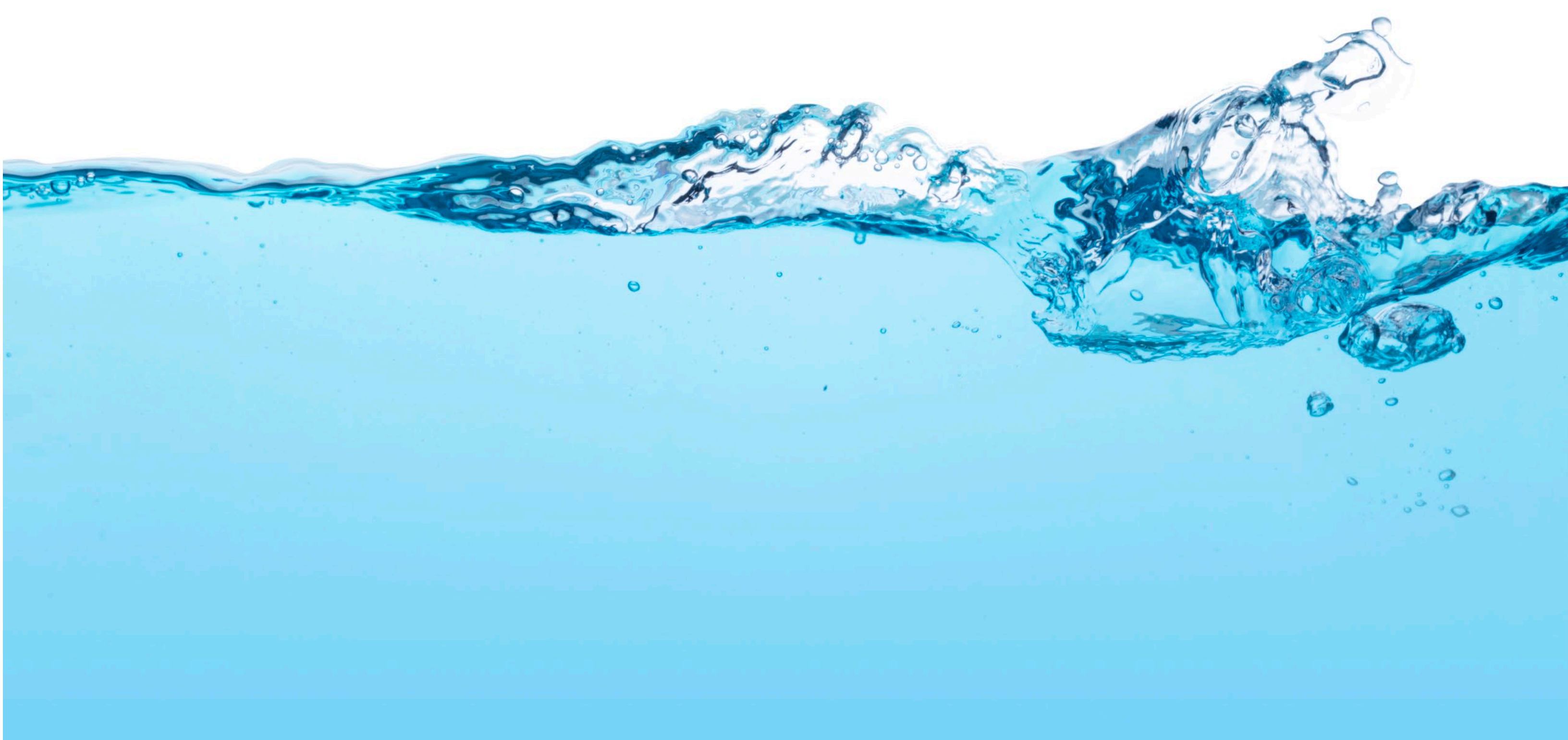
Water and Energy Use Benchmarking Study

Prepared for

International Bottled Water Association

November 14, 2018

Antea® Group



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Acknowledgements

The International Bottled Water Association (IBWA) would like to thank the member bottling companies and industry peer who contributed the facility-level data used to craft this report.

Study Execution

This benchmarking project was executed through the services of Antea USA, Inc. (Antea Group). Antea Group is a private, third-party consulting organization headquartered in St. Paul, Minnesota, USA.

Antea Group has been retained by the membership to execute the water benchmarking study of the International Bottled Water Association. All work conducted on this benchmarking study and use of the outputs is covered under a confidentiality, non-disclosure agreement between Antea Group and the IBWA participants. All participants and personnel working on this project are expected to comply with the terms of these agreements.

Executive Summary

The bottled water industry strongly supports comprehensive natural resource management and environmental stewardship. International Bottled Water Association (IBWA) member companies incorporate water conservation and energy reduction initiatives throughout bottled water production and distribution processes. IBWA has prepared the following benchmarking study to provide an update on the North American bottled water industry's water and energy conservation initiatives and performance.

Key Benchmarking Study Findings

- Participating bottlers represent **over half** of total 2018 United States bottled water production.
- **Water use ratio remained relatively flat** over the study period while total water use and production increased more than 20 percent.
- **Energy use ratio decreased 9 percent** over the study period.
- Bottlers are driving **process efficiencies** that result in water, energy, and cost savings, while **the industry experiences sustainable growth.**

2013

IBWA's inaugural benchmarking study established an average water use ratio for the North American (U.S. and Canada) bottled water industry.

2014

IBWA's second benchmarking study expanded upon the initial study by adding an energy use component.

2018

IBWA's third benchmarking study updates water and energy use trends observed over the past 5 years.

To establish a robust, consistent data set, each IBWA member was asked to provide five years (2013, 2015, 2017) of facility-specific information, including facility type, total water use, total energy use, total production, and supplementary process information (e.g., type of water treatment, use of refillable bottles). In total, 87 facilities participated in the 2018 study. It is important to note that the 2018 study represents an **amended data set** - facilities are added or removed based on acquisitions/divestitures and new participants in the study. **Please note: the water and energy ratios reported in previous studies have been revised in this report, and should be the referenced historic performance values moving forward.**

The study was managed by Antea®Group, a third-party consultant, who conducted the data collection process, verification, analysis, and reporting.

Key performance metrics:

- **Water use ratio -** average liters of water used in facility processes (including product water), to produce one liter of bottled water.
- **Energy use ratio** - average amount of total energy consumed on site from all sources (purchased electricity, fuel and steam – measured in mega joules, or MJ) used in facility processes, to produce one liter of bottled water.

Appendix 1 presents the scope of processes included in these ratios.

The 2018 benchmarking study report presents data and trends from the **73 North American bottled water facilities**[1], **representing five IBWA member companies and one industry peer,** that contributed full reporting years (2013, 2015 and 2017) to the study. The study represents 26.9 million kiloliters of bottled water production – **over half (55 percent) of total 2017 United States bottled water consumption**[2]. Participation levels in this study demonstrate the bottled water industry is committed to improving their understanding of water and energy use and more sustainable management of resources.

Energy Use Ratio decreased over 9% from 2013 to 2017, equivalent to an energy avoidance of over 593 million megajoules – enough to power nearly 16,000 single-family homes for a full year*.

**Source: US Energy Information Agency, 2017 Average Annual Energy Usage, Single Family Residence*

Industry Performance

IBWA members were asked to provide data from a five-year period (2013, 2015, and 2017). Figures ES- 1 and ES-2 present performance data in two ways – a **fixed data set** (column graphs) representing the facilities that provided all years of requested data, and a **dynamic data set** (line graphs) representing all facilities that provided any data over the five years of the study. As seen in Figure ES-1, water use ratio remained relatively constant over the five-year period from 2013 to 2017, while total water use and total bottled water production increased, indicating the water footprint of facilities remains steady even though demand for product has increased. In Figure ES-2, while energy use and total bottled water production increased from 2013 to 2017, energy use ratio decreased 9 percent over the same period. **Although an increase in production may require more water and energy use, facilities are taking steps to optimize resource use to avoid waste.** These trends in water and energy use performance demonstrate investments in efficiency measures and process improvements, coupled with improved data tracking by facilities, can lead to positive results in water, energy, and cost savings, while the industry experiences sustainable growth.

Figure ES-1:
Industry Water Use Ratio Performance
Fixed vs. Dynamic Data Set

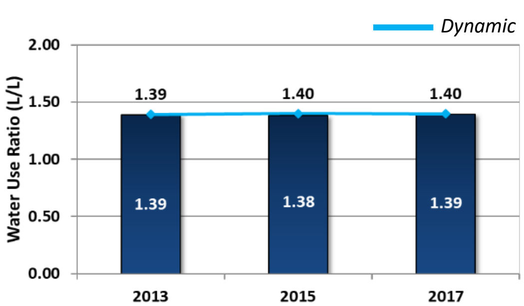
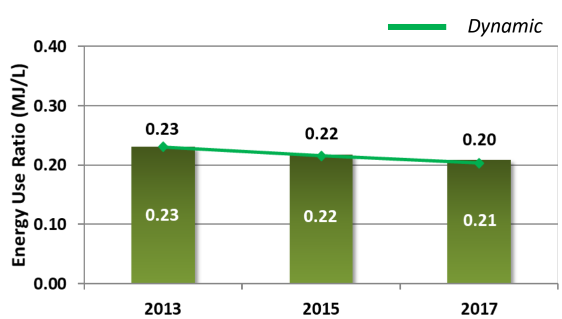


Figure ES-2:
Industry Energy Use Ratio Performance
Fixed vs. Dynamic Data Set



[1] Based on a fixed data set of facilities providing all three years of data, versus 87 total participating facilities.
[2] "Bottled Water in the U.S. Through 2022"; Beverage Marketing Corporation, August 2018.

Water				Energy		
2013	2015	2017		2013	2015	2017
73			Total Facility Count (fixed)	71		
21,430	25,877	26,877	Total Production (1000 kL)	21,204	25,631	26,648
29,709	35,788	37,468	Total Water (1000 kL) & Energy (1000 MJ) Use	4,892,142	5,579,348	5,554,477
1.39	1.38	1.39	Fixed Ratio	0.23	0.22	0.21

The 2017 fixed water use ratio for North American bottled water facilities was 1.39 L/L, and the 2017 fixed energy use ratio for North American bottled water facilities was 0.21 MJ/L. These ratios demonstrate a higher level of performance when compared to the global 2015 averages for bottled water facilities[3] (1.70 L/L water use ratio, 0.26 MJ/L energy use ratio).

Table ES- 1: Spring vs. Other Water and Energy Use Ratios, 2013 – 2017

	2013	2015	2017
Water Use Ratio			
Spring Water	1.32	1.32	1.29
Other Water	1.43	1.40	1.45
Energy Use Ratio			
Spring Water	0.24	0.22	0.20
Other Water	0.23	0.22	0.22

In general, bottled water facilities have the lowest water use ratio and energy use ratio when compared to other beverage sectors. In comparison, other beverage sectors[4] such as carbonated soft drink bottling and beer production average have larger water and energy use ratios driven by higher intensity processes unique to these other beverages, such as flavor mixing, blending, carbonation, fermentation, cooking, distilling, etc.

Quantifying Mega Joules
It takes approximately **3.6 mega joules** of energy to power a 100 watt light bulb for 10 hours.

Water use ratio varies in magnitude when compared across "types" of bottled water. In 2017, approximately 78 percent of participant facilities indicated that Other[5] water is their primary bottled product. This mix remained relatively constant throughout the five-year study period – Other water accounts for 60 percent of total bottled water production. As seen in Table ES-1, Other water bottlers reported an overall higher water use ratio than Spring water bottlers, as expected by the processes related to Other water production that may not be as prevalent in Spring water production (e.g., purification processes / reverse osmosis, startup/run time associated with product changeover, etc.). The water use ratio trend for Other water bottlers are likely influencing the overall industry water use trend; additional evaluation into specific process drivers to further explain these trends will be considered in future studies.

[3] Beverage Industry Environmental Roundtable, 2016. Note that the 2018 BIER Benchmarking Study will not be released until 2019; therefore, global 2015 averages were used for comparison.
[4] Beverage Industry Environmental Roundtable, 2016.
[5] For the purposes of this study, Other waters are defined as: *all bottled waters other than mineral and spring water, with or without the addition of minerals for taste. Includes purified water (produced by distillation, deionization, reverse osmosis, or other processes), sparkling bottled water, or well water.*

Information in the 2018 study supersedes the ratios and trends reported in previous studies. Benchmarking studies are meant to be a snapshot in time of the current industry status, and as such, we allow our members to review previously submitted data and make amendments based on their most recent understanding of data – both historic and current. The amended data set captured in the 2018 study accounts for industry changes like acquisitions and divestitures, amendments to previously-reported data, and new members providing study data.

Facility-based Results

The study also evaluated water and energy use ratio trends among the three bottled water facility types:

- **Small Pack:** facilities that package bottled water in containers from 8 ounces to 2.5 gallons
- **Home and Office Delivery:** facilities that package bottled water in reusable/refillable containers from 2.5 to 5 gallons
- **Mixed Packaging**: facilities with both Small Pack and Home and Office Delivery packaging

Table ES- 2: Water Use Ratio Performance by Facility Type (L/L), 2013 – 2017

	2013	2015	2017
ALL	**1.39**	**1.38**	**1.39**
Small Pack	1.37	1.36	1.37
Mixed Packaging	1.44	1.46	1.49
Home & Office Delivery	1.57	1.52	1.51

Note: *Ratios represent the fixed data set for all categories.*

Table ES- 3: Energy Use Ratio Performance by Facility Type (MJ/L), 2013 – 2017

	2013	2015	2017
ALL	**0.23**	**0.22**	**0.21**
Small Pack	0.24	0.23	0.22
Mixed Packaging	0.20	0.20	0.20
Home & Office Delivery	0.12	0.11	0.10

Note: *Ratios represent the fixed data set for all categories.*

As seen in Table ES-2, water use ratios for each facility type varied over the study period, decreasing from 2013 to 2017 in both Small Pack and Home & Office Delivery. As seen in Table ES-3, energy use ratios decreased in both Small Pack and Home & Office Delivery, while Mixed Packaging remained consistent from 2013 to 2017. The differences in ratio magnitude among the three facility types are largely process-driven, for example:

- Home and Office Delivery facilities bottle finished product in refillable containers, resulting in additional water use for sanitization processes that do not exist at facilities that use single fill packaging (e.g., most North American Small Pack facilities).
- Some Small Pack facilities have bottle blow molding operations on site, resulting in additional energy use that does not exist at facilities that use off-site blow molding operations to supply bottles (e.g., no Home and Office Delivery facilities in this study operated on site blow molding operations).

Industry Stewardship Efforts

The North American bottled water industry has worked to improve environmental stewardship in several ways. By improving data management and analysis at the facility level, bottlers can track and report their achievements in water and energy conservation. Understanding data to realize where there are opportunities to improve allows for active implementation of process changes to reduce water and energy use while still experiencing sustainable business growth. Participants in the study were asked to provide examples of their environmental stewardship efforts. **Water stewardship efforts include, but are not limited to**: improving performance in the reverse osmosis process; integrating concentrate recovery; optimizing washer units to maximize efficiency; improving data collection; and resolving system leaks. **Energy efficiency measures and initiatives include, but are not limited to:** lighting efficiency such as use of natural light or LED; system automation; increased employee engagement; regular inspections and repairs for compressed air and steam systems; energy audits and surveys; and process optimization through scheduling, settings updates, etc.

Conclusion

In this third benchmarking study, IBWA members have continued to demonstrate their commitment to promoting an environmentally responsible and sustainable industry, as evidenced by the exemplary participation in this year's study and impressive list of stewardship initiatives in action at North American bottled water facilities. Water and energy use ratios demonstrated constant or decreasing trends, while production continues to increase across the industry. Bottlers are driving process efficiencies that result in water, energy, and cost savings, while the industry experiences sustainable growth. The results of this study shall serve as a baseline to measure future progress in water and energy use reduction and conservation efforts across the industry.

Introduction

IBWA launched its 2018 water and energy use study to build upon performance metrics from past studies and continue to report on environmental sustainability progress. This 2018 report evaluates the changes and trends observed from 2013 to 2017. The water and energy benchmarking study provides a more specific understanding of process efficiencies and the impacts of water and energy use in the bottled water industry, while opening the door for future evaluations of the industry's broader environmental footprints.

IBWA Benchmarking Study Objectives

Assess
availability of energy & water use data

Measure
energy & water use across several years

Monitor
trends in environmental stewardship & performance

Methodology

To complete the study, IBWA utilized the benchmarking methodology established by the Beverage Industry Environmental Roundtable (BIER)[6]. This methodology uses the water use ratio and energy use ratio as key indicators for efficiency performance. Data collection workbooks were distributed to all IBWA bottler members in February 2018, with a collection deadline of July 2018. At a minimum, companies provided information on facility type, geographic location, total beverage production, total water use, and total production data at the facility level. Bottlers were also asked to report a beverage product mix, or a percentage breakdown of the different beverage types produced at each facility (e.g., spring water, mineral water, other water, etc.). To further evaluate data trends and observations, participants were also asked to provide information regarding facility-specific process characteristics, such as water treatment process, percent of finished product packaged in refillable containers, existence of on-site bottle blow molding, and process/product water sources[7].

In total, five IBWA member companies and one industry peer contributed to the benchmarking study, representing 73 facilities for the fixed water data set, and 69 facilities for the fixed energy data set. The study represents 26.9 million kiloliters of bottled

Water Use Ratio (WUR): the liters of water (including product water) used to make one liter of product.

Energy Use Ratio (EUR): the mega joules of total energy (electricity + fuel + heat) used to make one liter of product.

Notes:

- *The data in this report represents an **amended data set.** If a facility was added or removed from an IBWA member's operations due to acquisitions or divestitures, the historic data was updated to reflect these changes. Values reported in previous studies have been revised in this report, and should be the referenced historic performance values moving forward.*
- *Detailed data are presented in cases where at least three companies contributed to a given data set. The following sections will present data trends at an industry level as well as facility-type level.*

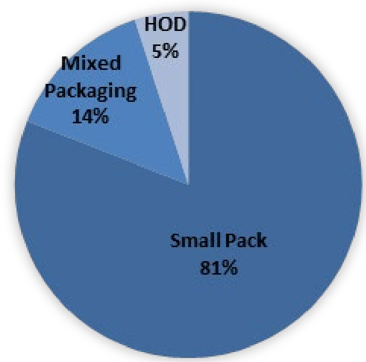
[6] BIER is a partnership of leading global beverage companies working together to advance the standing of the beverage industry in the realm of environmental stewardship. For more information visit http://www.bieroundtable.com.
[7] For further information on study definitions, please reference Appendix 1 – Glossary. For further information on study methodology, see Appendix 2 – Methodology.

water production – which is 55 percent of total 2017 United States bottled water consumption[8]. The continued participation in this study demonstrates interest and dedication of North American bottlers to better understand the industry's water and energy use performance.

Data were received by Antea Group, a third-party consulting firm. Antea Group reviewed the data for accuracy and consistency in meeting the study scope, and worked with participants to validate any identified data anomalies.

Industry-Wide Results

Figure 1:
2017 Key Data Set Characteristics



In total, 87 facilities participated in the 2018 study. It is important to note that the 2018 study represents an amended data set - facilities are added or removed based on acquisitions/divestitures and new participants in the study. The 2018 benchmarking study report presents data and trends from the 73 North American bottled water facilities, representing five IBWA member companies and one industry peer, that contributed full reporting years (2013, 2015 and 2017) to the study. Most of these facilities were Small Pack, accounting for 84 percent of 2017 production volume (Figure 1). For the purposes of this study, we will be focusing on the **fixed data set** (Figures 2 and 3), representing facilities that provided data for 2013, 2015, and 2017. Fixed data is presented throughout the remainder of this report, as there is more consistency and comparability among facilities that reported year over year data.

Figure 3 (on the following page) presents energy use performance data. Total energy use and total bottled water production[9] increased over the study period, while the energy use ratio decreased 9 percent over the study period.

[8] "Bottled Water in the U.S. Through 2022"; Beverage Marketing Corporation, August 2018.
[9] Total production and facility count differs between water and energy use, as some bottled water facilities that provided five full years of water data were unable to provide five full years of energy data.

Figure 2:
Industry Water Use, Production, and Efficiency

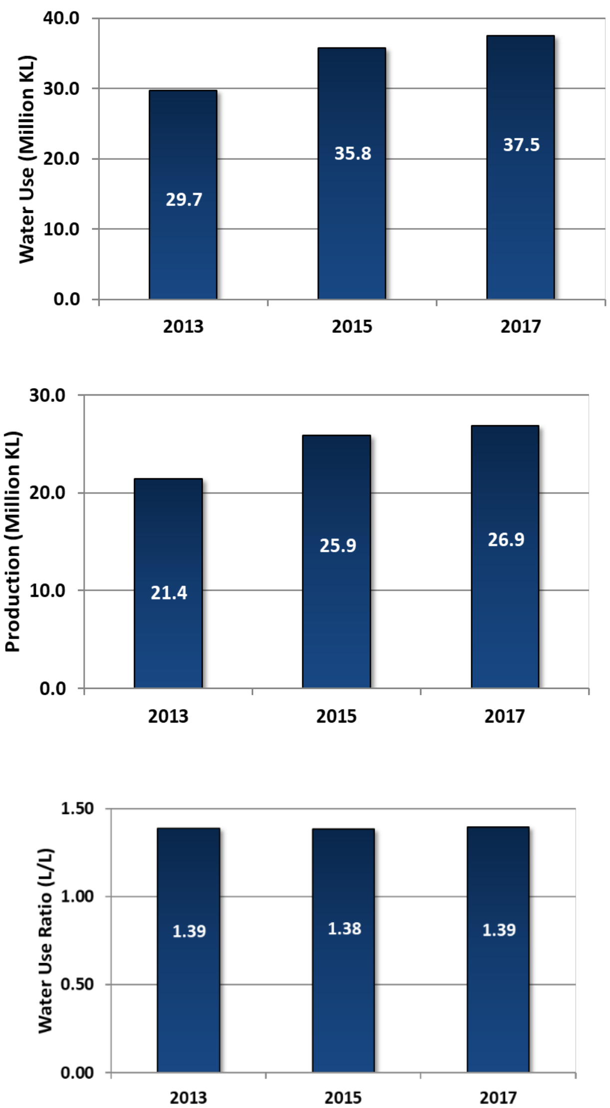
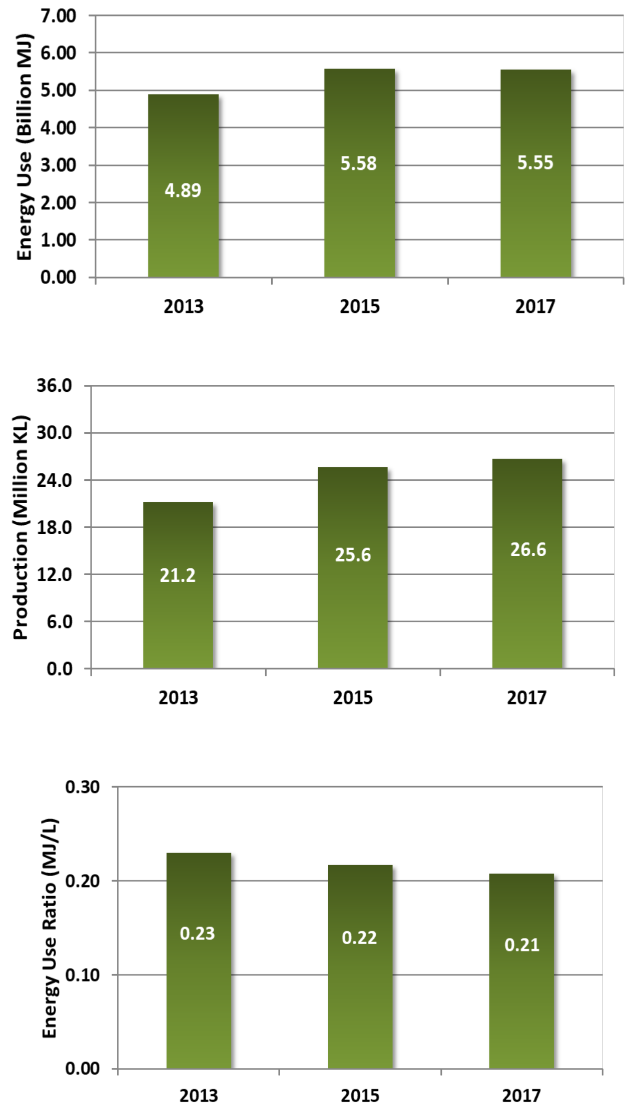


Figure 3:
Industry Energy Use, Production, and Efficiency



Industry-Wide Trends and Observations

Efficiency Performance: As described above, water and energy use increased as production increased over the study period. Water use ratio remained relatively flat from 2013 to 2017, while the energy use ratio decreased at a slight, incremental rate over the same period. These trends suggest that process efficiencies are being recognized while the industry experiences sustainable growth. In other words, although an increase in production may require more water and energy use, facilities are taking steps to optimize resource use avoid waste. There is an opportunity to further evaluate the specific process drivers for these trends in future studies, to validate performance efficiency. This is further discussed in the "Future Benchmarking Studies" section of this report.

North American Bottled Water Performance vs. Global Average: Bottled water facilities contributing to this study demonstrated a higher level of performance when compared to the global average. The 2017 water use ratio for North American bottled water facilities was 1.39 L/L, and the 2017 energy use ratio for North American bottled water facilities was 0.21 MJ/L. These ratios demonstrate a higher level of performance when compared to the global 2015 averages for bottled water facilities[10] (1.70 L/L water use ratio, 0.26 MJ/L energy use ratio).

Bottled Water Ratios vs. Other Global Beverage Sectors: When compared to other global beverage sectors, the bottled water industry's production processes (e.g., water treatment and bottling) tend to be less water and energy intense, resulting in the lowest water use and energy use ratios reported among packaged beverages. The brewing sector, for example, uses approximately 3.53 liters of water and 1.09 mega joules of energy to produce 1 liter of beer through mashing, boiling, fermenting, aging, and final packaging processes[11]. Corollary processes exist in the spirits (39.04 L/L, 15.46 MJ/L) and wine (2.78 L/L, 1.19 MJ/L) sectors, and result in additional water and energy use as part of the production process. Carbonated soft drink bottling facilities also exhibit larger ratios (1.89 L/L, 0.35 MJ/L) compared to water bottling facilities, likely driven by the additional production processes associated with adding and mixing flavors to the final product and a higher propensity for more diverse product mix or change-overs.

[10 & 11] Beverage Industry Environmental Roundtable, 2016. Note that the 2018 BIER Benchmarking Study will not be released until 2019; therefore, global 2015 averages were used for comparison.

Variations in Ratio vs. Facility Size:

Figures 4 and 5 demonstrate the correlation between water and energy use ratio and facility size as defined by production volume for individual facilities in 2017. Facilities that produce larger quantities of product annually (>250,000 kL) tend to report lower water and energy use ratios as compared to the entire data set. Potential drivers for this trend include the prevalence of automated processes at these facilities (e.g., timing and controls to optimize system efficiency) and the difference in production run lengths (e.g., round-the-clock operations that cut out time needed for shift change, daily start up, etc.). This does not mean, however, that large facilities are inherently more efficient than smaller facilities, or that employing automated processes always results in lower water and energy use ratios. Figures 4 and 5 demonstrate, there are many smaller production facilities that report ratios at or better than the industry average – an indicator that efficiencies are being recognized independent of facility size. As a best practice, even if a facility demonstrates water or energy use performance at or below the industry average, all facilities should continuously seek ways to integrate water and energy conservation into regular operations.

Figure 4: Water Use Ratio vs. Production Volume, 2017

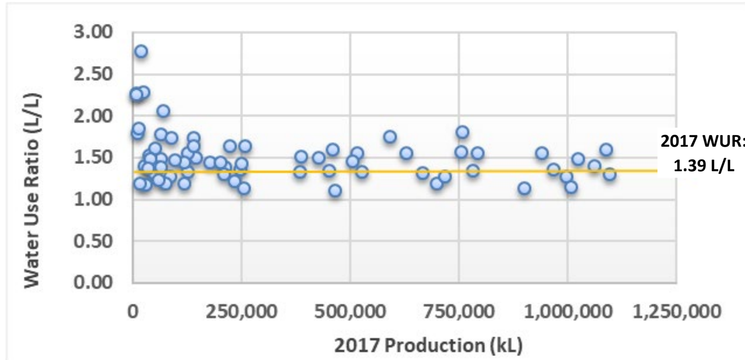
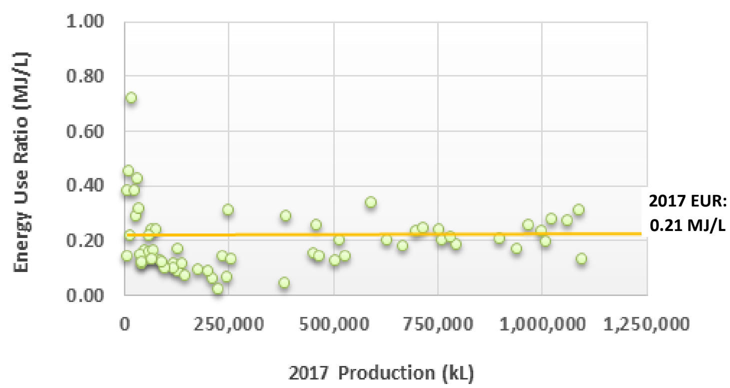


Figure 5: Energy Use Ratio vs. Production Volume, 2017



Additional Observations Based on Supplemental Process Data: Supplemental process data were provided for 84 facilities (see Appendix 3 – Supplemental Process Data Worksheet). Data were analyzed to evaluate how certain processes or controls influence water and energy use at a facility level. Our analysis indicated that there is not one definitive driver for water and energy use ratio performance; rather, a combination of factors influences water and energy use intensity depending on facility-specific processes. Observations include:

- **Source of Product and Process Water:** Most facilities (62 percent) source their *product* water from municipal sources, while 75 percent source their *process* water from municipal sources. All facilities that source their product water from municipal sources also use municipal water as their process water. 22 percent rely on wells as a primary product water source, with over half also using well water as their source of process water (the remaining using

	Primary Source of Product Water	Primary Source of Process Water
Municipal	62%	75%
Spring	16%	8%
Well	22%	67%

municipal). Spring water bottlers comprise the remaining 16 percent of facilities in the study, and, while spring water is the sole source for product water, 92 percent of spring water bottlers rely on wells or municipal sources for process water used for cleaning bottling equipment.

- **Variation in Water Use Ratio by "Type":** In 2017, approximately 78 percent of participant facilities indicated that Other water is their primary bottled product. This mix remained relatively constant throughout the five-year study period – Other water accounts for 60 percent of total bottled water production. Other water producers reported an overall higher water use ratio than Spring water bottlers, as expected by the processes related to Other water production that may not be as prevalent in Spring water production (e.g., purification processes / reverse osmosis, startup/run time associated with product changeover, etc.). The water use ratio trend for Other water producers is likely influencing the overall industry water use trend, and additional evaluation into specific process drivers to further explain these trends (e.g., influence of water treatment, number of product changeovers) will be further considered in future studies.
- **Water Treatment Processes:** Approximately 92 percent of facilities in this study indicated that reverse osmosis is the primary water treatment process used on site. Facilities using reverse osmosis reported a mean water use ratio of 1.46 L/L and a mean energy use ratio of 0.19 MJ/L. Distillation is the primary treatment process for 3 out of 84 facilities, reporting a mean water use ratio of 1.61 L/L and a mean energy use ratio of 0.24 MJ/L. The remaining facilities indicated reverse osmosis and distillation are both used at the facility. The observed water use trends are expected – the reverse osmosis process requires more water use for the filtration process than distillation. Distillation requires a heat source to boil water and remove impurities, resulting in more energy use for treatment when compared to reverse osmosis.
- **Finished Product in Refillable Containers:** Bottlers were asked to provide the percentage of finished product packaged in refillable containers (e.g., containers that are meant to be filled more than once for sale or distribution). Facilities that pack greater than 50 percent of finished product in refillable containers reported a mean water use ratio of 1.57 L/L and a mean energy use ratio of 0.18 MJ/L. The mean water use ratio for facilities with a majority of finished product packaged in refillable containers was greater than the ratio for facilities that package less than 50 percent of finished product in refillable containers (1.40 L/L); a trend attributed to the additional water required for cleaning/sanitization processes associated with the refilling process. The mean energy use ratio for facilities with a majority of finished product packaged in refillable containers was less than the ratio for facilities that package less than 50 percent finished product in refillable containers (0.21 MJ/L). On site bottle blowing is more prevalent at facilities that package less than 50 percent of finished product in refillable containers (Small Pack operations) – the additional energy required for bottle blowing is one driver for this higher energy use ratio.
- **Use of Carbon Filtration:** Carbon filtration processes are used by 74 percent of reporting facilities. Facilities with carbon filtration processes had a higher average energy use ratio (0.22 MJ/L) than those without carbon filtration on site (0.11 MJ/L). Water treatment process at these facilities is a driver for this trend – the facilities that did not use carbon filtration also utilized treatment processes that were less energy intensive (a mix of distillation and reverse osmosis; reverse osmosis only, or artesian source).

- **Presence of Cooling Towers:** Bottlers were asked to identify if cooling towers are used on site. Those that indicated they do not use cooling towers reported a mean average water use ratio of 1.70 L/L and a mean average energy use ratio of 0.15 MJ/L. These facilities have a higher water use ratio and lower energy use ratio than facilities that utilize cooling towers on site (1.45 L/L and 0.21 MJ/L, respectively). A lower energy use ratio at facilities without cooling towers is an expected observation – cooling towers are typically implemented on site with machinery that heats up during operation; for example, all participants with cooling towers also had bottle blowing operations on site. Facilities with cooling towers on site would be expected to demonstrate a higher mean water use ratio than those without cooling towers due to processes associated with cooling towers. In this case, most facilities reporting to the study had cooling towers on site, and the magnitude of this data could be impacting the comparative data trend.
- **On Site Bottle Blow Molding Operations:** Bottlers were asked to identify if bottle blow molding processes were conducted on site, and 42 percent of facilities indicated bottles are not blown on site. For those that operate a bottle blow molding process on site, 40 percent indicated that air rinsing is used as part of the process. Facilities with a blow molding operation on site reported an average energy use ratio of 0.21 MJ/L, greater than the energy use ratio for facilities that do not blow bottles on site (0.18 MJ/L).

Facility-Based Results

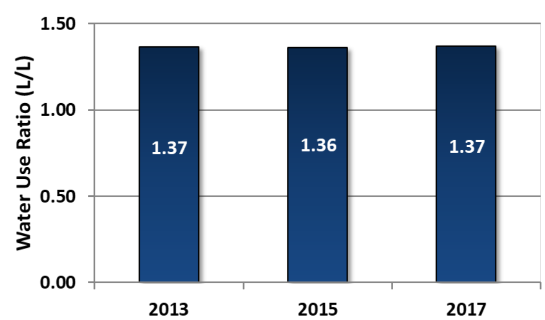
Variation in water and energy use ratios among different facility types is an expected outcome of the analyses. Although all facilities in this study produce bottled water, product packaging-specific processes, such as use of refillable containers, have varying effects on efficiencies. Further analysis of water and energy data was performed on each of the three facility types (Small Pack, Home and Office Delivery, and Mixed Packaging) to identify these water and energy use efficiency trends.

Small Pack Facilities

For the purposes of this study, Small Pack facilities are defined as **"facilities that package bottled water in containers from 8 ounces to 2.5 gallons."** Four companies provided water and energy data for 33 Small Pack facilities, which accounted for 81 percent (by volume) of the overall fixed industry data set.

Total water use increased 28 percent and total production increased 27 percent over the study period. As seen in Figure 6[12], water use ratio for fixed facilities remained relatively constant, while individual facilities reported an average ratio decrease of 1 percent. When compared to the other facility types,

Figure 6: Small Pack WUR Performance



N: 33
2017 Median: 1.36 L/L
2017 Range: 1.10 – 1.81 L/L
WUR Δ 2013-2017: 0 %

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[12] For all subsequent graphs, the following criteria apply: "water use ratio" represents a volume- mean.

Small Pack facilities had the lowest water use ratio, likely driven by the absence of refillable container use within this subset.

Of the Small Pack facilities evaluated, 36 percent identified a beverage product mix consisting of 50 percent or greater Other water. The 2017 water use ratio for these facilities was 1.43 L/L, slightly greater than the water use ratio for all Small Pack facilities. It may be inferred that facilities with a beverage product mix of majority Other water would have a higher water use ratio, as the processes related to other water types (such as distillation, deionization, or reverse osmosis), may require more water as part of the process.

Figure 7: Small Pack EUR Performance

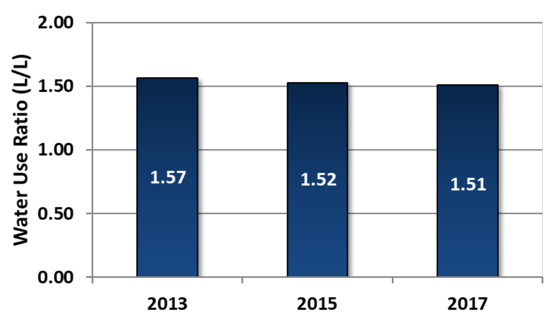
N = 33
2017 Median: 0.22 MJ/L
2017 Range: 0.09 – 0.31 MJ/L
EUR Δ 2013-2017: -8%

Total energy use for Small Pack facilities increased 14 percent and total production increased 27 percent over the study period. As seen in Figure 7, energy use ratio decreased 8 percent, with individual facilities reporting an average ratio decrease of 19 percent. The overall decrease in energy use ratio may be attributed to specific facility energy efficiency measures. When compared to the other facility types, Small Pack facilities had the highest energy use ratio. One driver for this trend may be the presence of on-site bottle blow molding operations within this facility type, which require more energy as part of the process.

Home and Office Delivery (HOD) Facilities

For the purposes of this study, Home and Office Delivery (HOD) facilities are defined as **"facilities that package bottled water in reusable/refillable containers from 2.5 to 5 gallons."** Three companies provided water and energy data for14 HOD facilities. HOD facilities accounted for 5 percent (by volume) of the overall industry data set.

Figure 8: HOD WUR Performance



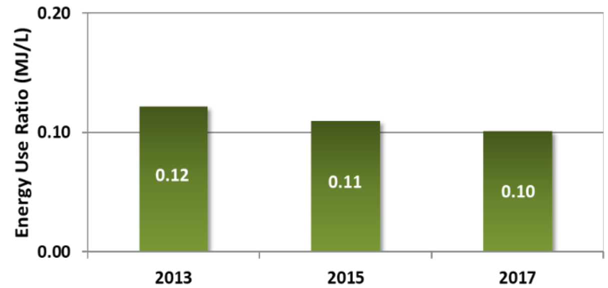
N = 14
2017 Median: 1.63 L/L
2017 Range: 1.18 – 2.78 L/L
WUR Δ 2013-2017: -4%

Total water use increased 11 percent and total production increased 16 percent over the study period. As seen in Figure 8, water use ratio decreased 4 percent from 2013 to 2017, with individual facilities reporting an average ratio decrease of 2 percent.

Total energy use decreased 4 percent and total production increased 16 percent over the study period. As seen in Figure 9, energy use ratio decreased steadily from 2013 to 2017.

When compared to other facility types, HOD facilities have the highest water use ratio. The use and processing of refillable containers is a primary driver for this trend, due to additional water required for the sanitization process.

Figure 9: HOD EUR Performance



N = 14
2017 Median: 0.13 MJ/L
2017 Range: 0.04 – 0.43 MJ/L
EUR Δ 2013 – 2017: -17%

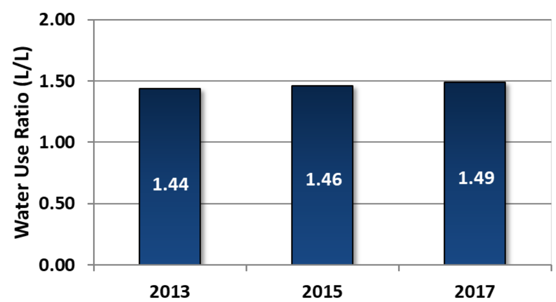
Mixed Packaging Facilities

For the purposes of this study, Mixed Packaging facilities are defined as **"facilities with both Small Pack and Home and Office Delivery packaging."** Three companies provided water and energy data for 26 Mixed Packaging facilities, which accounted for 14 percent (by volume) of the overall industry data set.

Total water use increased 23 percent and total production increased 18 percent over the study period. As seen in Figure 10, water use ratio for facilities increased 3 percent from 2013 to 2017, with individual facilities reporting an average ratio increase of 1 percent.

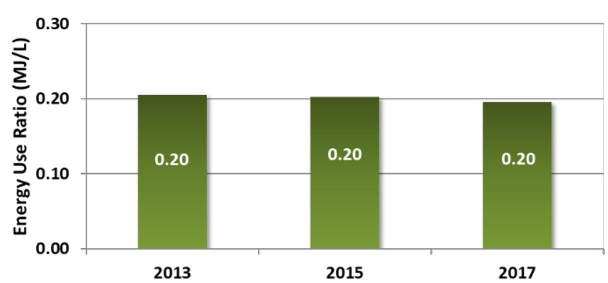
Total energy use increased 13 percent and total production increased 18 percent over the study period. As seen in Figure 11, the energy use ratio trend remained steady over the study period, while individual facilities reported an average ratio decrease of 27 percent. Several Mixed Packaging facilities implemented energy reduction initiatives, such as optimization of compressor energy requirements and equipment upgrades, that led to decreased energy use ratios.

Figure 10: Mixed Packaging Performance



N = 26
2017 Median: 1.44 L/L
2017 Range: 1.19 – 2.27 L/L
WUR Δ 2013-2017: 3%

Figure 11: Mixed Packaging Performance



N = 26
2017 Median: 0.13 MJ/L
2017 Range: 0.02 – 0.72 MJ/L
EUR Δ 2013-2017: 0%

Industry Stewardship Efforts

The North American bottled water industry has worked to improve environmental stewardship in several ways. By improving data collection and analysis, great benefits in water and energy conservation can be achieved. Understanding data to realize where there are opportunities to improve allows for active implementation of process changes to reduce water and energy use while still experiencing sustainable business growth. In 2016, IBWA completed a water risk and best practices study to advance the group's approach to water stewardship. The study provided valuable insight into water management strategies and solutions being utilized across the North American bottled water industry, and encouraged and enabled members to continue advancing their own water stewardship programs. As part of this study, participants were asked to provide examples of successful water stewardship efforts. One company noted that by improving water tracking standards and acting on best practice recommendations, they could realize nearly a 20 percent decrease in water use ratio at several facilities from 2013 to 2017. Examples of water stewardship efforts include:

- Improving performance and recovery in the reverse osmosis process;
- Integrated concentrate recovery;
- Xeriscaping around new plants;
- Optimization of washer units to maximize bottle washer efficiency through automated timers, selection of cleaning chemicals, valve adjustment and flow control, air rinsing, etc.;
- Improving data collection and tracking;
- Establishing guidelines for minimizing 5-gallon bottle washer purging; and
- Emphasis on eliminating system leaks which results in both water quality and quantity benefits.

Participants were also asked to indicate the energy management programs and initiatives that are in place at their facilities. The most common initiatives include, but are not limited to:

- Use of natural light in lieu of fixtures;
- Use of indoor and outdoor automatic light controls (e.g., parking lot lights on timers, light sensors in rooms);
- Encouragement of employees to power down electrical equipment when not in use;
- Regular inspection, leak testing and repair programs for compressed air systems and steam systems;
- Optimized production schedules to minimize frequency of startup/shut down times;
- Regular cleaning and inspection of HVAC systems for optimum performance;
- Automatic/timed temperature controls;
- Standard use of high-efficiency motors;
- Use of energy efficient light fixtures;
- Delegation of individuals or teams to be responsible for energy management and efficiency initiatives; and
- Comparison of metered energy data with energy invoices to ensure consistency in measurement;
- Optimized pressure settings for compressed air systems;
- Energy survey/audit scheduled or completed; and
- Automatic shut off for fans, pumps, conveyors, etc. as applicable.

Future Benchmarking Study Recommendations

IBWA has an impressive resource stewardship story to share, thanks in part to the proactive participation of member bottlers in this third benchmarking study. Member participation represents over half of total 2017 United States bottled water production. Members provided a robust data set for five years of benchmarking (2013, 2015, and 2017). Furthermore, members provided valuable insight into facility processes and stewardship efforts by completing the supplemental data questionnaires included in the survey.

Since select results of this study will be released publicly, there will be an expectation among stakeholders and peers that IBWA will continue to build upon this study in the future. As a best practice, IBWA should strive to continuously improve the study and explore additional industry trends and drivers as the study develops. Antea Group offers the following recommendations for future studies:

- ✓ **Encourage Participation:** Use the release of this report to continue to build interest in the study among membership and encourage additional participation in future studies. Continued engagement opportunities, such as educational sessions at IBWA conferences, will also help fuel future participation.
- ✓ **Enhance Supplementary Process Data:** Supplementary process data provided by members supports the identification of efficiency drivers and trends. IBWA should continue to work with members to identify additional process information that can be queried during future studies, as well as consider recommendations noted throughout this report (e.g., purified water data, energy costs). It would also be beneficial to explore the impacts certain processes have on total water use, to better understand where additional efficiencies may be possible (for example, understanding how water is used within the facility – employee use vs. process use, or impact of any permit / regulatory restrictions on water use).
- ✓ **Best Practice Development / Industry Insights:** IBWA members have an opportunity to "move the needle" on industry resource stewardship through collaboration, and sharing best practices is an excellent step toward broader industry impact. Members provided examples of effective efficiency initiatives they have implemented at their facilities, and "patterning" these efforts to see where there might be overlap among other companies could illuminate opportunities for development of future best practice guidance documents, or additional evaluation of water and energy use intensity associated with specific conservation initiatives. IBWA member collaborative efforts have produced the 2017 IBWA Life Cycle Assessment and IBWA's 2016 Water Risk and Best Practice Study – what are the next opportunities to share insights, or to create helpful guidance and tools, that can be used by the North American bottled water industry?

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