Beverage Industry Continues to Drive Improvement in Water and Energy Use

Beverage Industry Environmental Roundtable

2013 Trends and Observations

BEVERAGE INDUSTRY ENVIRONMENTAL ROUNDTABLE

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In its seventh year of benchmarking, the Beverage Industry Environmental Roundtable (BIER) recognized a number of key insights pointing to continued efforts on the part of the beverage industry to improve water and energy usage. The study experienced record growth, with participation from over 1,700 facilities representing 18 member beverage companies across six continents. As a whole, industry absolute water and energy use has decreased year to year as production has increased – a continuation of trends observed in previous BIER studies. Over the most recent three year study period, water use ratio decreases were reported by 70 percent of facilities and energy use ratios decreased for 66 percent of facilities. The industry has also seen a decreasing trend in water and energy use ratios for the four main facility types (brewery, distillery, winery, and bottling plants). Finally, the industry is achieving water use ratio improvement at facilities located in areas of water stress, and areas expected to increase water stress by 2025.

The bases for the analyses are the water use ratio and energy use ratio, which are broad indicators of how efficiently a facility uses water and energy for beverage production.

Since 2007, BIER has used an annual quantitative benchmarking study to evaluate water use and strengthen the understanding and practice of water stewardship in the beverage industry. Adding to this knowledge, in 2012 BIER conducted the first energy use benchmarking study to provide insight into energy use efficiencies within the beverage industry and pave the way for future evaluation of greenhouse gas performance. From these ongoing studies, it is clear that the beverage industry is making genuine strides towards utilizing water and energy more efficiently – each year of the study demonstrates a three-year decreasing trend in water and energy use ratios, coupled with increases in production over the same period. The studies also illustrate the clear concern and proactive approach these leading companies are taking to improve business practices and diminish environmental impacts.

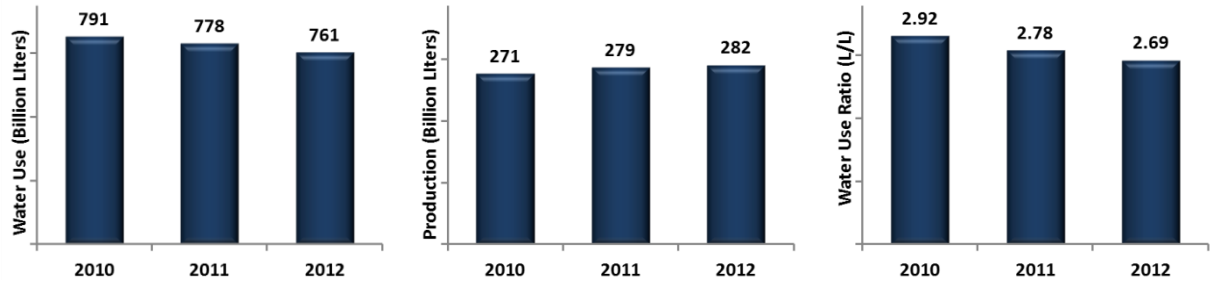
This article will present results of the 2013 annual water and energy benchmarking studies, revealing an improvement in the beverage industry's water and energy use ratios. Information on methodology and key definitions underpinning the study is presented at the end of the article.

2013 Water and Energy Benchmarking Results

Each year, the industry dataset continues to grow in size, with 2013 representing the most robust data set to date, including over 1,700 facilities distributed across six continents. To maintain consistency in data evaluation, however, only facilities which reported data in each of the three study years (2010, 2011, and 2012) were included in the subsequent analyses. It is important note that the benchmark represents an **amended data set** – facilities were permitted to submit revisions for 2010 and 2011 data, and facilities are added or removed based on acquisitions and divestitures within the individual participant companies.

Analyses were conducted to determine industry water use, production, and water use ratio over the three year period (from 2010 to 2012). As seen in Figure 1, total industry water use decreased 4 percent and total production increased 4 percent over the study period. Approximately 70 percent of facilities improved their water use ratio from 2010 to 2012.

Figure 1: Industry Trends in Water Use, Production, and Water Use Ratio



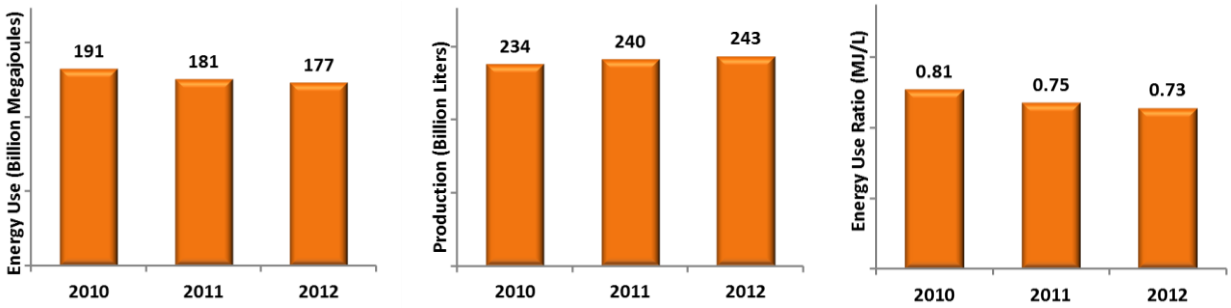
Water use ratio decreased from 2.92 L/L to 2.69 L/L, or 8 percent over the study period. The improvement in water efficiency over the study period corresponds to industry-wide[1] water use avoidance of approximately 65 billion liters in 2012, enough water to fill New York's Empire State Building 62 times[2].

Figure 2 on the following page summarizes the three year trend for energy use, production, and energy use ratio. Energy use across the fixed data set decreased 7 percent, while at the same time beverage production increased 4 percent. The corresponding industry-wide volume-weighted energy use ratio decreased 10 percent over the study period, from 0.81 to 0.73 MJ/L. Approximately 66 percent of facilities improved their energy use ratio from 2010 to 2012.

By improving water use efficiency, the industry avoided the use of approximately 65 billion liters of water in 2012 – enough water to fill New York's Empire State Building 62 times.

[1] "Industry-wide" is a collective term for the beverage industry, in this case defined by the eighteen BIER participant companies.
[2] Empire State Building Fact Sheet 2013 - http://www.esbnyc.com/

Figure 2: Industry Trends in Energy Use, Production, and Energy Use Ratio



Industry absolute total water and energy use decreased with a growth in production[3] over the three year period – this demonstrates positive results from process optimization and efficiency focus on the part of all beverage companies. Additionally, 52 percent of facilities reporting a decrease in energy use ratio also reported a decrease in water use ratio from 2010 to 2012. BIER will seek opportunities to further evaluate drivers that affect both water and energy performance in future studies.

Further analysis was performed on each of the four facility types to identify specific trends in water and energy use. Facility types, general process steps, and associated ratio trends are described in the next sections.

Bottling

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 ten beverage type categories[4] were represented among bottling facilities.

Bottling represented the largest data set of the study, with bottling facilities accounting for 68 percent (by volume) of the overall industry data set. Bottling facilities generally use the least amount of water and energy to make a liter of product, since there are fewer water- and energy-intensive processes as compared to other facility types (e.g. brewery, distillery, and winery). The bottling facility data set included a range of beverage types, processes, and production volume. For the purposes of this article, we will focus on the two largest sub-groups within the bottling data set: Carbonated Soft Drinks and Bottled Water.

Water and Energy Use Ratio Drivers for Bottling Facilities Include:

- *Use of refillable containers*
- *Presence of on-site bottle blowing processes, pasteurization processes, and/or automated cleaning processes*
- *Varying water treatment methods*
- *Use of high efficiency equipment*
- *Number/type of products*
- *Prevalence of on-site refrigeration*

[3] Total production and facility count differs between water use and energy use, as some facilities that provided three full years of water use data were unable to provide three full years of data for energy use.

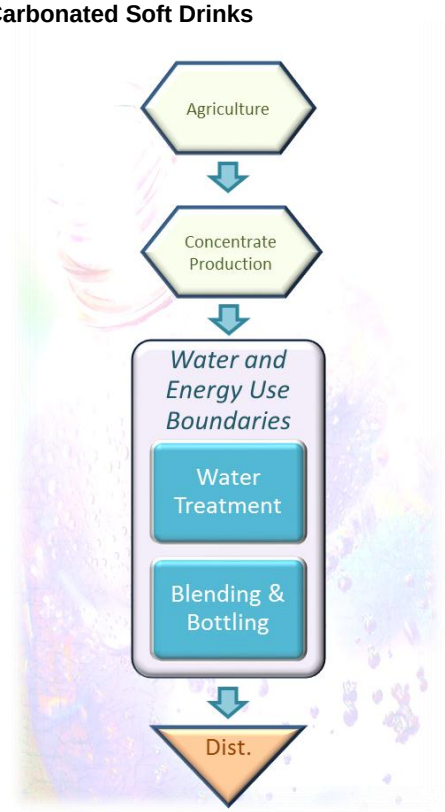
[4] See the Methodology section at the end of the article for descriptions of beverage type categories.

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 sub-group 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 and energy use was included in the benchmarking report.

Figure3: Process Map, Carbonated Soft Drinks



Carbonated soft drinks were the most well represented sub-group with facilities located on six continents. This sub-group also includes some of the largest facilities by production volume in the entire study.

Figures 4 and 5 demonstrate water and energy use ratio performance[5] for carbonated soft drink facilities. Water and energy use ratio decreased over the three year period and the majority of carbonated soft drink bottling facilities reported a decrease in water use ratio (69 percent) and a decrease in energy use ratio (65 percent) from 2010 to 2012. Of note, carbonated soft drink bottling facilities demonstrated the largest decrease in energy use ratio (12 percent) amongst other bottling subsets.

Figure 4: Carbonated Soft Drink Water Use Ratio Performance

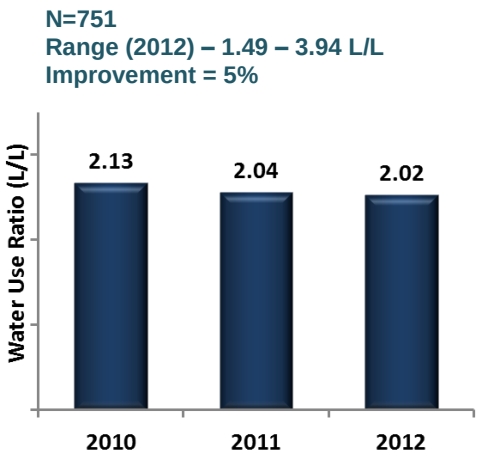
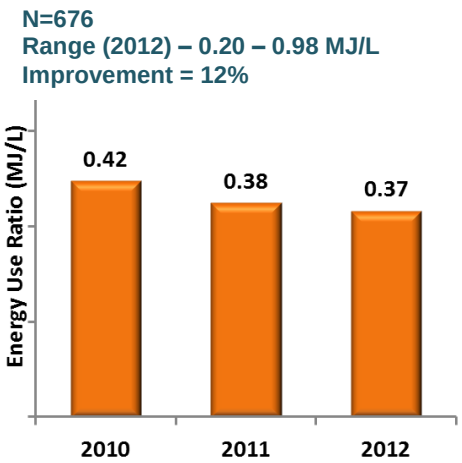


Figure 5: Carbonated Soft Drink Energy Use Ratio Performance



[5] For the purposes of this study, the following criteria apply: "water use ratio" and "energy use ratio" represent volume-weighted means; "range" refers to the middle 80 percent of the 2012 data set; and "improvement" refers to the percent change in water and energy use ratios from 2010 to 2012.

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.*

As seen illustrated in Figure 6, benchmarking accounts for water treatment (as applicable) and bottling processes, and also includes product water.

Figures 7 and 8 demonstrate water and energy use ratio performance for bottled water facilities. Water and energy use ratio decreased over the three year period; and the majority of bottled water facilities reported a decrease in water use ratio (56 percent) and energy use ratio (51 percent) from 2010 to 2012.

Figure 6: Process Map, Bottled Water

Figure 7: Bottled Water – Water Use Ratio Performance

N=146
Range (2012) – 1.19 – 2.18 L/L
Improvement = 2%

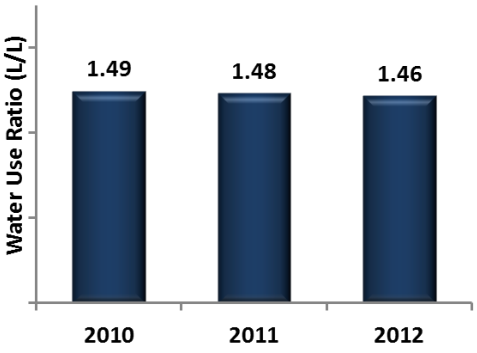
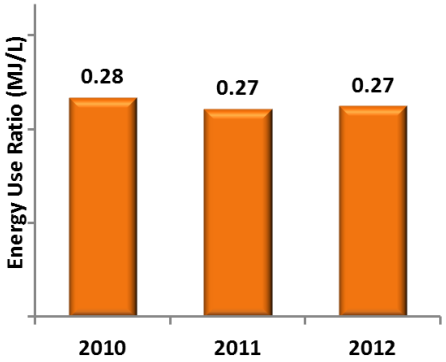


Figure 8: Bottled Water – Energy Use Ratio Performance

N=80
Range (2012) – 0.10 – 0.60 MJ/L
Improvement = 4%



Brewery

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 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 facilities accounted for over 31 percent (by volume) of the industry data set, the second largest facility type of the study. As seen in Figure 9, benchmarking accounted for all process steps except for upstream agricultural growth, malting and distribution of finished product.

Figures 10 and 11 present the water and energy use ratio performance of beer only breweries. Water and energy use ratio decreased over the three year period; and the majority of facilities decreased water use ratio (84 percent) and energy use ratio (77 percent) from 2010 to 2012.

Figure 9: Process Map, Brewery

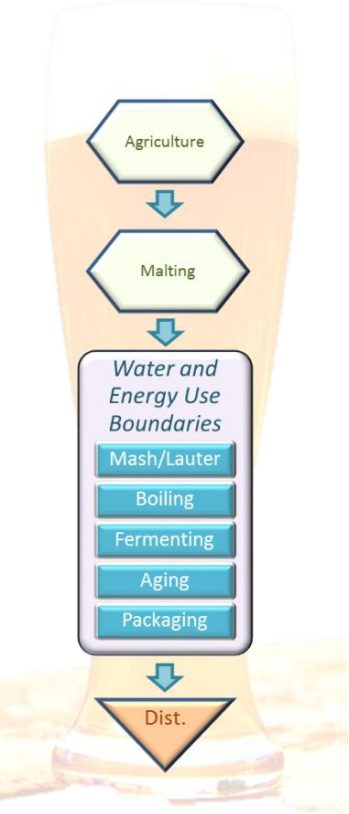


Figure 10: Brewery (Beer Only) Water Use Ratio Performance

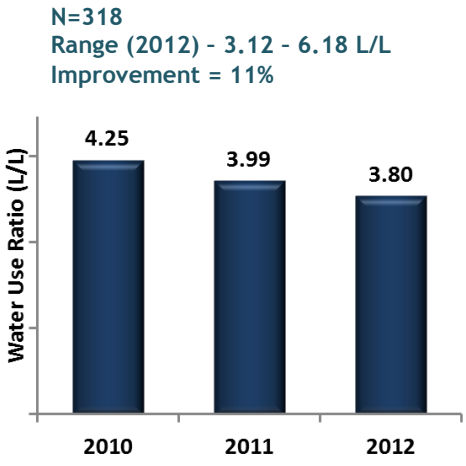
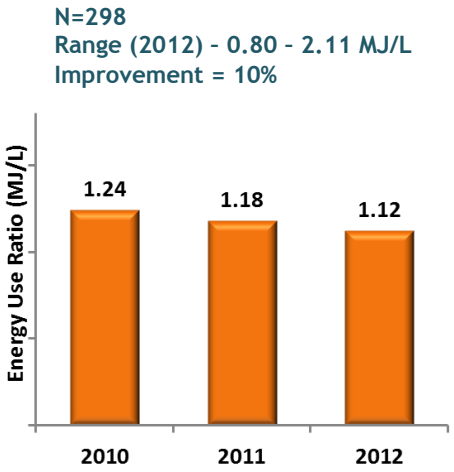


Figure 11: Brewery (Beer Only) Energy Use Ratio Performance



Water and Energy Use Ratio Drivers for Breweries Include:

- *Variation in brewing processes*
- *Level of cleaning process automation & use of high efficiency equipment*
- *Water use differences based on package type: small packaging (12 oz. bottles or cans) vs. larger or bulk packaging (kegs or tanks)*
- *Refillable container use*
- *Facility production volume (facilities with larger production volumes tend to report lower water and energy use ratios*
- *Pasteurization type (the average energy use ratio for facilities with tunnel pasteurization was greater than the ratio for facilities with flash pasteurization)*
- *Prevalence of on-site refrigeration*

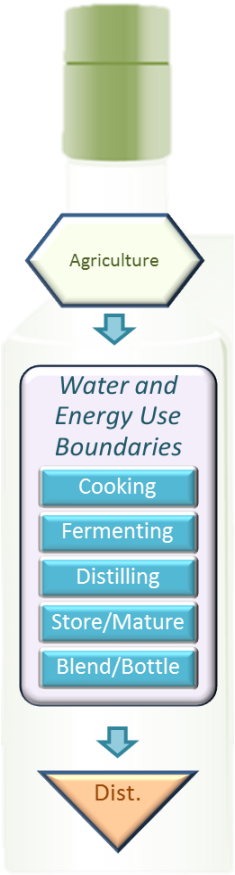
Distillery

A distillery was defined as:

> *Any facility that receives agricultural inputs (grains, agave, molasses, etc.) and conducts processes (cooking, fermenting, distilling and storage/maturation) to make bulk alcohol.*

Distilleries accounted for less than 1 percent (by volume) of the industry data set. Production volume at distilleries is reported as "wine liters", or the bulk volume of alcohol produced at the facility independent of alcohol content. The distillery data set includes facilities that included cooling water as part of total use and those who are unable to meter cooling water at this time.

Figure 12: Process Map, Distillery



Water and Energy Use Ratio Drivers for Distilleries Include:

- *Type/intensity of cooling water process*
- *Alcohol content and product mix*
- *Number and variety of products*
- *On-site bottling processes vs. offsite bulk shipment*
- *Prevalence of temperature control systems for storage and maturation*
- *Use of high efficiency equipment*
- *Byproduct management*

As illustrated in Figure 13 on the following page, 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: cooling water can constitute upwards of 46 percent of total water use. Different cooling water processes can also influence the magnitude of a water use ratio. 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. Additional drivers for water and energy use ratios are described in the call out box above.

Figures 13 and 14 present the water and energy use performance of distilleries. In general, water use ratio and energy use ratio decreased over the study period. The majority of facilities also reported a decrease in water use ratio (56 percent) and energy use ratio (66 percent) from 2010 to 2012.

Figure 13: Distillery Water Use Ratio Performance

N=84
Range (2012) – 13.27 – 129.62 L/L
Improvement = 3%

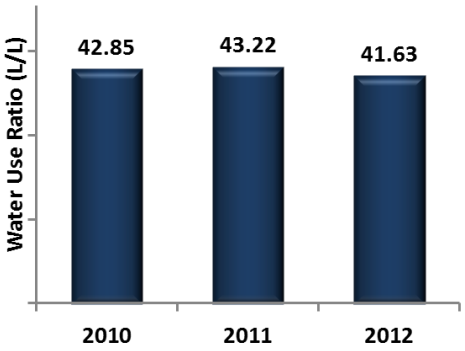
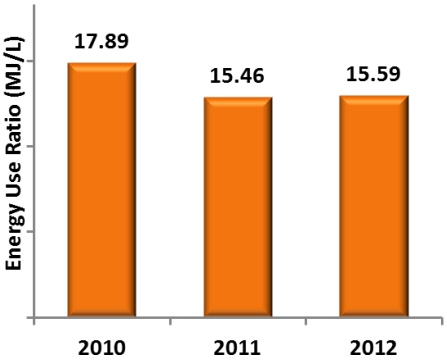


Figure 14: Distillery Energy Use Ratio Performance

N=74
Range (2012) – 8.84 – 30.31 MJ/L
Improvement = 13%



Winery

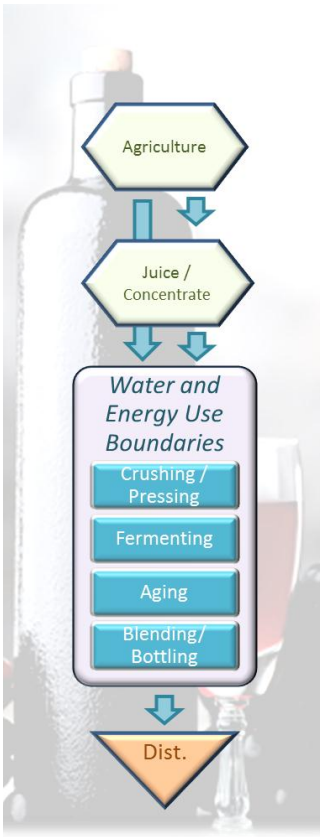
A winery is described as a facility where the scope of processes includes:

> *The crushing and pressing of grapes, fermentation, storage/aging and bottling of product.*

Water and Energy Use Ratio Drivers for Wineries Include:

- *Variations in the wine making process*
- *Types of inputs used (concentrated juice, grapes, both)*
- *Prevalence of temperature control for the aging process*
- *Use of high efficiency equipment*
- *Type/blend of product*

Figure 15: Process Map, Winery



Wineries accounted for less than 1 percent (by volume) of the industry data set. Wineries achieved the greatest improvements in water and energy use ratio of all facility types (see Figures 16 and 17 on the following page). Wineries increased production by 19 percent over the three year period, the first time a production increase has been reported for this data set since 2007. Water use and energy use both decreased over this period, demonstrating that efficiencies are being recognized at the facility level as production increases.

Figure 16: Winery Water Use Ratio Performance

N=25
Range (2012) – 2.17 – 14.61 L/L
Improvement = 20%

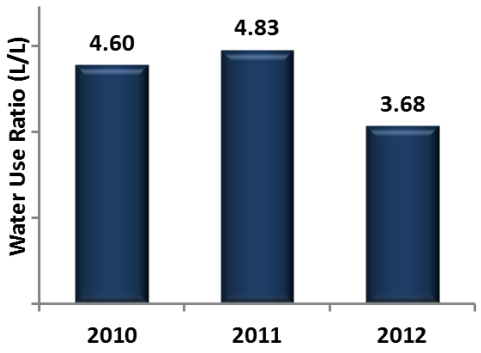
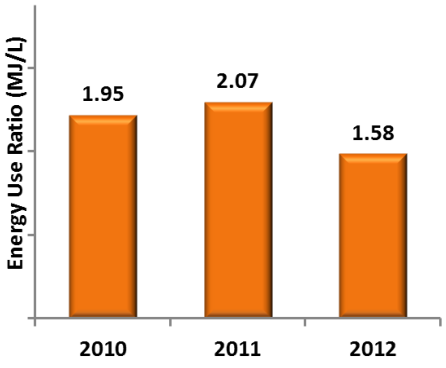


Figure 17: Winery Energy Use Ratio Performance

N=25
Range (2012) – 0.79 – 6.94 MJ/L
Improvement = 19%



Water Scarcity Evaluation

Beverage companies are acutely sensitive to water stress and scarcity issues and as such have looked closely at how they can reduce their demand and impacts in water scarce regions. Several BIER members have conducted water risk assessments at a facility level across their operations, and in 2012, BIER published *A Practical Perspective on Managing Water-Related Business Risks and Opportunities in the Beverage Sector* to share collective experience in proactively identifying, prioritizing, and managing water-related risks and opportunities. The 2013 report included an evaluation of water use relative to water scarce/water stressed geographies, using the World Business Council for Sustainable Development (WBCSD) Global Water Tool[6] and the World Resources Institute (WRI) Aqueduct Water Risk Atlas[7].

Figure 18: Facility WUR Improvement vs. Water Availability

Annual Renewable Water Supply per Person, 1995 (m3/person/year)	Number of Facilities	% Reporting WUR Improvement, 2010 - 2012
< 500	178	69%
500 - 1,000	176	71%
1,000 - 1,700	196	68%
1,700 - 4,000	325	72%
> 4,000	545	71%

WBCSD roughly defines water scarcity on the basis of annual renewable water supply per person[8], denoting five levels of availability as defined in Figure 18. Precise facility location data was available and used for water scarcity mapping for all of the 1,561 facilities reporting three full years of water use data to the study. Figure 18 presents an analysis of where efficiency improvements are being realized relative to general water scarcity indicator definitions of WBCSD. As seen in the figure, 178 facilities operate under extreme water scarcity and 176 facilities operate under water scarce conditions. These facilities comprise approximately 28 percent of the production volume

[6] World Business Council for Sustainable Development Global Water Tool (2012): http://www.wbcsd.org/web/watertool.htm
[7] World Resources Institute Aqueduct Water Risk Atlas (2011): http://insights.wri.org/aqueduct/atlas
[8] Annual Renewable Water Supply Per Person - Indicates the average annual renewable water supply per person for individual river basins as of 1995. http://www.wbcsd.org/web/gwt/GWT_Datasets_2011_Upgrade.pdf

represented by the facilities with available scarcity data. The majority of facilities in each water scarcity category reported an improvement in water use ratio from 2010 to 2012.

The WRI Aqueduct Water Risk Atlas tool provides an evaluation of baseline water stress (e.g., an indicator of the level of concern for freshwater availability) and projected change in water stress based on Intergovernmental Panel on Climate Change (IPCC) emissions scenarios. Figure 19 presents an analysis of where efficiency improvements are being realized relative to the projected 2025 water stress conditions based on IPCC Climate Change Scenario A1B. [9] The industry is making improvements in areas where stress is expected to increase in the next 12 years – 76 percent of facilities located in areas expected to increase stress demonstrated an improvement in water use ratio from 2010 to 2012.

Figure 19: Facility WUR Improvement vs. 2025 A1B Scenario

Projected Climate Change Scenario 2025 A1B	Number of Facilities	% Reporting WUR Improvement, 2010 - 2012
Exceptionally More Stressed	20	67%
Extremely More Stressed	255	79%
Severely More Stressed	196	72%
Moderately More Stressed	56	71%
Drier but still Low Stress	87	84%
Near Normal Conditions	421	64%

Benchmarking Next Steps

Since the first benchmarking study in 2007, BIER has gained exceptional insight into process drivers, performance trends and figures that members continue to share with stakeholders and peers. The benchmarking study has provided value to members as a means to assess performance amongst peers and a basis for target setting at a facility level - adding an energy use component to the benchmarking study has further enhanced this value.

The 2013 study identified an overall improvement in water and energy use ratios at an industry level and at each of the four main facility types. Absolute water and energy use decreased as production steadily increased from 2010 to 2012, demonstrating that process efficiencies are being recognized as production volumes continue to grow. BIER members have also increased their focus on water stress, and demonstrated significant water use improvements at operations in water scarce areas and areas that are forecasted to be more stressed in the near future.

Actions planned for the 2014 benchmarking study include:

- Enhanced supplemental process questions to further evaluate efficiency drivers for water (e.g. cooling processes), energy (e.g. on-site bottle blowing), and both water and energy (e.g., use of refillable containers).
- Further evaluation of water and energy use ratios as they relate to product mix; and,

[9] IPCC Scenario A1B – a realistic projection of the future incorporating rapid economic growth, population growth that peaks mid-century, and introduction of efficient energy technologies that are balanced across all energy sources (e.g. not reliant on just one energy source, like fossil fuels). WRI Aqueduct Drought Severity Interpretive Guidelines (2011): http://docs.wri.org/aqueduct/freshwater_sustainability_analyses.pdf

- Additional analysis of performance in water risk areas based on publically-available scarcity information (e.g., WRI Aqueduct information on physical and regulatory/reputational risk) to support BIER's heightened interest in context-based metrics.

Acknowledging the importance of transparency, BIER plans to continue publishing results of the benchmarking study to external stakeholders on an annual basis.

Benchmarking Methodology / Facility Level Data Set

To establish the data set, each of the 18 member companies submitted three years (2010, 2011, 2012) of facility-specific data as described below:

- **Total Water Usage (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) - Cleaning/sanitizing processes - Cooling waters - Heating waters - Sanitation - Landscaping - Stormwater captured for aforementioned activities	- Return water (underground water returned to the aquifer, recharge area, or natural drainage basin without significant modification).[10] - Concentrate, syrup or flavor production - Agriculture - Production of raw materials (plastic, glass, etc.) - Shipment of raw materials - Distribution of finished product - User consumption purposes (e.g. addition of ice cubes, spirits dilution, etc.) -

- **Total Energy Use (MJ):** All energy consumed on site from all sources used for activities including but not limited to: facility operation, beverage production, cleaning/sanitizing processes, bottling processes, pasteurization, cooling, sanitation, etc. Energy use includes purchased/sourced energy from off-site sources including on-site power generation; but does not include energy combined through heat and power systems to avoid double-counting. The study details energy quantities derived from the billing point ("fence line") and from use of renewable energy sources located on site. Energy used within the value chain (e.g., energy use for agriculture, off-site bottle blowing, distribution of product, customer refrigeration) is not included in total energy use.

- **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 of product (not scaled for alcohol content) was represented in the beverage production total.

[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.

- **Water Use Ratio (L/L)**: a calculated ratio of the total water usage to total beverage production at each facility.
- **Energy Use Ratio (MJ/L):** a calculated ratio of the total energy usage 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, ten beverage types were identified: beer, bottled water, carbonated soft drinks, distilled spirits (high-proof), distilled spirits (low proof), juice – not from concentrate, juice from concentrate, non-carbonated beverages, wine and other.
- **Facility location:** continent, nation, latitude and longitude.

Participants also submitted supplemental process information for their facilities (e.g., package type, cooling water use, pasteurization type) to evaluate trends observed during data analysis.

The bases for the analyses are the water use ratio and energy use ratio, which are broad indicators of how efficiently a facility uses water and energy for beverage production. The annual study, including data collection, analysis, verification, and reporting, has been managed by Antea®Group, a third-party consultant, since the study's inception.

For the purposes of this study, four types of beverage production facilities were identified: bottling, brewery, distillery and winery. While all water and energy uses at these facility types (including water and energy 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. Further, bottling facilities were broken down into 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.

BEVERAGE INDUSTRY ENVIRONMENTAL ROUNDTABLE

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About the Beverage Industry Environmental Roundtable

The core mission of Beverage Industry Environmental Roundtable (BIER) is to advance the sector's environmental sustainability by developing industry-specific methods and data. In other words, we seek to create tools and methodologies that accelerate sustainability and its journey from analysis to action.

BIER is a technical coalition of leading global beverage companies working together to advance environmental sustainability within the beverage sector. Formed in 2006, BIER aims to accelerate sector change and create meaningful impact on environmental sustainability matters. Through development and sharing of industry-specific analytical methods, best practice sharing, and direct stakeholder engagement, BIER accelerates the process of analysis to sustainable solution development.

BIER developed six principles of *World Class Water Stewardship in the Beverage Industry* to help guide the beverage sector in pursuit of excellence in water stewardship. Annual water use benchmarking supports Principle II and is designed to allow for the measurement of water use-reduction efforts.

Additionally, recent BIER accomplishments include: the development of "Beverage Industry Sector Guidance for Greenhouse Gas Reporting", "A Practical Perspective on Water Accounting in the Beverage Sector", "Impacts and Dependencies of the Beverage Sector on Biodiversity and Ecosystem Services: An Introduction", Beverage Category Greenhouse Gas Modeling, 7th Annual Water Stewardship Benchmarking Study, 2nd Annual Energy Benchmarking Study, "A Practical Perspective on Managing Water-Related Business Risks and Opportunities in the Beverage Sector", and dialogue initiatives with several trade, NGO and customer organizations.

BIER is facilitated by Antea®Group, a third-party engineering and environmental consulting firm (Link).