Rubbermaid Commercial Products

RCP'S PASSIVE AIR CARE SYSTEMS:

TCELL™ VS CIRCULAIR 90™

LCA Environmental Footprint Summary Report

AUGUST 2025

INTRODUCTION

Rubbermaid Commercial Products (RCP) mission in environmental sustainability focuses on reducing its products’ environmental impact, championing recycling, and fostering more sustainable practices in both product design and manufacturing.

IN LINE WITH THIS COMMITMENT, RCP CONDUCTED A COMPREHENSIVE LIFE CYCLE ASSESSMENT (LCA) TO COMPARE THE ENVIRONMENTAL IMPACTS OF ITS NEW CIRCULAIR 90™ PASSIVE AIR CARE INNOVATION AGAINST ITS PREDECESSOR, THE TCELL™.

This study aimed to quantify the potential environmental benefits resulting from moving from the current passive air care system to the redesigned CirculAir 90™ device.

The primary difference between the products lies in changes in the refill technology, material selection, and fragrance oils. The CirculAir 90™ features a reduced weight and material usage, utilizes a mono-material refill for enhanced recyclability without dismantling, and crucially, has eliminated the fuel cell to further streamline end-of-life processing.

LIFE CYCLE ASSESSMENT

Life Cycle Assessment (LCA) is a metric-based methodology that quantifies the environmental impacts of a product or service across its entire lifespan, from raw material extraction to end-of-life.

These impacts include, for example, greenhouse gas emissions, mineral and metal resource depletion, water consumption, and land use.

This specific LCA study, performed by the independent third-party global climate consultancy South Pole and conducted according to ISO 14040 and 14044 guidelines, evaluated the environmental performance of two RCP passive air care devices: **the current TCell™ refill and the newly designed CirculAir 90™refill.**

The study's primary objectives were to compare these two devices (with a specific focus on their refill systems), identify environmental hotspots throughout their respective life cycles, and propose areas for further environmental improvement. Ultimately, it aimed to quantify the potential reduction in environmental impacts achieved by transitioning from the current to the redesigned passive air care device.

CRITICAL REVIEW

The study's credibility and reliability are ensured through adherence to stringent internal standards and methodologies. The LCA respects ISO 14040 and 14044 standards for public disclosure of results. The study has been peer reviewed by an independent third-party LCA expert.

METHOD

FUNCTIONAL UNIT: The functional unit for the study is defined as the production, distribution and use of one passive air care device (refill+ dispenser) over 90 days in a 6000 cubic feet room with the "light" setting to refresh the air, and its disposal after use.

This study, modeled using Simapro 9.6.0.1 and the ecoinvent 3.10 database, and assessed with the EF3.1 method, is intended for both internal RCP stakeholders (engineers, R&D, marketing) and external communication to support environmental claims.

TCELL™ FULL DEVICE

(refill + fragrance + dispenser)

CIRCULAIR 90™ FULL DEVICE

(refill + fragrance + dispenser)

Figure 1. RCP Passive Air care devices in LCA scope

LCA APPROACH: A "cradle-to-grave" approach

(raw materials, transportation, production, distribution, use, and disposal) is applied to both systems considering all identifiable activities across the products' life cycles.

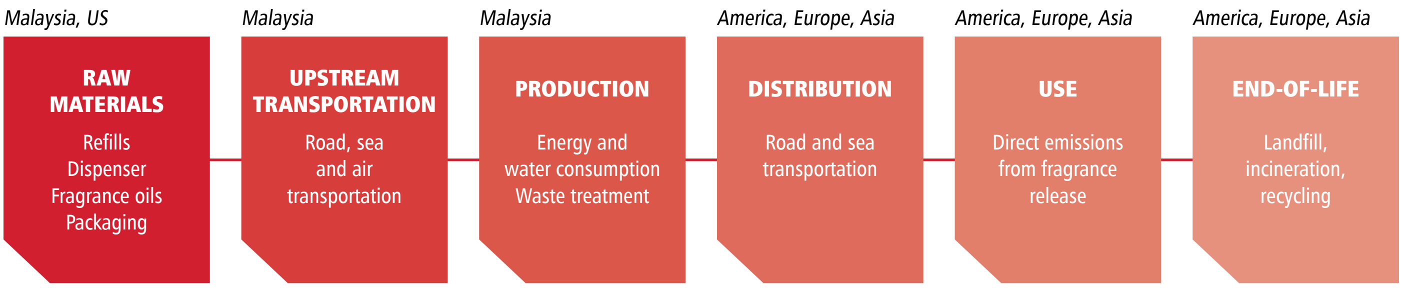

Figure 2: The process flow diagram for the product systems (cradle-to-grave)

GEOGRAPHICAL COVERAGE:

The study encompasses the global end-user base, with final distribution and end-of-life impacts profiled per country or region based on market share.

LCIA METHODOLOGY AND TYPE OF ENVIRONMENTAL IMPACT SELECTED:

For this particular study, the EF3.1 LCIA method - described in Andreasi Bassi et al. (2023) was used.

The assessment includes a total of 16 environmental impact indicators from the European Commission Environmental Footprint (EF) 3.1 method. In order to select and deep dive on the most relevant environmental impacts and use the two indicators with major significance and reduction potential for communication purposes, results were normalized and weighted using the EF 3.1 method to generate a single score.

The indicators contributing more than 80% of the total single score were selected: Climate change, Particulate matter, Human toxicity non-cancer, Resource use of fossils and Resource use of minerals and metals. For RCP's voluntary external communication purposes, only Climate change and Resource use of minerals and metals are used.

DATA COLLECTION:

All data has been assessed to ensure that it meets the quality standards required to make comparative assertions.

The LCI was compiled using a combination of quantitative and qualitative primary, secondary, and proxy data, considering specified exclusions. **Primary data**, provided by RCP for 2023, 2024 and 2025, included product-specific details such as raw material acquisition, upstream transportation, manufacturing (including electricity consumption), and market distribution for each region. **Secondary data**, sourced from ecoinvent 3.10 and relevant literature, filled gaps where primary data were unavailable, covering aspects like final product distribution distances. Proxy data were used as stand-ins when other data types were not available.

ASSUMPTIONS AND LIMITATIONS

- The dispenser's 3-year lifespan is a conservative estimate based on product warranty.
- No maintenance activities or additional environmental impacts are assumed during the product's use phase.
- No production waste at the factory.
- Secondary data and proxies have been utilized for modeling certain processes, where data gaps exist. These data, while selected with care, may not mirror the actual processes perfectly, leading to potential deviations in the impact calculations.
- The current passive air care device, TCell™, upon reaching the end of its life cycle, will be treated as municipal waste that is subject to either landfill or incineration, as it is not designed for recycling. However, it is assumed that the new passive air care refill, CirculAir 90™, as it is designed to be recyclable, will be treated as a recyclable flow by some end-users. The ratio used is based on country or region-specific statistics on plastic waste treatment.
- Some impact categories within EF3.1 demonstrate higher robustness than others. Categories like climate change and particulate matter benefit from well-established and validated models. In contrast, newer categories such as human toxicity are still undergoing scientific validation, although the most recent validated versions are utilized to provide initial impact assessments for their specific emission types.
- RCP provides passive air care devices with different fragrance oil options. Due to the complexity of their compositions, it was not part of the scope of the study to model each option. Additionally, these fragrance oils are composed of multiple chemicals, and most of them are not available in the LCA databases. Therefore, a lot of conservative proxies are used which hold high uncertainties and do not allow for a fair comparison between fragrance oils. The study was performed using the best seller fragrance oil: TCell Citrus mix (in EMEA and UK) and Citrus (in rest of the world) and globally for CirculAir 90™ Citrus Mix. A scenario analysis was conducted on two additional fragrance oils: Eucalyptus mint and Mango.

RESULTS AND CONCLUSIONS

- Over the life cycle of both passive air care devices, most of the environmental impacts come from raw materials extraction.
- The only exception is the human toxicity indicator, for which most of the impacts are due to the direct emissions from the fragrance oil during the use phase. In particular, linalool is responsible for most of the impacts.
- During the raw materials extraction stage, the refills and fragrance oil are the primary contributors to impacts for Climate Change, Particulate Matter, and Fossil Resource Use. The dispenser, by contrast, has a lower environmental impact at this stage. It's important to note that the dispenser's impacts are linearly allocated over its lifespan, meaning only a partial share of its total production impacts is considered within the current system's scope.
- Comparing the new CirculAir 90™ passive air care device (refill, fragrance, and dispenser) against the current TCell™ system reveals a consistent pattern of superior environmental performance. Across all 16 assessed environmental indicators and throughout every stage of its life cycle, the CirculAir 90™ demonstrates lower environmental impacts.
- When evaluating the refill and fragrance (excluding the dispenser), the new CirculAir 90™ system demonstrates environmental improvements compared to its predecessor. It achieves an 11% reduction in climate change impact, a 36% reduction in mineral and metal resource use, a 7% reduction in fossil resource use, and a 12% reduction in particulate matter. These improvements largely stem from the CirculAir 90™'s design, featuring a lower overall mass and fewer components, significantly reducing the environmental burden primarily associated with the TCell™'s fuel cell.
- Focusing solely on the refill packaging (excluding the fragrance), the CirculAir 90™ demonstrates even greater environmental advantages. Across its entire life cycle, the CirculAir 90™ refill has a 14% lower carbon footprint compared to the current TCell™ refill. The most significant reduction is in the resource use of minerals and metals, where the CirculAir 90™ refill achieves a remarkable 50% lower impact, primarily due to the elimination of both metal-based components and the fuel cell.

RESULTS AND CONCLUSIONS *continued*

- When evaluating the entire system (refill, fragrance, and dispenser), the most substantial impacts on mineral and metal resource use stem from the Printed Circuit Board Assembly (PCBA) within the dispenser. This component currently limits the overall reduction potential between the TCell™ and CirculAir 90™ entire systems. However, removing the PCBA from the dispenser could lead to a significant 87% reduction in this impact by switching to CirculAir 90™ with a PCBA-free. While initial redesign efforts focused on the refill, this LCA highlights a critical opportunity for further environmental improvement of the dispenser. Consequently, RCP is actively exploring near-term redesigns for the dispenser to eliminate these no longer essential components.
- Human toxicity (non-cancer) impacts were reduced by 18% globally driven by the global transition of our fragrance oil from Citrus Zest (previously sold worldwide except EMEA and the UK) to the Citrus Mix variant, which was already established in EMEA and the UK markets.

CLIMATE CHANGE

The new CirculAir 90™ system (comprising refill, fragrance, and dispenser) demonstrates a 9% reduction in climate change impacts over its entire life cycle compared to the current TCell™ system.

When considering only the refill and fragrance, this reduction is slightly higher, at 11%

THE TOTAL LIFECYCLE CLIMATE CHANGE IMPACT PER FUNCTIONAL UNIT FOR EACH PRODUCT IS AS FOLLOWS:

- Current TCell™ device (refill with fragrance + dispenser): **0.86 kg CO_2e/FU**
- New CirculAir 90™ device (refill with fragrance + dispenser): **0.78 kg CO_2e/FU**

AND WHEN ISOLATING ONLY THE REFILL WITH THE FRAGRANCE WITHOUT THE DISPENSER:

- Current TCell™ device (refill with fragrance): **0.70 kg CO2e/FU**
- New CirculAir 90™ device (refill with fragrance): **0.62 kg CO_2e/FU**

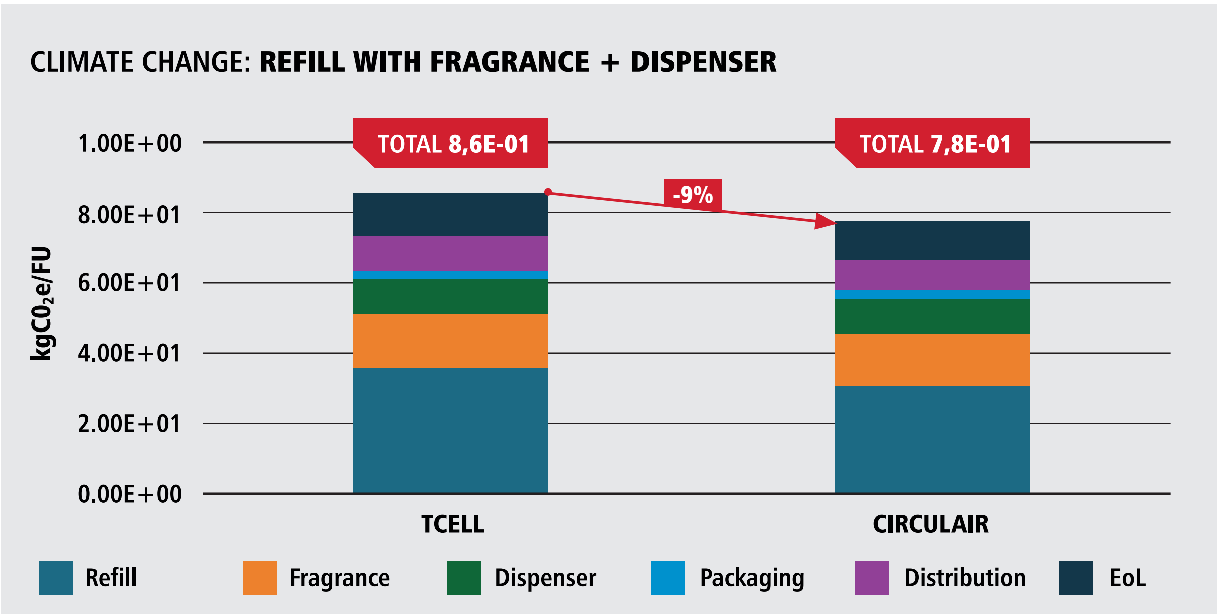

Figure 3. Comparison of climate change impacts of TCell™ and CirculAir 90™ full system (Refill with fragrance + Dispenser).

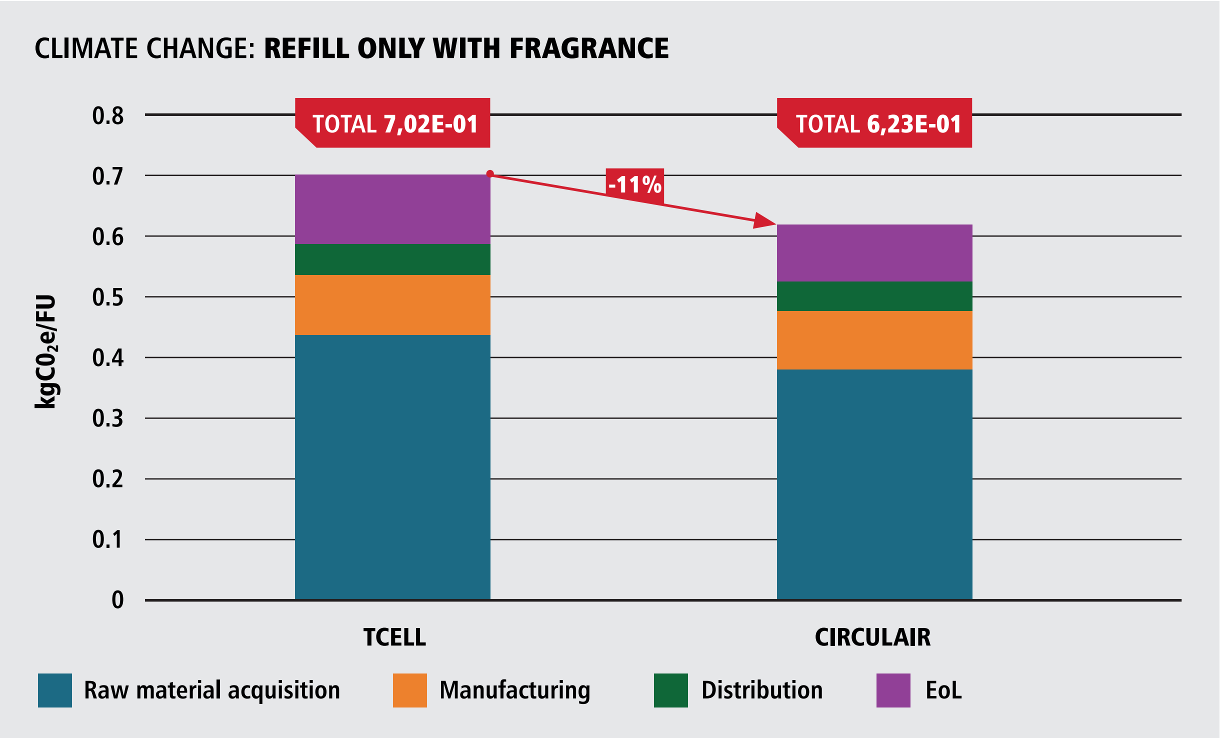

Figure 4. Comparison of climate change impacts of TCell™ and CirculAir 90™ Refill with fragrance (without Dispenser).

An isolated comparison of the refill components only (excluding fragrance oil) indicates a more pronounced environmental advantage. **The CirculAir 90™ refill yields a 14% reduction in climate change impact across its full life cycle** relative to the TCell™ refill.

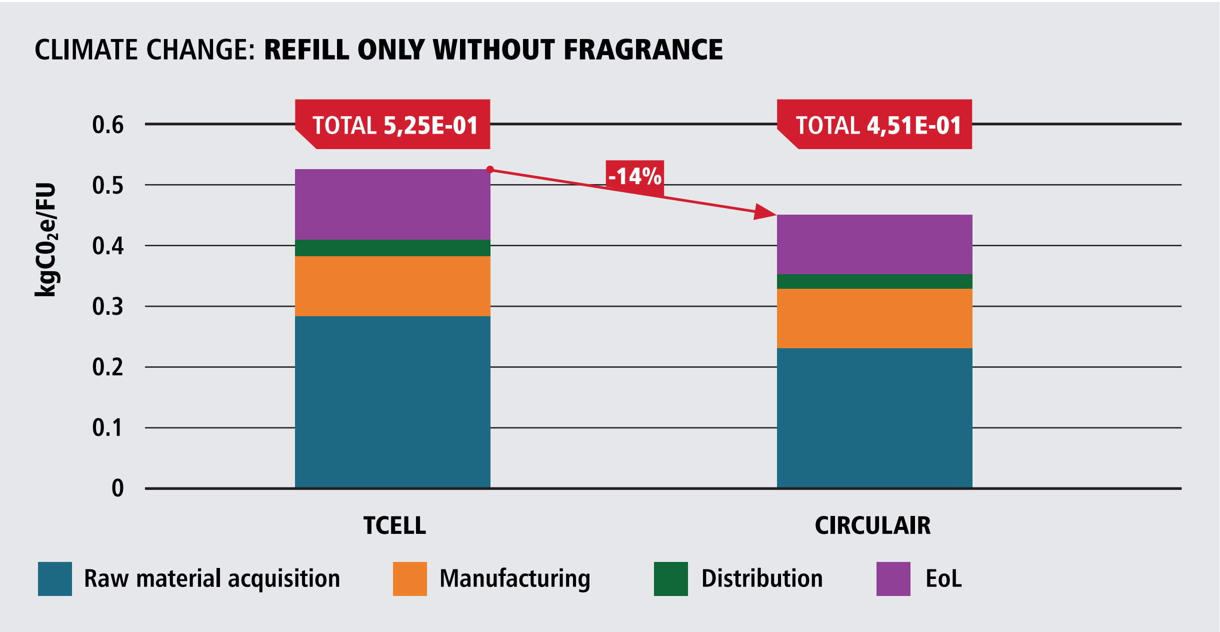

Figure 4. Comparison climate change impacts of TCell™ and CirculAir 90™ Refill (without fragrance and dispenser)

RESOURCE USE, MINERALS AND METALS

Focusing solely on the refill, the CirculAir 90™ demonstrates a significant reduction in the resource use of minerals and metals compared to the current TCell™ refill: **36% with fragrance and 50% without.**

A major contributor to this reduction is the removal of the fuel cell, **which alone accounted for 32% of the TCell™ refill impacts.** The elimination of other metal-based components further contributes to this notable difference between the two refills.

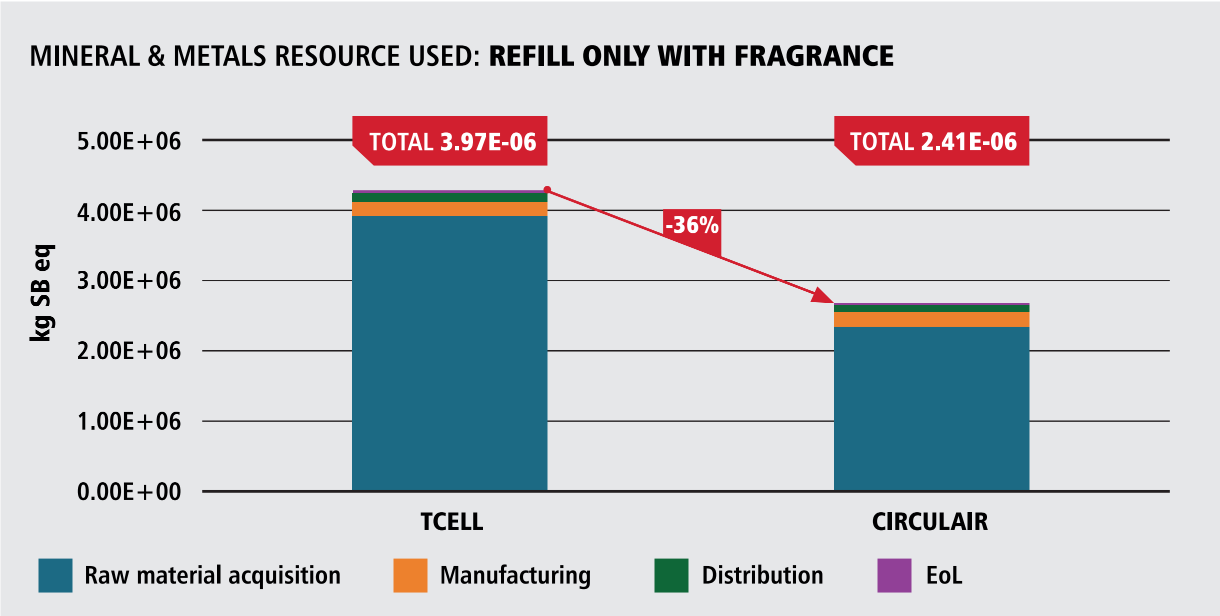

Figure 5. Comparison Resource use, minerals and metals impacts of TCell™ and CirculAir 90™ Refill with fragrance (without dispenser)

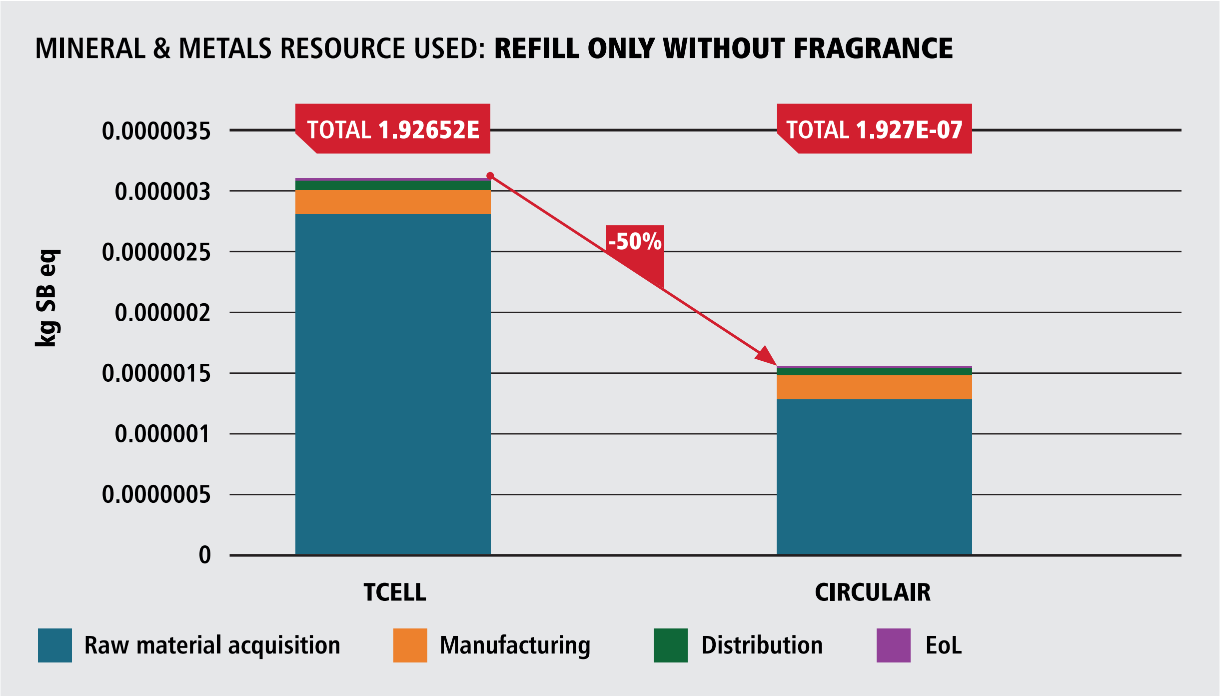

Figure 5. Comparison Resource use, minerals and metals impacts of TCell™ and CirculAir 90™ Refill (without fragrance and dispenser)

Considering the entire device's life cycle (refill, fragrance, and dispenser), switching to the new CirculAir 90™ refill **resulted in a 6% reduction in the resource use of minerals and metals.** This improvement is attributed to the removal of metal-based components and the fuel cell from the refill.

However, the majority of the overall impact on this indicator for the complete device originates from the Printed Circuit Board Assembly (PCBA) in the dispenser, a component that was outside the scope of this redesign effort.

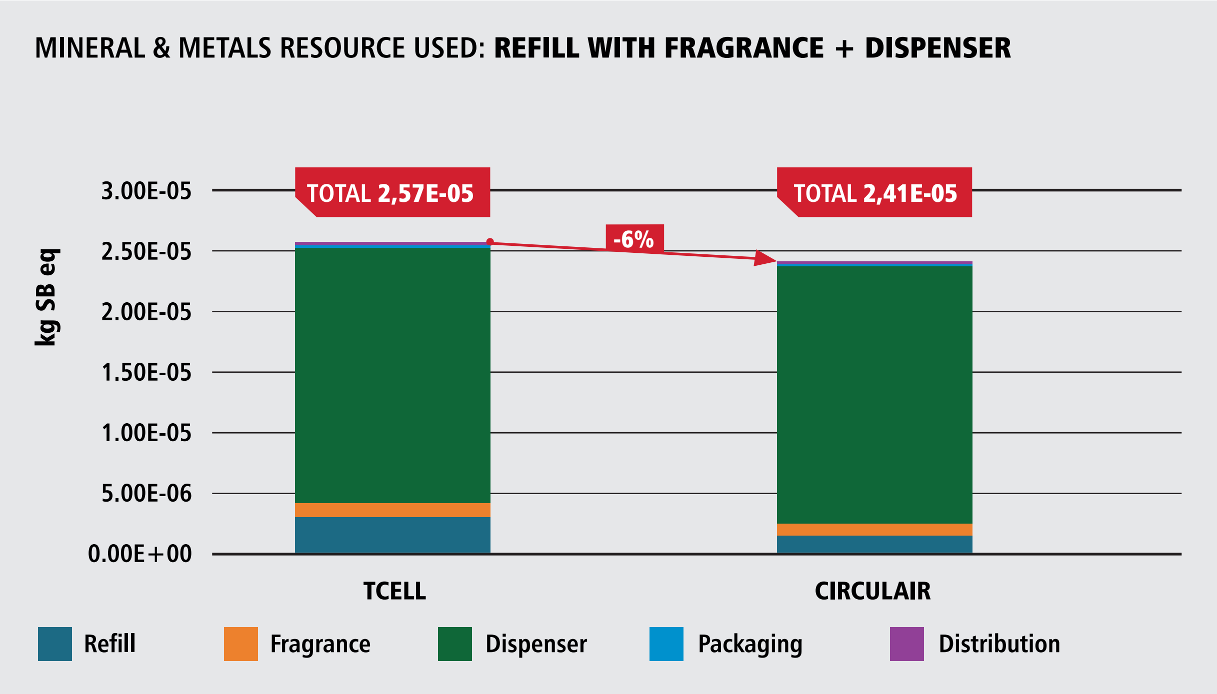

Figure 6. Comparison Resource use, minerals and metals impacts of TCell™ and CirculAir 90™ devices (with fragrance and dispenser)

THE TOTAL LIFECYCLE RESOURCE USE OF MINERALS AND METALS IMPACT PER FUNCTIONAL UNIT FOR EACH PRODUCT IS AS FOLLOWS:

- Current TCell™ device (refill with fragrance + dispenser): **2.57E-05 kg Sb eq /FU**
- New CirculAir 90™ device (refill with fragrance + dispenser): **2,41E-05 kg Sb eq /FU**

AND WHEN ISOLATING ONLY THE REFILL WITH THE FRAGRANCE WITHOUT THE DISPENSER:

- Current TCell™ device (refill with fragrance): **4,31E-06 kg Sb eq /FU**
- New CirculAir 90™ device (refill with fragrance): **2,74E-06 kg Sb eq /FU**

EXTERNAL COMMUNICATIONS

RCP might communicate additional claims regarding the savings on metal and plastic material used based on raw material weight.

CALCULATIONS ARE BASED ON THE FOLLOWING DATA:

MATERIALS PER WEIGHT ON REFIL		
	TCELL™	CIRCULAIR™
PLASTIC	50.47g	48.11g
METAL	3.81g	0g

Figure 7. Table with material weigh per material type in Passive Air care refills

In order to make claims more understandable and accessible, we use equivalencies in our external communication about carbon footprint results using the following equivalencies and data sources.

RELEVANT REGION	EQUIVALENCY TYPE	ADDITIONAL INFO AND ASSUMPTIONS	SOURCE
EU & UK	1 HR LED LIGHT IN EUROPE	**9 W LED bulb light available on the market. Assumed energy consumption of 9 Wh** (production of the bulb is not included, only use)	Ecoinvent
	1 PERSON TRAVELING ON A REGULAR UK TAXI	**EF 0.1486 kgCO2e/passenger-km**	BEIS 2025. www.climatiq.io/data/emission-factor/d92cfff4-ce4c-425e-8c28-2bbe3140ff36
US	1 HR LED LIGHT IN THE US	**9 W LED bulb light available on the market. Assumed energy consumption of 9 Wh** (production of the bulb is not included, only use)	Ecoinvent
GLOBAL	1 PERSON TRAVELING 1 KM BY HIGH-SPEED TRAIN - GLOBAL AVERAGE	**Production of the mean of transport and use stage**	Ecoinvent
	STREAMING 1H VIDEO ON LAPTOP	**HD video, global electricity mix average using high wifi**	www.iea.org/commentaries/the-carbon-footprint-of-streaming-video-fact-checking-the-headlines
	1 PERSON TRAVELLING FROM LONDON TO NEW YORK BY PLANE (ROUND TRIP)	**International long-haul flight premium economy class - with RF effect EF: 0.1873 kgCO2e/ passenger-km. Distance roundtrip London-NYC Planned: 11 252 km** Source: FlightAware	BEIS 2025. www.climatiq.io/data/emission-factor/e5189259-396d-45b4-a423-9f87451b84ee

Figure 8. Table with equivalencies and sources used in external communications

EQUIVALENCY TYPE	ADDITIONAL INFO AND ASSUMPTIONS	SOURCE
AA BATTERY	AA Varta / Duracell battery	www.varta-ag.com/en/consumer/product-categories/batteries/alkaline/energy-aa docs.rs-online.com/2a27/0900766b814ef4c0.pdf
AFRICAN SAVANNA (BUSH) ELEPHANT		www.wwf.org.uk/learn/fascinating-facts/elephants
HIPPO		wwf.panda.org/wwf_news/?60880/Hippopotamus-video#:~:text=Hippos%20average%203.5%20metres%20(11,(3%2C300%20to%207%2C000%20lb).

Figure 9. Table with weight equivalencies and sources used in external communications

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External Review

Life Cycle Assessment of RCP's passive air care products

Study by South Pole for Rubbermaid Commercial Products (RCP)

Authors of the study: Miora Frossard, Lorenzo Mazzola, Caroline Peyer (all South Pole)

Reviewer: Martin Lehmann, myclimate, Zürich, Switzerland

Based on: LCA report by South Pole as of July 7, 2025

1 Objective

The objective of the study carried out by South Pole was to analyse and compare the life cycle impact of two RCP's passive air care products regarding all environmental indicators with a special focus on climate change, particulate matter, human toxicity non-cancer, resource use fossils and resource use minerals and metals.

myclimate has been asked to perform the external review. The independence of the review is given, Martin Lehmann nor the Foundation myclimate have an economic interest in the business development of RCP or South Pole or are dependent on these companies. In addition, Martin Lehmann fulfils the conditions that are required to perform an external review, due to his 20 years of experience in the field of Life Cycle Assessment.

2 Review Criteria

The reviewer checks the following criteria related to the calculations, the results and the report (Klöppfer&Grahl 2009, ISO 14040/44):

- the methods used to carry out the LCA comply with the international standard (ISO);
- the methods used to carry out the LCA are scientifically and technically correct;
- the data used are sufficient and appropriate in relation to the objective of the study;
- the calculations take into account the recognised limitations and the objective of the study.

Doing this, myclimate will put a focus on the following aspects:

- **Goal and scope:** Are the objectives of the study and the framework of the investigation mentioned?

- Functional unit: Is the Functional unit well-chosen and clearly described?

- System boundaries: What processes are included in the calculation model? "Cradle-to-gate" approach or "Cradle-to-grave" approach, as suggested by the ISO Standards 14040 ff.?

- **Impact assessment methods:** Which ones are applied, and are they suitable for the study at hand?

- **Modelling software:** What modelling software has been chosen for the inventory?

- Database / Emission factors:: What is the underlying LCI database? Are the applied emission factors appropriate?

- **Data:** How reliable and accurate are the collected data? What is the quality of the secondary data?

- **Completeness:** What is the cut-off criteria? Have more than 5% of the inventory been left out?

- **Assumptions:** Are the chosen assumptions representing the current situation?

- **Uncertainty:** Are the uncertainties mentioned and shown in the result charts?

- **Readability of the results:** Are the graphs clear? Is the identification of significant parameters guaranteed?

3 Review comments

The first *general impression* of the report was very good. The setup is clear and well structured.

The *goal and scope* of the study are mentioned, the framework (geography, time, technology …) is explained. The purpose is clearly described as "comparative study of two passive air care devices". The intended audience is stated as "a wide range of internal stakeholders at RCP, including engineers, research and development scientists, marketing teams and external stakeholders."

The *Functional Unit* has been described as "Production, distribution and use of one passive air care device over 90 days in a 6000 cubic feet room with the setting "light" to refresh the air and its disposal after use." Here, it is important to keep in mind that the real lifetime of the dispenser is 3 years, so the FU has to be adjusted in the results by a factor 0.079.

The *system boundaries* represent the cradle-to-grave approach, meaning that the use-phase and the end-of-life phase are taken into account for the calculation of the final results. Figure 5 in the report describes the process flow diagram for the product systems in a very understandable manner. Two separate Figures (6 and 7) discuss the differences between the two products regarding the process steps from cradle-to-gate (materials, upstream transportation and production). The detailed discussion of the cut-off criteria and general exclusions deserves a special mention.

The applied *impact assessment methods* (Environmental Footprint version 3.1) is a good choice. Altogether, 5 environmental indicators are calculated, which gives a solid assessment on the various impacts. Both the Total environmental impact (single score) as well as the impact of the 5 mentioned indicators at mid-point level have been investigated, covering more than 80% of the total single score environmental impact. This provides a comprehensive overview on the impacts within the framework of this comparative LCA study.

The *modelling software* SimaPro was used to model the system under study and generate the environmental impact. This is also a good choice representing a well-established standard software in the LCA community.

ecoinvent 3.10 was chosen as a LCI *database*, which is one of the leading and most transparent databases worldwide. Unfortunately, the ecoinvent database does not offer a generic dataset for most of the fragrances under investigation. However, as the fragrance oils were not the focus of the study, the reviewer supports the decision by the authors to model the fragrances with the next best proxy datasets.

The collected *data* represents primary data by the producer RCP in the USA (production site in Malaysia), therefore the data quality is considered as rather high, except for the manufacturing stage. Primary data could be provided for the raw material acquisition, upstream transportation and market distribution for each region. Secondary data were gathered from pre-existing sources including ecoinvent 3.10 and literature, covering transport distances for product distribution to each market.

Completeness: The life cycle inventory of the study shows a nearly 100% coverage of the required data, with a cut-off criteria of as little as 1%. This is much less than the required 5% promoted by the ISO Standards.

All the *assumptions* mentioned in Chapter 3.2 and 3.1.2 make sense, considering the data and dataset situation. Assumptions were taken for electricity and water consumption, as no specific data were available for single production lines in the factories in Malaysia. It was also assumed that both the refills (current refill and CirculAir 90 refill) require the same amount of electricity and water, which is a logic conclusion. Further assumptions are touching the lifespan of the two comparative devices, the maintenance of the devices, their end-of-life treatment as well as the modelling of the fragrance oil options.

The *uncertainties* of the results are described in Chapter 5.4 “Uncertainty analysis”, which is important. For a next LCA study, the reviewer recommends to display the uncertainty margins of the calculated results with fine black bars to indicate that the calculated values can vary due to the gap between real life and model.

All the requirements are fulfilled regarding the *readability of the results*. All the important outcomes and findings are reported and described accordingly. A special mention deserves the discussion of the refill as the main impact contributor with an in-depth analysis!

Another welcomed chapter (Chapter 5) deals with the *sensitivity issues*, namely on Incorporating recycled content (5.1), Removing components from the dispenser (5.2) and Switching fragrance oils (5.3). Through this, the emission reduction potential is clearly demonstrated.

The *report* shows all relevant elements of an LCA report. It is written in accordance with the ISO Standards 14040 and 14044. The limitations are mentioned in a separate chapter, the conclusions are clearly described, and a number of to-the-point recommendations are listed, among others the suggestion to explore possible alternative materials.

4 Results and Final Statement

After a first evaluation by the reviewer, some minor adjustments in the report and calculations have been made by South Pole, e.g. the process for the modelling of the printed circuit board (PCB).

A rough calculation by the reviewer shows that the refill (including manufacturing) is the major contributor and responsible for more than 40% of the total impact regarding greenhouse gas emissions (GWP 100a). The distribution of the finished product takes up for a substantial part of the total impact, depending on the indicator up to 14%. The end-of-life phase should not be neglected with a carbon footprint share of around 14% of the total.

Based on some random checks, the calculations are correct and the basis for the data generation and graphs is reliable. The results and conclusions are plausible and easy to understand. The methodological approach is scientifically sound and corresponds to the initially defined objectives.

Special mention should be made of the sensitivity analysis carried out, which can provide the decision-makers with important insights for optimizing the product.

The study is highly transparent, describing all the built-in materials and fragrances with their individual weight, which makes a sample check easily possible.

Potential for improvement is only located in a possible inclusion of uncertainty bars in the result diagrams. An exploded view drawing of the inside of the air care device could help the reader to easily identify the components.

Zurich, July 21, 2025

For myclimate

Martin Lehmann, Senior Expert Sustainability Consulting