

Goal & Scope Report: Life Cycle Assessment of Liquid Hand Soap Refill Packaging for Home Use

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Introduction

In recent years consumers have demanded more sustainable products and practices from the companies they purchase from. This is most apparent in the household soap industry. There have been several innovations like detergent sheets claiming to make the soap more sustainable by reducing the impact of transportation. However, less change has occurred in the hand soap space. The changes that have occurred focus on the container rather than the soap product itself.

Similarly, multiple studies have been conducted on the sustainability differences between soap types including a comparison between liquid and bar soaps (Witlox et al., 2015) and different bio-detergents (Villota-Paz et al.). Comparative LCAs have been completed on different soap dispenser types (Coppini et al., 2017) and laundry detergent packaging methods (Kim & Park, 2020). The publicly available information on soap refill packaging is limited to companies with vested interest in selling their product like Zacros, a company offering refill pouches which claim to be the most sustainable option (Keane & Petlack). Given the lack of publicly available information on the sustainability of liquid hand soap packaging this assessment seeks to provide consumers with a LCA from a source unaffiliated with the industry.

Goal & Scope

The goal of this life cycle assessment (LCA) is to compare the environmental sustainability of liquid soap refills packaged in plastic bottles versus soap refill bags, which are marketed as a more sustainable alternative. This assessment aims to provide household consumers with information on the environmental impacts of these liquid soap packaging options, helping environmentally conscious shoppers make informed purchasing decisions. The results of this comparative assessment will be publicly disclosed.

Function and Functional Unit

This assessment focuses on the packaging rather than the soap product contained within and will strive to compare identical or similar liquid soaps to focus on the packaging. The function of the product is to refill a soap dispenser rather than to clean hands. The scope of the project, as defined above, assumes that the soap liquid contained by the different packaging is comparable. However, the capacity (volume) of the packaging

is a factor in the assessment. The functional unit of this assessment will be 12¹ fl oz of soap to refilled, required to fill the average soap dispenser. Among a wide range of sizes, 12 fl oz soap dispensers emerge as a common standard size in the U.S. market.

Process-Flow & System Boundaries

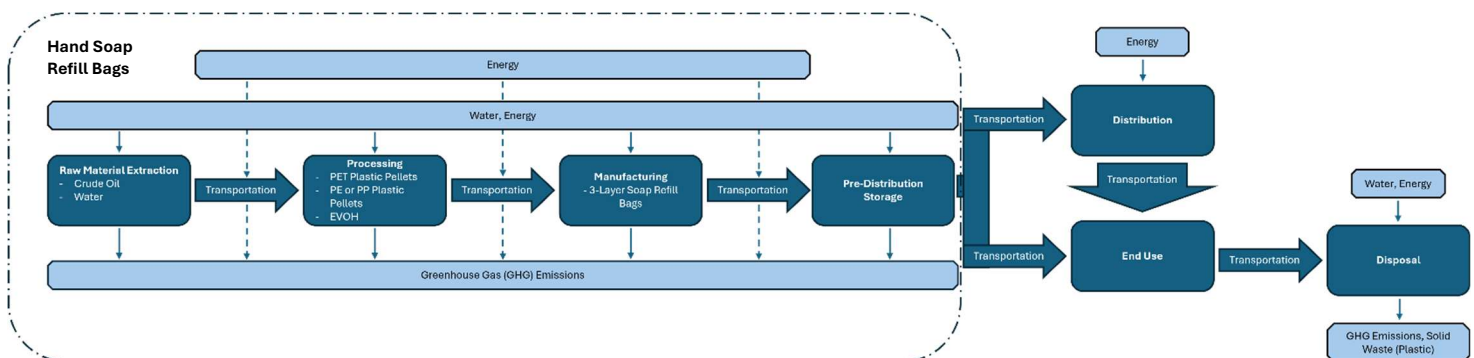
To create a reasonable scope for the funding and time available to the assessment, the proposed system boundary is a cradle to gate LCA, excluding distribution, use and disposal of the produce. This is helpful in comparing products fairly because many of the companies producing bag refills are shipping direct to consumer rather than selling through retailers which presents challenges for assessing transportation costs. Many of the claims by bag refill companies allude to reduced waste and transportation costs, a cradle to grave assessment would be useful in the future to further explore the subject. To briefly explore this idea, this study will assume that the manufacturer controls a pre-distribution warehouse facility separate from the production facilities are 50 miles apart.

The following assumptions have been made to reduce confounding factors where possible:

- The average soap bottle is 12 fl oz.
- The liquid soap is the same between the package options.
- The packaging as well as the soap are manufactured the United States.
- The production facility is 50 miles via highway from the pre-distribution warehouse, goods are transported between these locations with tractor-trailers.
- All raw materials used in the packaging are virgin.

The figures below illustrate the process-flows including inputs and outputs for plastic bottle and plastic bag soap refill packaging. As these products are compositionally similar,

Figure 1: Process Flow Diagram for Hand Soap Refill Bags*



¹ This volume may change after the publishing of this Goal & Scope Report, before any assessment takes place based on feedback and further assessment of market options. The functional unit being a volume of soap refilled will not change.

* Transportation outside of the system boundary is assumed to have the same inputs and outputs as the labeled transportation arrows inside the system boundary.

the process-flows differ only in raw material inputs and, at a more detailed level, the transportation impact per unit will differ because of the different materials.

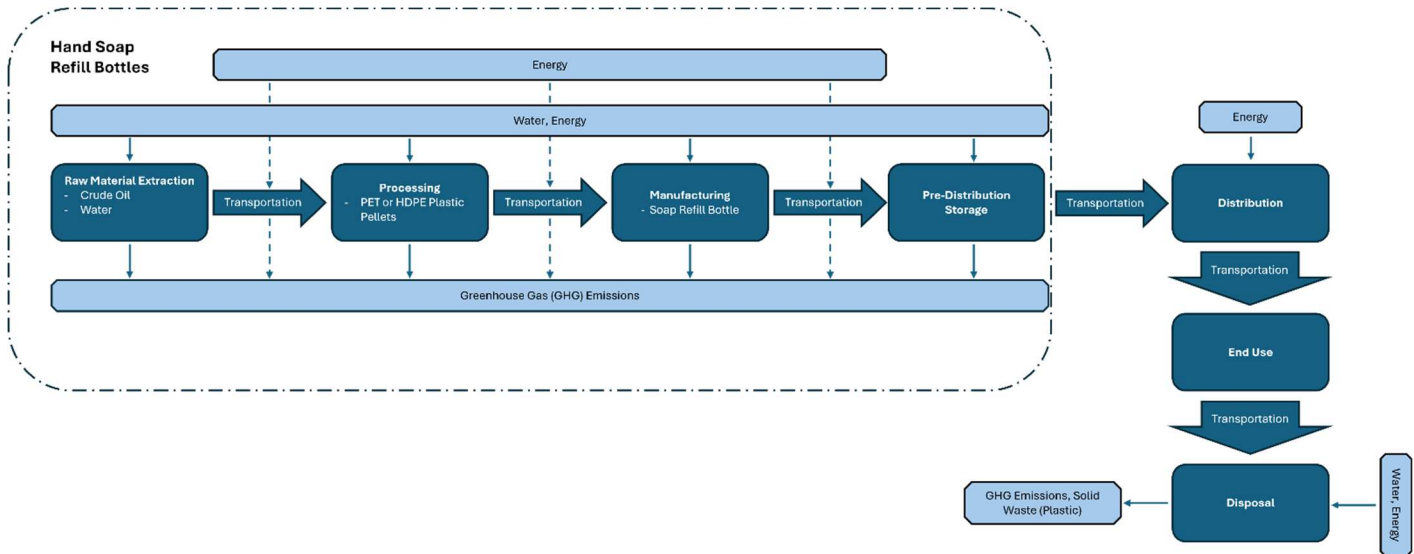


Figure 2: Process Flow Diagram for Hand Soap Refill Bottles*

Data Quality

This assessment will use secondary and tertiary data. This assessment will use data from the ecoinvent V3.11 database and literature data found in the references section of this report. There will be a preference for data from sources domestic to the United States of America as that is the author's country of origin and the location of the products which inspired this LCA. All literature data will be the most recent data available. The literature data used will be no data used prior to 2000. Given the limited resources and time, the scope may be narrowed to one environmental impact, likely global warming potential, if there is insufficient data to assess multiple impacts. The ecoinvent database will be accessed through OpenLCA the software tool used to model the assessment.

Environmental Impacts

Global warming potential and resource depletion are the two primary environmental impact areas of interest. Of those impact categories, greenhouse gas emissions (kg CO₂e) and water usage (gal) are the primary concerns. Energy consumption (is a secondary impact of concern that will be assessed if data are available and time allows. Both product flows are very similar, differing primarily in the additional raw material types required for the soap refill bags and the transportation impacts resulting from the different packaging. The assumptions detailed in this report will guide the focus of the environmental impacts and some of the secondary concerns may be excluded from the LCA report if they end up beyond the scope of this project.

References

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