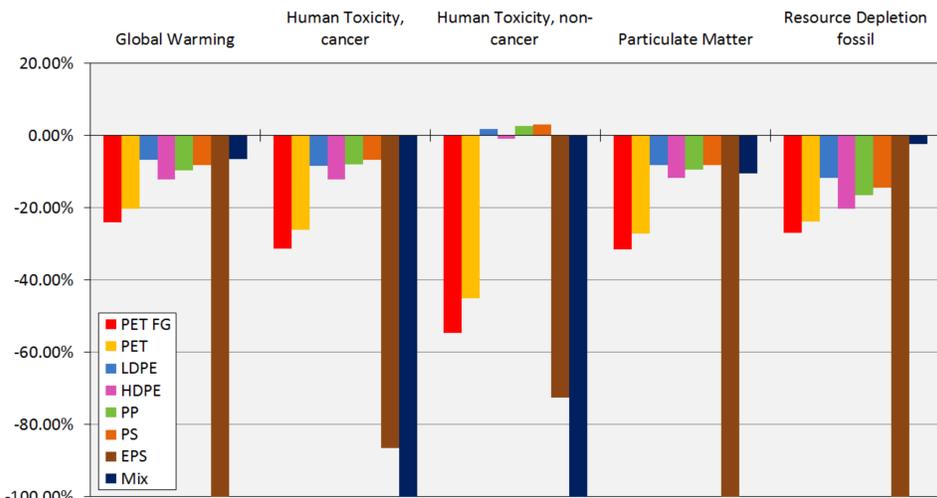


Figure 3: Impacts per tonne of the mechanical recycling of 8 fractions, normalized to the highest absolute value.

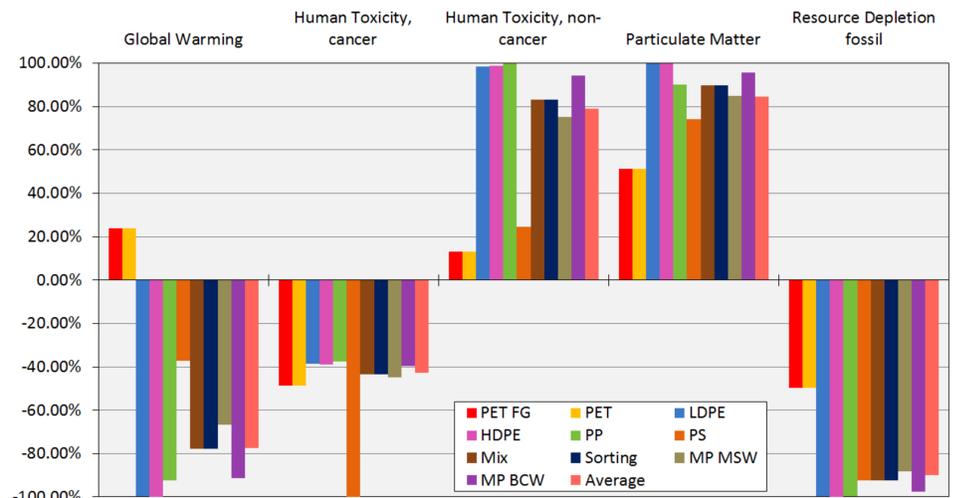


Figure 4: Impacts per tonne of the industrial incineration of 11 fractions, normalized to the highest absolute value.

To illustrate the effect of less detailed MFA data, **two alternative scenarios for the knowledge-level** with respect to the waste flows were constructed:

- Input composition with respect to **polymers** is known, but only **average transfer-coefficients (TCs)** are available for collection, sorting and recycling.
- Input composition is only known with respect to **hard vs. soft** plastics and **average TCs** are used for collection, sorting and recycling.

This lack of knowledge introduces uncertainty with respect to the destination of certain waste flows, so **two options (conservative and optimistic)** were calculated:

- Polymers known: PET to fibre or food-grade recycling?
 - Hard vs. soft: hard plastics to PP or PET food-grade recycling?
- These two options illustrate the spread of the results due to a lack of MFA data, and the results are shown in Figure 5.

In this specific case, the lack of polymer-specific TCs introduced a moderate amount of spread in the results, in the same order of magnitude as the parameter uncertainty. The lack of knowledge on the polymer composition however caused a very large spread of the results.

Therefore, **high-resolution MFA data, especially on the polymer composition, are needed** to accurately assess plastic waste management.

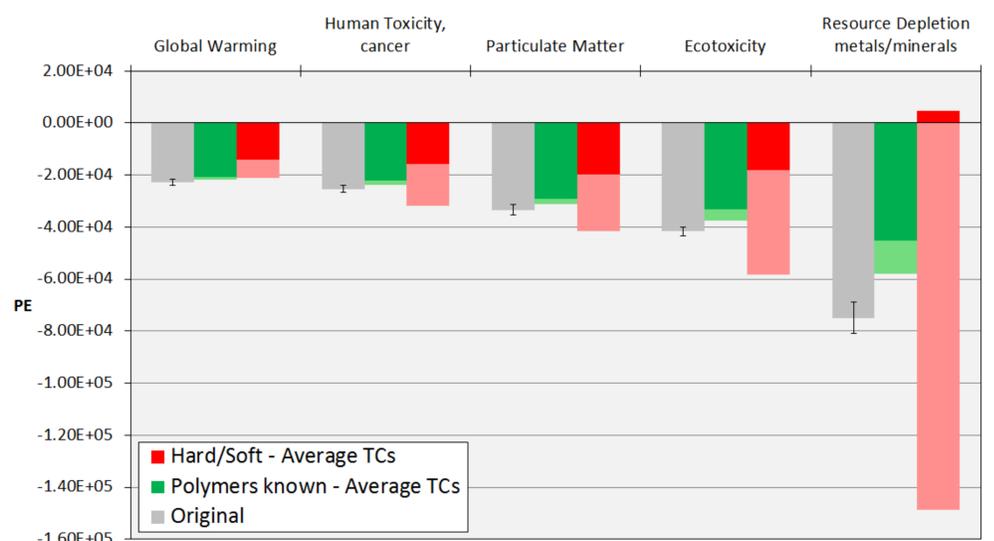


Figure 5: Results of the two scenarios with decreasing knowledge on the waste flows. The lighter colours indicate the difference between the conservative and optimistic options.