



# LIFE CYCLE INVENTORY AND ENVIRONMENTAL FOOTPRINT OF BOTTLED WATER FOR THE NORTH AMERICAN MARKET: EXECUTIVE SUMMARY

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## PROJECT INFORMATION

**Project title** LIFE CYCLE INVENTORY AND ENVIRONMENTAL FOOTPRINT OF BOTTLED WATER FOR THE NORTH AMERICAN MARKET

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**Contracting organization** International Bottled Water Association

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# EXECUTIVE SUMMARY

This study evaluated both small pack and home and office delivery (HOD) bottle water production to provide the environmental footprint to the International Bottled Water Association (IBWA). The aim is to understand the industry's environmental performance and progress and to set strategies for continued advancement<sup>1</sup>.

The following items are key recommendations based on the findings of the study for reducing the industry's footprint related to climate change (greenhouse gas, or GHG, emissions), energy use and waste. These recommendations center on three areas of action: *material innovation, reduction and recovery, and energy usage and logistics*:

- Continue to innovate around the types of materials used for bottles, such as exploring biobased products, seeking out less impacting alternatives;
- Continue to optimize the amounts of primary and secondary packaging<sup>2</sup>;
- Continue to promote recycling, as well as the use of recycled content, in primary and secondary packaging;
- Continue to reduce the generation of wastes at the bottling plant, and find uses for waste that offset conventional material production.
- Reduce bottling plant energy use and implement low-carbon energy sources (e.g., on-site wind turbines and photovoltaics); and
- Continue to optimize logistics, including consideration for routing and truck energy sources (e.g., fuel types) and emissions. This is particularly important for HOD product delivery to customers.

## Introduction

IBWA has commissioned Quantis to assemble an updated life cycle inventory (LCI) and calculate industry-average product environmental footprints of bottled water sold in the North American market. The two product categories studied are small pack bottled water (containers from 8 ounces to 2.5 gallons) and home and office delivery ("HOD", in reusable bottles that range in size from 3 to 5 gallons). This study assesses the life cycle of bottled water from the extraction and processing of all raw materials through the end-of-life of all components, including

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<sup>1</sup> In 2009, IBWA issued an LCI report that assessed the footprint of industry operations in 2007. Due to the important differences between the approaches used in the 2007 and 2015 footprint calculations, including the portion of industry captured, background databases, and calculation methodology, using the two studies to evaluate and compare industry performance over time is not meaningful. That information is therefore not included in this report. Materials usages in 2007 and 2015 can be compared and are provided in APPENDIX A: LIFE CYCLE INVENTORIES.

<sup>2</sup> Primary packaging is all packaging that is directly in touch with the product (e.g. plastic bottle, cap, labels) while secondary packaging refers to all packaging required to transport the product to the end-customer (e.g. cardboard boxes, pallets, plastic film etc.).

transportation. The exception is the use phase of the life cycle, which is excluded<sup>3</sup>. The functional unit of this analysis is delivery of 10,000 gallons of bottled drinking water for sale and consumption in North America.

### **Industry representation**

The Life Cycle Inventories (LCIs) assembled here are based on data from companies representing 57% of the 2015 North American bottled water market. The small pack LCI represents 62% of that market, while the HOD LCI represents 25% of that market.

### **Results**

While direct comparison of environmental performance in 2007 and 2015 is not possible due to the extent of differences between the approaches used in the 2007 and 2015 footprint calculations (see Footnote #1), the study found that bottled water providers reduced the amount of material used in small pack bottles by approximately 42.8%. While PET plastic is still the most common bottle material for small pack bottles, HPDE plastic used mostly for gallon size bottled water has become the second most common material, as opposed to glass, which was the case in 2007. Table ES-1 provides a summary of materials usage by the industry in 2007 and 2015.

Results for the industry's key environmental metrics—climate change (GHG emissions), energy, and solid waste—are summarized below. For both product systems (small pack and HOD), additional indicators (human health, ecosystems quality, resources, and water consumption) are evaluated in the main part of this report and serve as an introduction to these metrics, as well as a baseline for future evaluation.

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<sup>3</sup> Product use—particularly refrigeration—can be an important contributor to the footprint of bottled water products and should be a key consideration for the bottled water industry sustainability strategy.

Table ES-1. Comparison between 2007 and 2015 study of pounds of material used per 10,000 gallons small pack shipped.

Item	Industry average 2007		Industry average 2015	
	kg	lb	kg	lb
Total PET, bottles	904	1,995	692	1,530
Total HDPE, bottles	106	234	32.6	71.8
Total glass, bottles	282	623	13.8	30.5
Total plastic caps	106	234	74.7	165
Total metal caps (aluminum)	0.226	0.50	0.602	1.33
Total plastic labels	Not included	Not included	10.4	23.0
Total paper labels	Not included	Not included	10.4	23.0
Total corrugated (cardboard)	490	1,082	219	483
Total pallets (wood)	Not included	Not included	34.8	77.1
Total plastic film	109	242	92.9	205
TOTAL*	1,998	4,411	1,180	2,610
Total grams of bottle material per gallon of bottled water (includes only the items above designated as "bottles")	129		73.9	

\*TOTAL may not exactly equal the sum of the masses of individual items due to rounding.

### Climate change (GHG emissions)

The climate change indicator is a measure of greenhouse gas emissions (GHG) expressed as carbon dioxide (CO<sub>2</sub>) equivalents (CO<sub>2</sub>-eq). The key outcomes of this analysis are as follows:

- Small pack bottled water products had a footprint of 6,920 kg CO<sub>2</sub>-eq per 10,000 gal of water sold in 2015. The highest contribution comes from raw materials processing (40%) followed by bottling plant operations (22%), and distribution and backhaul (21%).
- HOD bottled water products had a footprint of 6,720 kg CO<sub>2</sub>-eq per 10,000 gal of water sold in 2015. The highest contribution comes from distribution and backhaul (64%), followed by bottling plant operations (20%), and raw material processing (11%).
- The GHG emissions from the bottled water industry in 2015 totaled 7.49 million metric tonnes of CO<sub>2</sub>-eq.

For reference purposes, the total U.S. GHG emissions in 2015 was 6.58 billion metric tonnes of CO<sub>2</sub>-eq, as reported by the U.S. Environmental Protection Agency in its *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2015* (2017b). While the life cycle emissions of the bottled water industry compared to the U.S. total emissions is approximately 0.1%, it does not mean that the bottled water industry has an unimportant environmental footprint. Such conclusions can only be made if the bottled water industry footprint is compared to an absolute limit (e.g., set by society) for bottled water beverages, which does not exist. Alternatively, comparisons to alternative beverages can evaluate the potential GHG savings compared to consuming an alternative product and other drinks.

On the latter point, while comparisons of bottled beverage products require careful consideration of the functional unit (e.g., nutritional content, ability to quench thirst), some high-level comparison can be made using publicly available literature. For instance, Quantis (2009) found that bottled water has a lower carbon footprint compared to bottled sports drinks and vitamin-fortified bottled water when compared on the basis of a 16.9 oz (500 ml) serving. In addition, comparing the carbon footprint of small pack bottled water sold on the U.S. market as calculated in the present study (6,920 kg CO<sub>2</sub>-eq per 10,000 gal) to the carbon footprint of carbonated soft drinks computed by BIER (2012) (20,400 kg CO<sub>2</sub>-eq per 10,000 gal) a similar conclusion could be drawn. A robust product LCA is needed to validate this comparison and better describe the potential environmental savings of bottled water over alternative packaged beverages.

### *Energy*

Energy is assessed in terms of non-renewable energy consumption throughout the entire life-cycle of bottled water production in units of megajoules (MJ). This includes the energy content of fuels, as well as the energy embedded in materials used for material production (such as the energy within crude oil that is used for resin production). The key outcomes are as follows:

- The small pack bottled water products used approximately 243,000 MJ of non-renewable energy per 10,000 gal of water sold in 2015, the majority of which is consumed in distribution and backhaul (57%), followed by raw material processing (26%).
- The HOD bottled water products used approximately 116,000 MJ of non-renewable energy per 10,000 gal of water sold in 2015, the majority of which is consumed in distribution and backhaul (62%), followed by bottling plant operations (19%).
- In 2015, the total non-renewable energy consumption by the bottled water industry was 0.247 trillion MJ.

For reference, the total non-renewable energy consumption of the U.S. in 2015 was 83.7 trillion MJ reported by the U.S. Energy Information Administration (EIA 2017). While the energy used by the bottled water industry (considering only direct energy use by the industry – i.e., bottling plant operations and distribution of bottled water) compared to the U.S. total energy use is

0.2%, it does not necessarily mean that the bottled water industry consumes a negligible quantity of energy. Such conclusions can only be made if the bottled water industry footprint is compared to an absolute limit (e.g., set by society) for bottled water beverages, which does not exist. Similarly, concluding that the energy use is relatively low requires comparison to the life cycle energy use of other bottled beverage industries.

### *Solid waste*

This report also looked at solid waste (in kg) for waste produced during manufacturing and at product end-of-life. Waste generated during other parts of the life cycle are expected to be negligible in comparison. Solid waste is the amount of waste sent to a landfill, rather than to incineration, recycling or repurposing. The key observations are as follows:

- Small pack bottled water products generated 718 kg of solid waste per 10,000 gal of water sold in 2015, mainly during post-consumer use (i.e., bottle disposal).
- HOD bottled water products generated 44.5 kg of solid waste per 10,000 gal of water sold in 2015. This is significantly less than small pack bottled water products due to the reuse of the plastic bottles by bottled water providers.
- In 2015, the total bottled water industry generated 0.288 million metric tonnes of solid waste.

In the US, approximately 258 million metric tonnes of municipal solid waste (MSW) were generated in 2014 reported by the U.S. EPA (EPA 2017a). While the amount of solid waste generated by the bottled water industry compared to the U.S. total solid waste generation is 0.1%, it does not mean that the bottled water industry generates a negligible quantity of waste. Such conclusions can only be made if the bottled water industry footprint is compared to an absolute limit (e.g., set by society) for bottled water beverages, which does not exist.