NORSUS
Norwegian Institute for Sustainability Research

Date: 20. mars 2025

From: Pieter Callewaert v. NORSUS

Life cycle thinking in the design of TOMRA R2

Introduction

NORSUS has conducted a life cycle assessment (LCA) for TOMRA R2. The LCA was performed during the design phase of the product and enabled a systematic evaluation of its environmental impact.

Throughout the project period, three iterations of the LCA were completed. The first iteration (19.12.2023) provided a general overview of the product's environmental impact. The second iteration (28.06.2024) incorporated an updated Bill of Materials (BOM) with increased use of recycled material and an additional transport analysis. The third iteration (09.10.2024) focused on improving the representation of the electrical components for greater accuracy.

The following sections present the methodological choices made in these analyses, after which the results for three key design choices are highlighted.

Method

The LCA considers the entire life cycle of TOMRA R2, including the production-, use- and end-of-life phases of the machine. The EF 3.0 method (Fazio, 2018) was used to calculate the environmental impact while SimaPro v9.6.0.1 was used to perform the calculations and analyze the results.

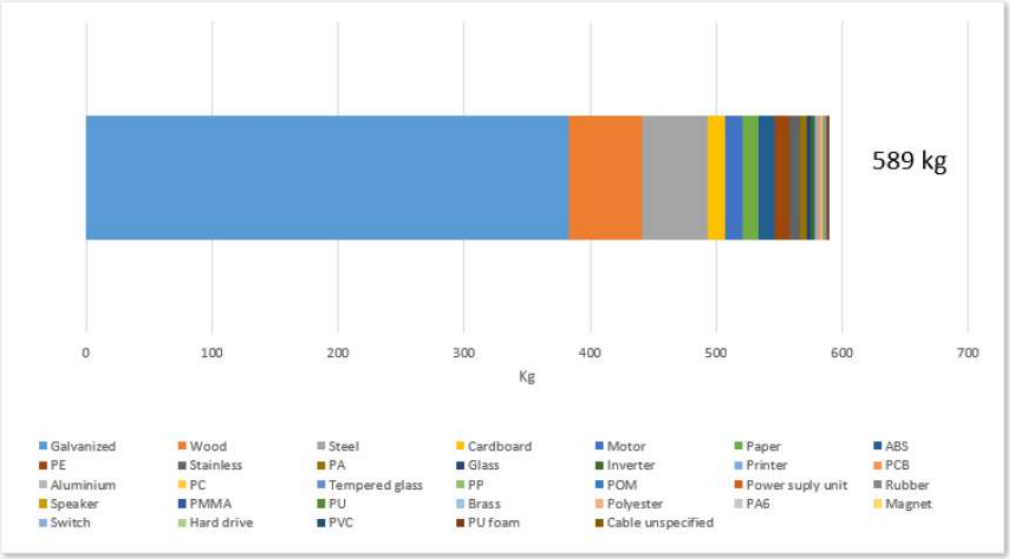


Figure 1 - Material composition of TOMRA R2 (including packaging and pallet for transportation)

The production phase was modelled by grouping individual components from the BOM in specific material categories, which were then connected to their respective production impacts using ecoinvent v3.10 (Wernet et al., 2016).

For the assembly phase, data on energy consumption and waste generation of a similar product, a TOMRA T9, was gathered for use in this analysis.

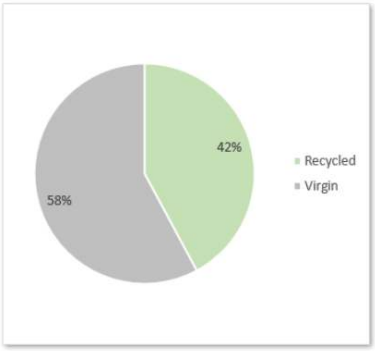
The use phase is covered through data on energy consumption (both idle and active mode), information on maintenance visits, and expected repair needs. TOMRA Collection typically uses Germany as a proxy market in LCA calculations, as the market plays a major role in TOMRA's business and offers more conversative estimates of energy-related emissions than European averages, while providing a specific geography for calculating transport distances. Therefore, the machine was assumed to be active in Germany, and hence, the analysis includes distribution impact to Germany and the use of electricity consumed in Germany. Based on transportation from TOMRA's production facility in Norway to Germany, a distance of approximately 1126 km is assumed.

Based on insight from TOMRA's existing multi-feed reverse vending installations, as well as the design specifications of TOMRA R2, the assumed throughput is 25,5 million used beverage containers (UBCs) across an assumed minimum operational lifetime of 7 years.

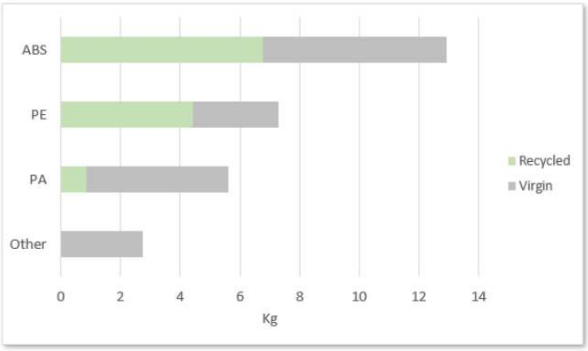
The end-of-life impacts were modelled using the average recycling rates given in JRC (2020). The cut-off approach was used to divide the environmental loads from recycling between product life cycles. If the life of the material is ending (for example in landfill or incineration), then the impact is allocated to TOMRA R2 and included in the results. Whereas, if the life of the material involves being sent for recycling, then the impact is not allocated to TOMRA R2, and is excluded from the results.

Results

This section presents the environmental benefits (on the impact category "climate change") of three design choices: the use of recycled plastics, the possibility to pack the product frontend (user-facing parts) into the product backend during transportation, and the power saving mode during idle time.



This figure shows the total recycled content of all components made from plastic. The recycled content varies from 50% to 100% across components.



This figure shows the recycled content share per plastic type. Please note that HTPA is included under PA.

Figure 2 - Recycled polymer content of TOMRA R2

1. Plastic components of TOMRA R2 use on average 42% recycled material, with different recycled content rates across plastic types. The analysis shows that using this proportion of recycled material results in a reduced impact of 46 kg CO2 eq. per TOMRA R2.

2. Having the possibility to pack the frontend of TOMRA R2 into the backend, leads to less use of packaging materials and allows for better truckload efficiency. When fully implemented, the analysis shows that this results in a reduced impact of 52 kg CO2 eq. per TOMRA R2.

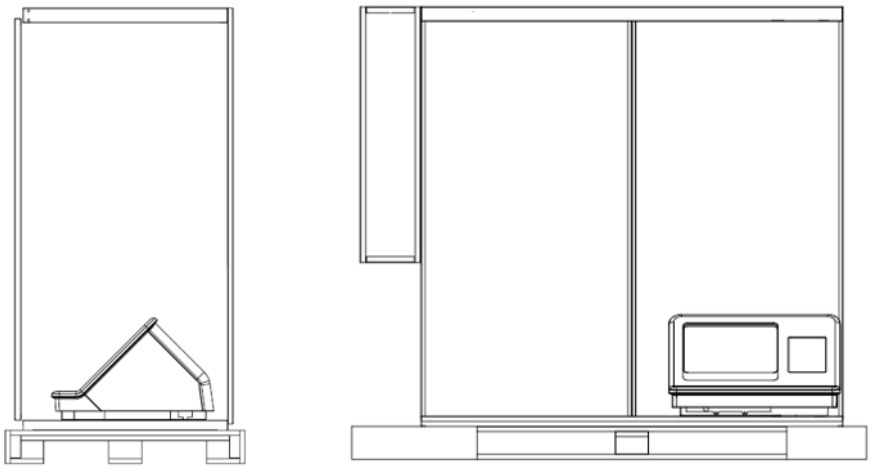


Figure 3 - TOMRA R2 nested transportation

3. The energy consumption of TOMRA R2 was reduced by implementing a power saving mode during idle time. Over the entire lifetime of TOMRA R2, this reduced the impact by 306 kg CO2 eq. It should be noted that this figure is based on the German electricity mix, and will vary based on the climate intensity of the actual electricity mix used during the use phase.

Further information

For more information about the life cycle assessment of TOMRA R2, or how TOMRA Collection works with sustainability, whether in product design or more broadly, please contact Christina Ek, Head of Sustainability at TOMRA Collection: christina.ek@tomra.com

References

FAZIO, S., CASTELLANI, V. SALA, S. SCHAU, EM. SECCHI, M. ZAMPORI, L., DIACONU E. 2018. Supporting information to the characterisation factors of recommended EF Life Cycle Impact Assessment method.

JRC 2020. Product Environmental Footprint Category Rule for IT Equipment.

WERNET, G., BAUER, C., STEUBING, B., REINHARD, J., MORENO-RUIZ, E. & WEIDEMA, B. 2016. The ecoinvent database version 3 (part I): overview and methodology. *Int J LCA,* 21**,** 1218-1230.