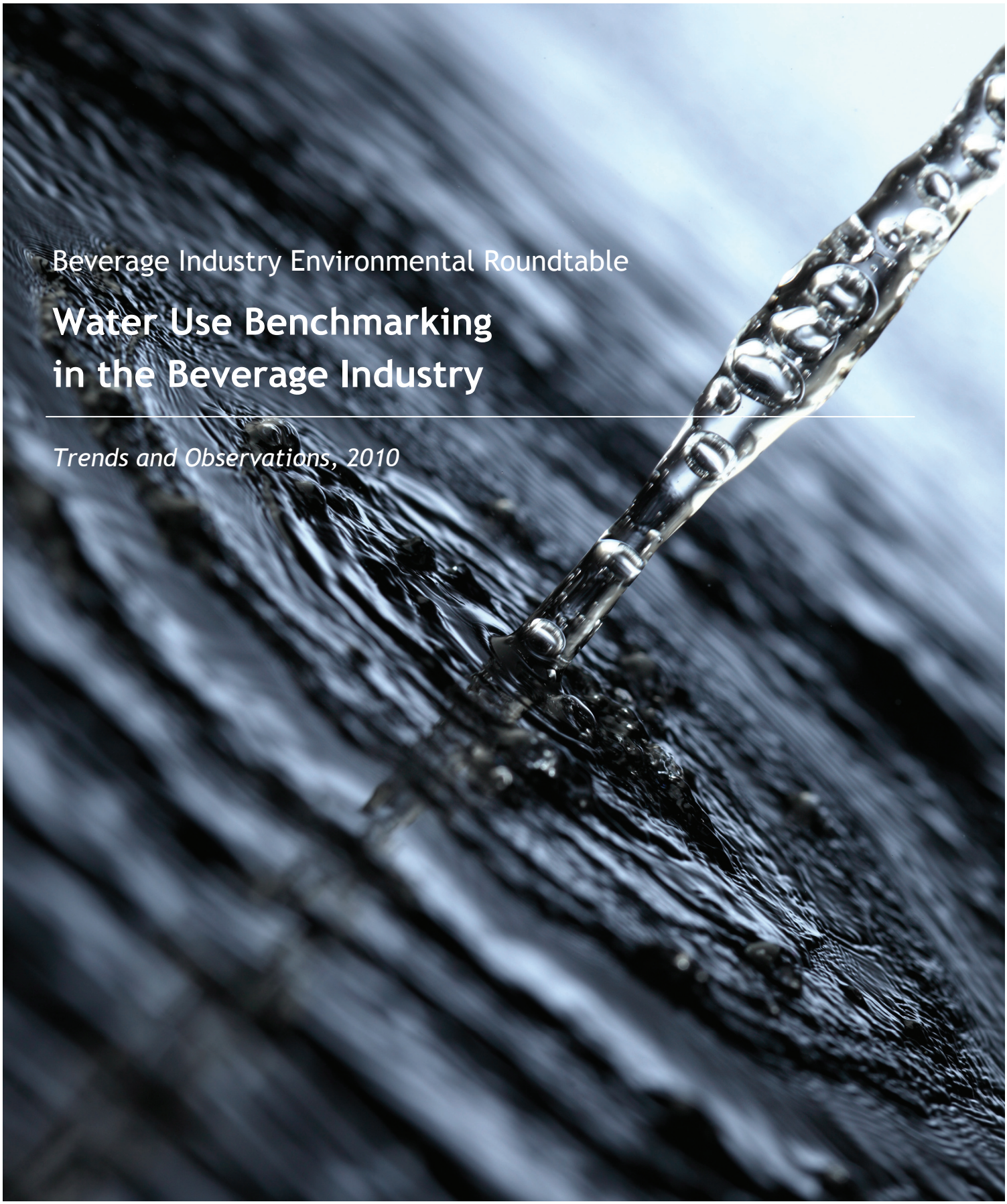


Beverage Industry Environmental Roundtable

Water Use Benchmarking in the Beverage Industry

Trends and Observations, 2010

Beverage Industry
Environmental Roundtable

anteagroup

Water Use Benchmarking in the Beverage Industry
Trends and Observations, 2010

Clean, high-quality water is the essential ingredient for all products of the beverage industry. For years, beverage companies have focused on water use avoidance and conservation to demonstrate one aspect of environmental stewardship. Since 2007, the Beverage Industry Environmental Roundtable (BIER) has completed an annual quantitative benchmark to evaluate water use and efficiency in the beverage industry. This article shares some of the water use and performance information collected as part of this study. Further, some of the best practices employed to drive water use avoidance and efficiency are summarized.

Benchmarking Process

BIER completed its fourth annual water use benchmark in 2010, evaluating the performance of more than 1,500 beverage manufacturing locations representing 16 beverage enterprises. Each year the study evolves, as BIER members fine-tune the benchmarking process by redefining benchmarking metrics (Table 1), determining the most critical data to collect, and adjusting the data analysis process for an ever-expanding data set. In 2010, BIER membership determined the benchmarking process was sufficiently mature to share results with external stakeholders in support of the Transparency Principle of *World Class Water Stewardship in the Beverage Industry 2010: Water Efficiency and Beyond*[1].

In 2010, each of the 16 member enterprises submitted three years (2007, 2008, 2009) of facility-specific data, as described in Table 1. At a minimum, all enterprises provided facility-specific data for total water use, total beverage production, facility type and location. The basis for efficiency analysis is the water use ratio, which describes how efficiently a facility uses water for beverage production. The Global Corporate Consultancy of Antea™Group, a third-party consultant, has managed the annual study since its inception, including data collection, analysis, verification and reporting.

For the purposes of this study, four types of beverage production facilities were identified: bottling, brewery, distillery and winery. While all water uses at these facility types (including water used for employee services, on-site landscaping, etc.) were included, non-manufacturing facilities, such as office buildings and warehouses, were excluded from the study. Facility type was determined by the primary process conducted at each facility. Bottling facilities were assigned additional sub-categories based on product mix to account for the various product types processed at bottling facilities. All facilities reported a beverage product mix, or a percentage breakdown of the different beverage types produced at each facility (Table 1). Characteristics of each facility and beverage type are further explained in the following sections.

[1] *World Class Water Stewardship in the Beverage Industry 2010: Water Efficiency and Beyond*, Beverage Industry Environmental Roundtable, November 2010.

Table 1: Quantitative Facility-Level Data Set

- **Total Water Use (kL):** all water used by the facility (including bottling and industrial water) from all sources used for activities as identified below:

Includes water used for:	Excludes water used for:
- Facility-level beverage production and packaging (accounts for water contained in product)	- Return water (underground water returned to the aquifer, recharge area, or natural drainage basin without significant modification).[2]
- Cleaning/sanitizing processes	- Concentrate, syrup or flavor production
- Cooling waters	- Agriculture
- Heating waters	- Production of raw materials (plastic, glass, etc)
- Sanitation	- Shipment of raw materials
- Landscaping	- Distribution of finished product
- Stormwater captured for aforementioned activities	- User consumption purposes (e.g. addition of ice cubes, spirits dilution, etc.)

- **Total Beverage Production (kL):** the volume of finished product generated at a facility or by a company. For facilities that produced alcoholic beverages, the actual volume (not scaled for alcohol content) of product was represented in the beverage production total.

- **Water Use Ratio (L/L)**: a calculated ratio of the total water consumption to total beverage production at each facility.

- **Facility Type:** designated as brewery, distillery, winery, or bottling based on primary process enacted at each facility.

- **Beverage Product Mix (%):** percentage breakdown of the different beverage types produced at each facility. For purposes of this study, nine beverage types were identified: beer, bottled water, carbonated soft drinks, distilled spirits (high-proof), distilled spirits (low proof), 100% juice, non-carbonated beverages, wine and other.

- **Facility location:** continent, nation, latitude and longitude.

[2] Return water use is most frequently associated with the bottled water industry. A constant flow is maintained for microbiological purposes; displaced water which does not enter the facility is returned to the watershed as defined above. Other industries with a similar arrangement for private water resources may also exclude return water from their total water use.

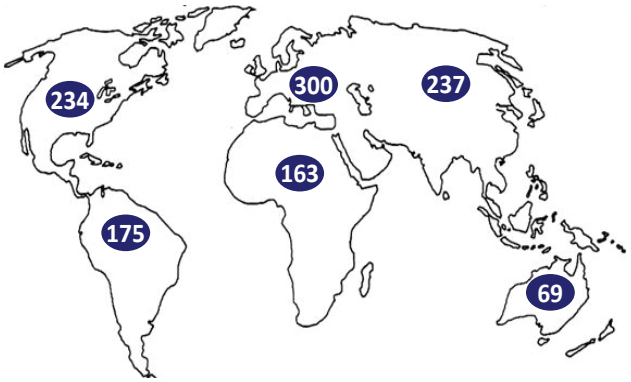
BIER members determined that benchmarking would focus on the manufacturing and packaging sections of the value chain only, as upstream and downstream processes vary dramatically between the four beverage types. As noted in Table 1, water used in upstream processes such as agriculture (water used to grow ingredients), production of flavors or concentrates, and production of other raw materials (e.g., plastics, metals, etc.) was not included in water use totals. Similarly, water used in downstream processes such as distribution of finished product was not included in water use totals. Upstream and downstream processes are addressed under Principle VI of *World Class Water Stewardship in the Beverage Industry*. It should be noted that water contained in the final beverage product *was* included in water use totals and beverage production totals. However, any water added to finished product by users as ice or to dilute product was excluded. Further information on the processes included in water use is defined for each facility type.

Enterprises were also asked to submit supplemental process information for their distillery, brewery and winery facilities. Process-specific information such as package type, pasteurization type, and alcohol content was collected to evaluate trends observed during data analysis.

2010 Water Stewardship Benchmarking Results

The 2010 study was the most robust report to date, with over 1,500 facilities spread throughout six continents reporting data into the study. However, to maintain consistency in data evaluation, only facilities which reported data in each of the three study years were included in these analyses. Due to acquisitions, divestitures, site openings and closures, or gaps in data reporting; this results in a data set of 1,178 facilities for detailed analysis (Figure 1).

Figure 1: Continent Facility Representation (# of Facilities)

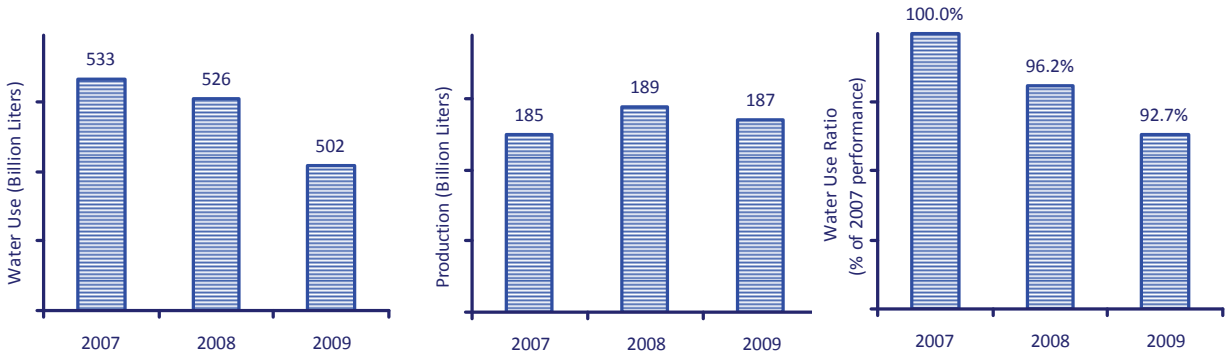


Analyses were conducted to determine industry water use, production, and water use ratio over the three year period. As seen in Figure 2 below, industry aggregate water use ratio improved by 7 percent from 2007 to 2009. Aggregate beverage production remained relatively stable, increasing 1 percent from 2007 to 2009. Industry aggregate water use decreased approximately 6 percent from 2007 to 2009. By improving water efficiency, the industry avoided the use of approximately 19 billion liters of water in 2009, enough water to supply the average daily water use for the entire population of the United Kingdom for two days.

Further analysis was performed on each of the four facility types to identify trends in water use. Facility types, general process steps, and associated water use ratio trends are described in the next section. Annual water use benchmarking has revealed the unique processes that use water at each facility type and the many variances between facility processes within the same facility types. BIER recognizes that it is impossible to compare water use ratios across

different facility types or with other consumer goods industries because of these unique processes. Similarly, BIER abstains from "ranking" facility efficiency within beverage types in consideration of the unique characteristics of individual facilities.

Figure 2: Industry Trends in Water Use, Production, and Water Use Ratio Improvement



Bottling

For the purposes of the benchmarking study, bottling facilities were defined as locations where concentrate, syrup, flavors/infusions, and/or bulk alcohol are blended with water and packaged into various container types. Bottling facilities also encompass facilities which receive finished bulk product (such as completely brewed beer or matured whiskey). No fermenting or distilling processes are conducted at bottling facilities. All nine beverage categories were represented in this facility type (Table 1).

Bottling represented the largest data set of the study, with bottling facilities accounting for 82 percent (by volume) of the industry data set. Bottling facilities generally use the least amount of water to make a liter of product, since there are fewer water-intensive processes as compared to other beverage types (e.g. cooking, fermenting and distilling). However, bottling facilities typically package a mix of several different products and beverage types; 29 percent of these facilities had a beverage product mix of more than one type of beverage. If a facility manufactures more than one product, water is used during rinse cycles to switch between products. Water used for rinse cycles and sanitization is a known driver of water use.

The bottling facility data set included a range of beverage types, processes, and production volume. This article focuses on the two largest subgroups within the bottling data set: Carbonated Soft Drinks and Bottled Water.

Carbonated Soft Drinks

Carbonated soft drinks are defined as non-alcoholic, flavored carbonated beverages. This category includes colas, ginger ales, and seltzers but excludes non-carbonated beverages such as ready to drink teas, coffees, fitness drinks, energy drinks, and juice drinks. Facilities included in this subgroup reported a beverage production mix (percentage of each type of beverage produced at the facility, totaling to 100) of 50 percent or more carbonated soft drinks. Figure 3 shows the boundaries of the operations where water use was included in the benchmarking report.[3]

In 2010, 687 carbonated soft drink bottling facilities submitted three years of data for the benchmarking study. Carbonated soft drinks were the most well represented subgroup with facilities located on six continents. This subgroup also contained some of the largest facilities by production volume in the entire study.

Of the 687carbonated soft drink bottling sites, 64 percent showed an improvement in water use ratio from 2007 to 2009. As seen in Figure 4[4], the overall carbonated soft drink subset water use ratio showed a 3 percent improvement from 2007 to 2009. Facilities with a beverage product mix of 100 percent carbonated soft drinks (523 facilities) showed a similar improvement of 4 percent from 2007 to 2009.

Figure 3: Process Map, Carbonated Soft Drinks

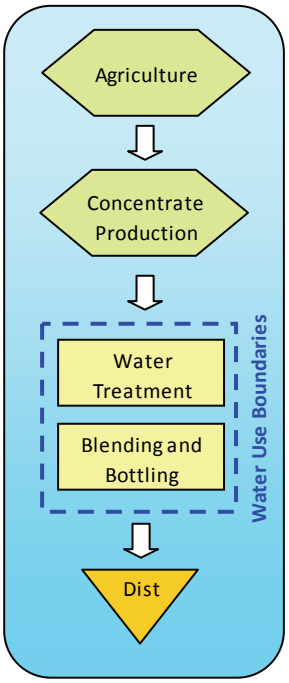
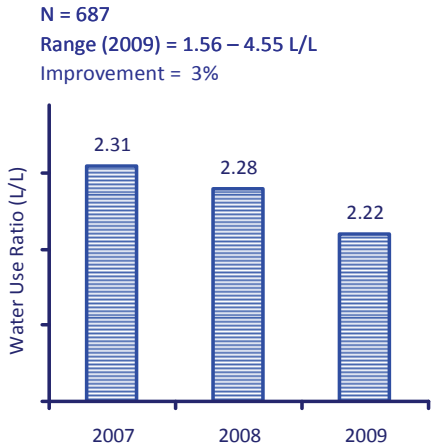


Figure 4: Carbonated Soft Drinks Performance

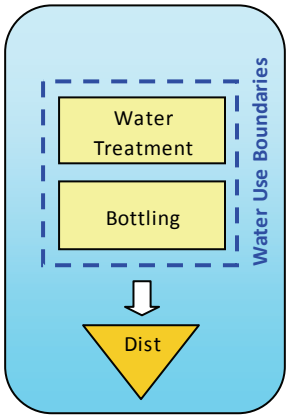


[3] For all subsequent figures, the following criteria apply: blue dashed box identifies process steps included in benchmarking.
[4] For all subsequent graphs, the following criteria apply: "water use ratio" represents a volume-weighted mean. "Range" refers to the middle 80 percent of the 2009 data set. "Improvement" refers to the percent change in water use ratio from 2007 to 2009.

Bottled Water

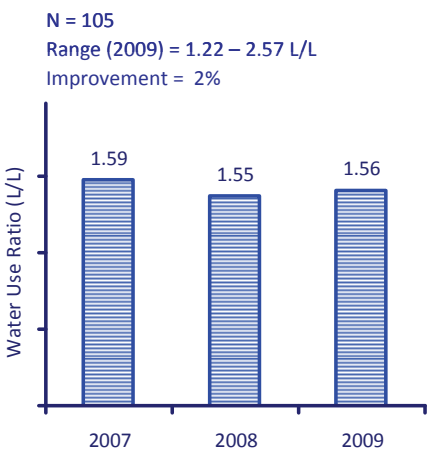
Bottled water is defined as all unflavored bottled waters including spring water, purified water (produced by distillation, deionization, reverse osmosis or other processes), mineral water, sparkling bottled water or well water. The study process data sheets offered three choices for specifying bottled water mix: spring water, natural water or mineral water. For the purposes of this article, data is presented for facilities that had a beverage product mix of 50 percent or more of any bottled water type. As seen in Figure 5, benchmarking accounts for water treatment (as applicable) and bottling processes.

Figure 5: Process Map, Bottled Water



In 2010, 105 bottled water facilities submitted three years of data for the benchmarking study, or 14 percent (by volume) of the bottling facility data set. As seen in Figure 6, the water use ratio range reported in this subgroup had the smallest range of all subgroups.

Figure 6: Bottled Water Performance

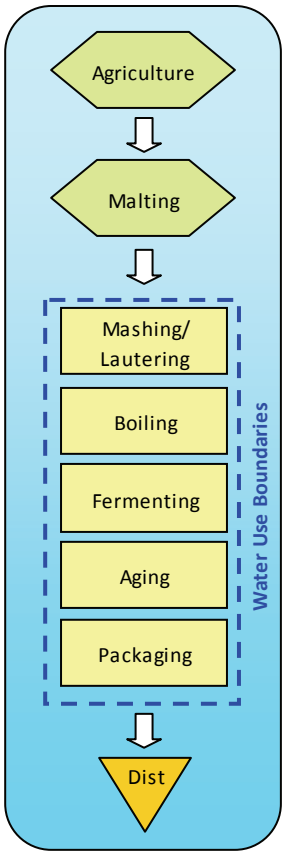


Of these 105 sites, 60 percent showed an improvement in water use ratio from 2007 to 2009. The overall bottled water subgroup water use ratio showed a 2 percent improvement from 2007 to 2009. Facilities with a beverage product mix of 100 percent bottled water (62 facilities) showed a similar water use improvement of 4 percent from 2007 to 2009.

Brewery

For the purposes of the benchmarking study, a brewery was defined as a facility conducting all processes after the malting process to produce beer (mashing/lautering, boiling, fermenting, aging, and packaging). All breweries in this study also conducted bottling operations on site; a small number also shipped product off site in bulk containers to a separate bottling facility. Breweries may have also produced other beverages (carbonated soft drinks, bottled water) in addition to beer, but in all cases, the majority of beverage product mix was beer. Brewery (beer only) facilities accounted for 16 percent (by volume) of the industry data set, the second largest facility type of the study. As seen in Figure 7, benchmarking accounted for all process steps except for upstream agricultural growth, malting and distribution of finished product.

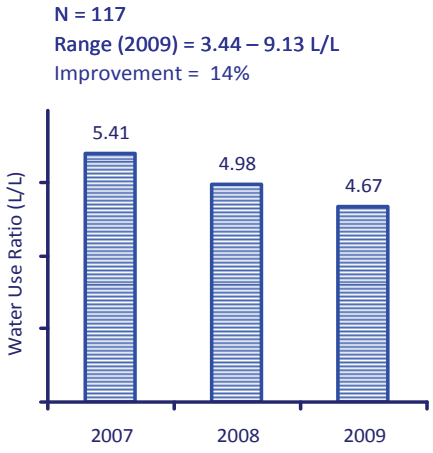
Figure 7: Process Map, Brewery



In 2010, a total of 142 breweries submitted three years of data for the benchmarking study. Of these breweries, 117 manufactured beer only, while 25 facilities produced other beverages in addition to beer. Figure 8 presents the water use ratios of the 117 facilities that produced beer only. The range in water use ratios observed in the brewery data set can be attributed to several factors, including:

- Breweries that package the majority of their product in small package configurations (such as 12oz or 33cL bottles and cans) typically use more water than a facility which packages a majority of product in large format containers (such as kegs).
- Within larger facilities, there was less variation in water use ratio. Facilities with a 2009 production volume greater than 1,000,000 kiloliters reported water use ratios below 5.0 L/L. Additionally, these facilities demonstrated a 19 percent improvement in water use ratio from 2007 to 2009.

Figure 8: Brewery Performance

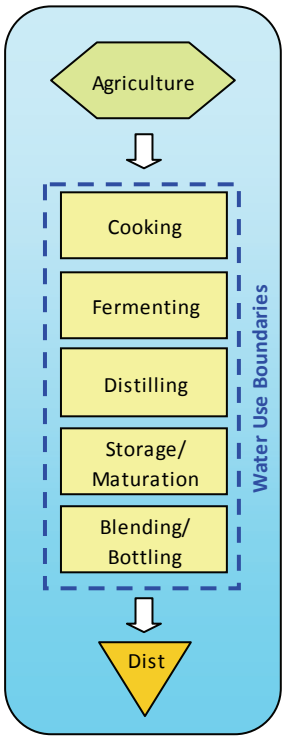


Of these 117 breweries, 70 percent showed an improvement in water use ratio from 2007 to 2009. The overall data set water use ratio improved 14 percent from 2007 to 2009, the greatest improvement in the study.

Distillery

For the purposes of the benchmarking study, a distillery was defined as any facility that takes agricultural inputs (grains, agave, molasses, etc.) and conducts processes (cooking, fermenting, distilling and storage/maturation) to make bulk alcohol. Production volume at distilleries is reported as "wine liters," or the bulk volume of alcohol produced at the facility independent of alcohol content. As seen in Figure 9, benchmarking did not account for upstream agricultural processes or distribution of finished product. Approximately one-quarter of reporting facilities also gauged and packed product on site; however, based on a statistical analysis, there was no discernible trend of water use ratios at these locations compared to those which shipped product off site for blending and bottling.

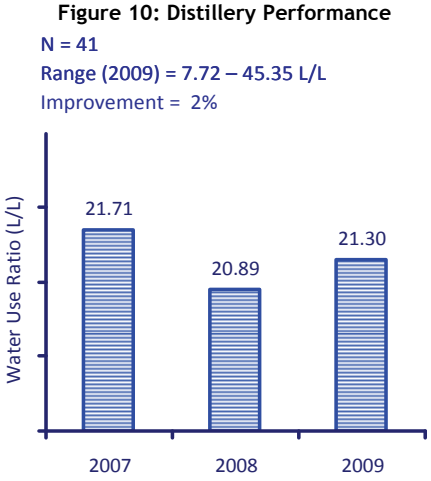
Figure 9: Process Map, Distillery



Similar to bottling facilities, distilleries produce a wide variety of products, each of which can require a different number of manufacturing processes that can impact the total water use at the facility, including differences in the distillation process itself. Additionally, facilities that produce a single product or product-type experience lower water use ratios due to reduced cleaning requirements than those facilities that produce more than one type of spirit. Distillery production processes varied by type of spirit manufactured and by each facility and enterprise. Similarly, facilities that produce one type of product would use less water for cleaning between cycles.

Alcohol content is also a driver for water use ratio in distilleries. The spirits that result from the distilling process have a range of alcohol content; a lower proof spirit has more water in the final beverage product than a high proof spirit. Additionally, due to transportation regulations and proximity to the bottling facility, some products are partially blended to a lower proof at the distillery.

Figure 10: Distillery Performance



In 2010, 41 distilleries provided three years of data. As seen in Figure 10, distilleries had the greatest water use ratio range in the industry data set. One of the main drivers for this range was the extensive cooling water requirements of distilleries. The type of cooling water system is one of largest drivers of water use. For example, a once-through cooling water system which draws from a surface water body typically uses more water than either an open recirculating or a closed loop cooling system.

Of these 41 facilities, 54 percent improved their water use ratio from 2007 to 2009. The overall distillery data set showed an improvement of 2 percent from 2007 to 2009 – a smaller-scale improvement than other data sets.

Winery

For the purposes of the benchmarking study, the scope of winery processes included the crushing and pressing of grapes, fermentation, storage/aging and bottling of product. As seen in Figure 11, water used for agriculture, including crop irrigation, was not included in total water use data. Water used for concentrate production and distribution also was not included in benchmarking. Only some facilities included the blending and bottling process in benchmarking data.

Wineries represented the smallest data set, with 37 facilities reporting three years of data in 2010, accounting for less than 1 percent (by volume) of the industry data set. Like distilleries, wineries also had a large range of water use ratios among facilities, which was the result of various facility sizes, type of inputs used (concentrated juice, grapes or both), and the type/blend of product (red, white or sparkling wine).

Of these 37 facilities, 59 percent improved their water use ratio from 2007 to 2009. The overall winery data set showed an improvement of 4 percent from 2007 to 2009, which similar to distilleries, is likely attributed to a range of water use ratios and facility production volumes throughout the data set.

Wineries were the only facility type where the year to year change in production volume at individual facilities showed a statistically significant correlation to a change in water use ratio. This was most notable from 2008 to 2009, when the aggregate production of wineries in the data set decreased 13 percent, and water use ratio increased 5 percent. This indicated that the size (or production volume) of a winery is a factor in determining its water use ratio.

Figure 11: Process Map, Winery

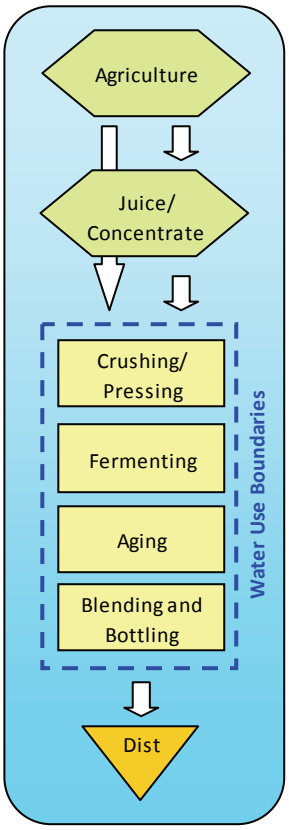
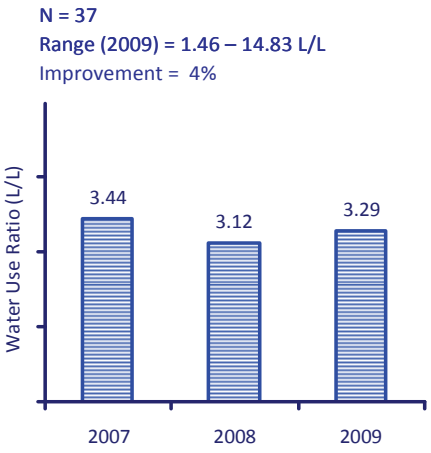


Figure 12: Winery Performance



Water Use Efficiency Drivers

Water use ratios vary in the beverage industry due to availability of advanced technology, packaging requirements for different beverage types, and general company practices. BIER has identified some of the following water use drivers through four cycles of water use benchmarking and best practice sharing:

- **Process Automation and Efficiency:** Facilities with newer equipment often report lower water use ratios. Automated processes, where water use is more closely controlled and regulated, will also result in water use efficiency and improvement.

- **Number of Unique Products:** Facilities that produce more than one unique product (e.g. different brews of beer, types of soft drink, etc) will require additional water use for cleaning of equipment between products.

- **Use of Returnable Containers:** Returnable container use is known to be a driver of higher water use ratios, as the bottle washing and sterilization process is water intensive.

- **Use of Non-returnable Containers:** Rinsing practices associated with non-returnable containers represent another potential source of water use at beverage facilities. However, new applications in non-returnable bottle use, such as air rinsing and improved controls on bottle production, reduce the need for water rinse.

- **Water Recovery and Re-use:** Water recovery and re-use for non-product purposes can significantly reduce the total volume of water used by a facility. Water that is not suitable for product (e.g. treatment reject, rinse water, "used" cooling water, etc.) can be recovered and reused for irrigation, sanitary water supply, line lubrication, facilities maintenance, cooling/heating water, or other cleaning purposes.

- **Clean-in-place Technology:** Commercial beverage manufacturing operations use automated clean-in-place technologies to sanitize process lines and tanks to preserve product quality. Automated controls of chemical concentration, cycle duration, system temperature, and mechanical flow/system pressure can be modified and regulated to efficiently clean equipment with less water and fewer downtime periods.

- **Facility Water Efficiency Efforts:** Most BIER members publically report sustainability data, including annual water use ratio (or similar value) and long-term conservation goals. Dedicated enterprise and facility-level efficiency management systems (establishing key performance indicators, clear targets, accountability for targets, monitoring, monthly reporting, etc) establish a culture of water conservation are significant drivers of water use ratio improvement.

Next Steps

Through four years of water use benchmarking, BIER has collected a robust data set to share trends and figures with external stakeholders. The 2010 study identified an overall improvement in industry-wide water use ratio and within the four main facility types. Through analysis of process data and practice sharing, BIER is able to present some best practices and process drivers that have reduced water use in manufacturing processes. BIER plans to work with member enterprises to continue the annual water use benchmark and improve the quality and depth of data collected. Acknowledging the importance of transparency, BIER plans to publish select results of the benchmarking study to external stakeholders on an annual basis.

About the Beverage Industry Environmental Roundtable

BIER is a technical coalition of leading global beverage companies working together to advance the standing of the beverage industry in the realm of environmental stewardship (Table 2). Since 2006, BIER has combined resources and expertise to develop a common framework for stewardship, share best management practices, and inform public policy related to three core focus areas: Water Stewardship, Energy and Climate Change, and Stakeholder Engagement.

Following the core focus of water stewardship, BIER developed six principles of *World Class Water Stewardship in the Beverage Industry* (Table 3). [5] Annual water use benchmarking supports Principle II, and is designed to collect quantitative facility-level metrics data, as well as supplemental process information to support data trends.

Table 2: 2011 BIER Membership

Member Enterprises	
Anheuser-Busch InBev	Heineken
Bacardi	MillerCoors
Beam Global Spirits and Wine	Molson Coors
Brown-Forman	Nestlé Waters North America
Carlsberg Group	New Belgium Brewing Company
The Coca-Cola Company	Ocean Spray Cranberries
Groupe Danone	Pernod Ricard
Diageo	PepsiCo

Trade Members
American Beverage Association
Diversey
Ecolab

BIER's water stewardship agenda is not limited to the water use and efficiency benchmarking effort; BIER members also share best management practices, and perform quantitative benchmarking related to qualitative elements of the leadership principles. Additionally, BIER is currently preparing a guidance document for water footprinting to support water stewardship throughout the supply chain. For more information about BIER, please visit www.bieroundtable.com or contact info@bieroundtable.com.

[5] *World Class Water Stewardship in the Beverage Industry 2010: Water Efficiency and Beyond*, Beverage Industry Environmental Roundtable, November 2010.

Table 3: Six Principles of World Class Water Stewardship in the Beverage Industry
Leaders **Act** with the understanding that: I. Water is a finite and shared resource II. Continuous improvement of water efficiency is fundamental to operational excellence
Leaders **Engage and Communicate** with the understanding that: III. Community engagement is essential for sustained solutions IV. Partnerships lead to more effective water management V. Open and honest communications define transparency
Leaders **Work to Influence** with the understanding that: VI. Responsibility for water stewardship extends throughout the value chain