

CURB THE THIRST

Efficacy of Bottled Water Bans in Reducing Plastic Waste

ELIZABETH MARY D'ALTRUI

OVER THE PAST DECADE, DRINKING PLASTIC BOTTLED WATER HAS BECOME INCREASINGLY POPULAR. AS THE DEMAND FOR BOTTLED WATER HAS INCREASED, THE DAMAGING EFFECTS OF UN-RECYCLED PLASTICS AND THE POLLUTION CREATED IN THE MAKING OF THE PLASTIC BOTTLES HAVE GREATLY HARMED THE PLANET. MANY POLICYMAKERS HAVE SOUGHT NEW WAYS TO AVOID THIS PROBLEM. ONE OPTION HAS BEEN TO COMPLETELY BAN THE SALE OF SINGLE-USE PLASTIC WATER BOTTLES IN SOME CITIES AND ON SOME COLLEGE CAMPUSES. TO ILLUSTRATE THE EFFECTIVENESS OF THE BAN OF PLASTIC WATER BOTTLES, THIS ARTICLE WILL EXAMINE TWO CASE STUDIES: UNIVERSITY OF VERMONT AND WASHINGTON UNIVERSITY IN ST. LOUIS. THESE CASES ARE INDICATIVE OF THE TWO VERY DIFFERENT POSSIBLE OUTCOMES OF THIS BAN.

INTRODUCTION

Drinking bottled water has become increasingly popular during the past decade.¹ With the rising demand for plastic bottled water, comes the negative externality of greater pollution both on land and in the oceans. Policymakers in cities, towns, and even universities have sought new methods to lessen the dramatic negative impact of plastic water bottles on the environment. A new and unique proposal has been to ban the sale of bottled water entirely in selected towns, national parks, and college campuses. Why has this been the chosen policy and what have the outcomes been thus far been?

The past decade has shown an increasing consumer preference of bottled water over tap water. As of 2015, bottled water held 19% of the consumption share of beverages in the United States, whereas tap water and other beverages only amounted to 13.6% of the consumption share. According to Parag and Roberts, the effects of the creation, transportation, and disposal of bottled water on the environment is more than 100 times higher than that of drinking tap water.² The rise in bottled water use has huge implications for the environment. Consequently, policy makers have sought new ways to reduce bottled water consumption.

This paper will focus on the policy option to ban bottled water in select cities and college campuses. First, the paper

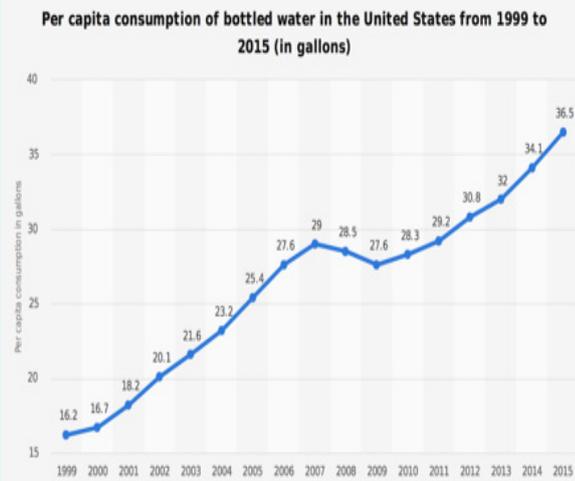


FIGURE 1. UNITED STATES PER CAPITA CONSUMPTION OF BOTTLED WATER, 1999-2015 (COURTESY OF INTERNATIONAL BOTTLED WATER ASSOCIATION)

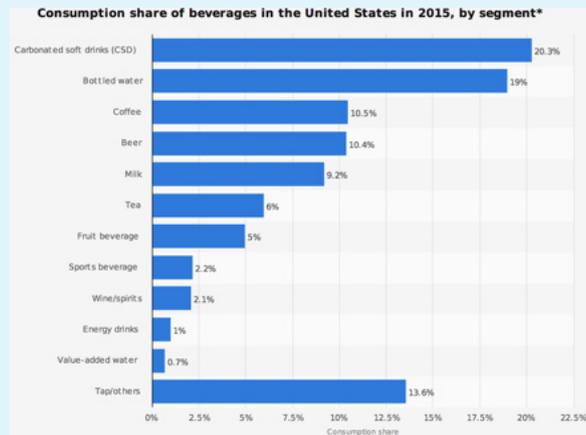


FIGURE 2. UNITED STATES BEVERAGE CONSUMPTION BREAKDOWN IN 2015 (COURTESY OF INTERNATIONAL BOTTLED WATER ASSOCIATION)

will analyze the behavior of consumers. Following, it will show the environmental effects of bottled water and the reasoning for the ban of bottled water. Then, it will report on the findings of the ban at Washington University in St. Louis that show the environmental benefits of the prohibition of sale on campus and then analyze the negative externalities of the ban at the University of Vermont. It will list the other potentially harmful effects of possible future bans. After this pro-con analysis of the policy, the paper will describe the best solution to resolve, or at least mitigate the current issue. It will also consider other attempts to alleviate the environmental damage of bottled water. Incorporating ideas from all the different policies, I will demonstrate what I believe to be a comprehensive solution to the thirst for bottled water.

BACKGROUND

Numerous studies have analyzed why consumer preferences have changed significantly over the past decade. Annual US consumption of bottled water tripled from 12 billion bottles in 2000 to 36 billion bottles in 2006.³ This number has continued to rise over the past ten years. In 2015, the total volume of bottled water consumed in the US was 11.7 billion gallons, which is roughly 88.6 billion bottles. Since 2000, there have been two years of double-digit percentage growth rates of bottled water volume.⁴ In 2002, bottled water volume grew by 12 percent and 10.8 percent in 2005. Bottled water is now the second largest commercial beverage category in the US after carbonated soft drinks.⁵ The increase in the popularity of bottled water

is not limited to the US. There was an increased consumption worldwide from 2007 to 2012, and forecasts predict 391 billion liters to be consumed in 2017. Also, consumption of bottled water in liters almost doubled between 2000 and 2006 in the United Kingdom.⁶ For many consumers, bottled water has become a complete substitute for tap water.

Consumer Preferences

In many ways this rise is impossible to justify based on the market economy; the cost to drink bottled water is thousands of times more than tap water.⁷ Consumers do not act in the expected manner. There are, however, many other factors that contribute to consumers' preference for bottled water. Studies have shown that the reasons include convenience, taste, mistrust of tap water, and health concerns.⁸ Bottled water's versatility makes it suitable for consumption at any time or place. The portability and various packaging types allows for a variety of uses.⁹ When considering taste of bottled water and mistrust of tap water, Viscusi et al. found, "over two-fifths of the sample"¹⁰ believe that bottled water tastes better than tap water, and almost one-third of all respondents believe that bottled water is "safer than tap water."¹¹ According to Ward et al., most participants in a BMC Public Health study believed that, compared to tap water, bottled water conferred additional health benefits even though the majority were unsure as to why.¹² In actuality, bottled water has to meet less stringent regulations than tap water. This means that it can contain bacterial or chemical contaminants that exceed industry standards, whereas tap water must be inspected daily and contains small amounts of chlorine to kill bacteria.¹³ Finally, bottled water is chosen due to health concerns. Due to worries about obesity and other health matters, bottled water's lack of calories and artificial ingredients attracts conscientious consumers.¹⁴ When analyzing the public policy issue of the ban, it is crucial to understand the recent change in consumer preferences because it will help to predict the response. Bottled water has become more popular primarily because of its convenience, taste, and the perception that it is healthier.

Environmental Impacts

Since the demand for bottled water has steadily increased during the last decade, the damaging effects of bottled water on the environment has also risen proportionally. According to Parag and Roberts, bottled water's environmental impacts are local and global. Pollution impacts stem from the production, to distribution, and disposal.¹⁵ One major environmental impact involves the extracting and

processing of oil to make the plastic containers. Bottled water production uses 17 million barrels of oil per year and requires triple the amount of water to make a bottle as it does to fill it.¹⁶ The Earth Policy Institute found that it takes over 50 million barrels of oil every year to pump, process, transport, and refrigerate bottled water.¹⁷ Most plastic bottles are not recycled and accumulate in landfills, taking hundreds of years to biodegrade.¹⁸ In 2005, two million tons of plastic bottles were dumped in landfills.¹⁹ Water bottles are made completely of Polyethylene terephthalate plastics (PETs), but PETs do not biodegrade quickly. They break down into smaller fragments that absorb toxins that pollute the waterways, contaminate the soil, and sicken animals.²⁰ Plastic bottled water companies also cause harm and damage to local bodies of water and watersheds by pumping groundwater to bottle and sell, causing local water levels to drop. For example, in Mecosta County, Michigan residents fought Nestlé, a leading supplier of bottled water, to lower the amount of water pumped from Dead Stream and Thompson Lake in fear of reduced flow levels.²¹ Plus, plastic bottles cause air pollution because the manufacturing of one ton of PETs, the main component of plastic bottles, produces around three tons of carbon dioxide. According to Palliser, in 2006, more than 2.5 million tons of CO₂ were emitted to make plastic water bottles.²² These plastic bottles clearly have damaging effects on the environment and many campuses and towns have taken action to protect the environment by banning the sale of bottled water.

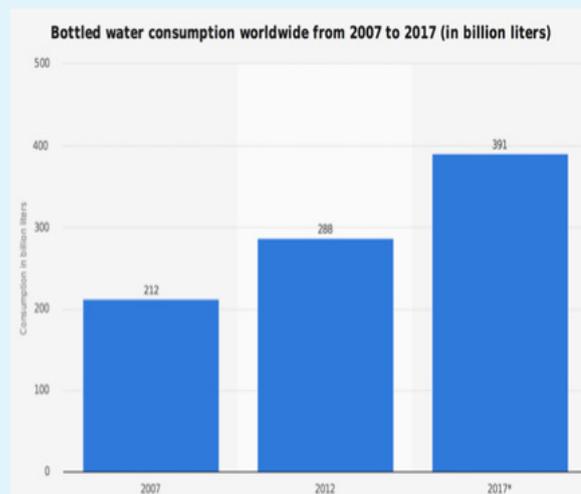


FIGURE 3. GLOBAL CONSUMPTION OF BOTTLED WATER, 2007-2017 (COURTESY OF NESTLÉ)

What is the ban?

In response to environmental damages from bottled drinking water, cities such as San Francisco and Concord, and college campuses such as Washington University in St. Louis and the University of Vermont, have implemented controversial policies to ban plastic bottles. The bans have been more pronounced on college campuses with more than 70 universities in the United States having implemented a campus-wide ban on the sale of plastic water bottles.²³ What is the motivation for these bans and what are the specifications? Most of these entities cite environmental reasons for implementing a ban. In the Massachusetts town of Concord, the bylaw states, “It shall be unlawful to sell non-sparkling, unflavored drinking water²⁴ in single-service polyethylene terephthalate (PET) bottles of 1 liter or less in the Town of Concord on or after January 1, 2013.”²⁵ In Concord, stores that violate the law first receive a warning, then a \$25 fine, followed by a \$50 fine for all subsequent infractions.²⁶ San Francisco took similar action to ban the sale of plastic water bottles on city property. This ban exempts sporting events and gives food trucks and large nonprofits until 2018 to comply. In San Francisco, all vendors selling single-service plastic bottles on city grounds after October, 2014, are subject to a fine up to \$1000.²⁷ Among colleges, Washington University in St. Louis and the University of Vermont enacted similar bottled bans.

Possible Limitations

It is necessary to note that there have been neither formal program evaluations of the bans nor in-depth analyses of

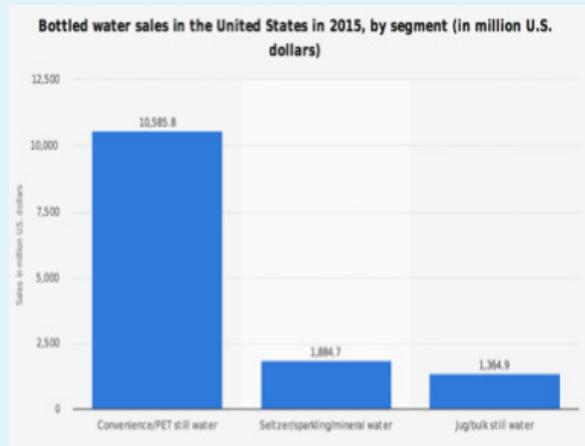


FIGURE 4. UNITED STATES BOTTLED WATER SALES BY TYPE IN 2015 (COURTESY OF BEVERAGE WORLD)

the economic repercussions in any of the cities or universities with the exception of Washington University in St. Louis.²⁸ The University of Vermont, however, did publish qualitative evaluations. Therefore, this paper will examine the ban at each university, interestingly, each universities produced very different results. A possible cause for the discrepancy could be the location of the school and the culture of the student body. Washington University is located in the city of St. Louis, whereas the University of Vermont is located in the smaller town of Burlington. In the city of St. Louis, students might have access to different options to buy other than bottled water. Also, Washington University took other steps to increase sustainability across campus by adding newly retrofitted refill water stations, which might have had a positive impact on the results. The fact that St. Louis tap water was rated as the best in the country in 2007 certainly could have positively influenced the school-wide movement to switch from bottled water to tap.²⁹ Additionally, while difficult to measure, the culture of the student body can directly affect the way in which students change their behavior, which could contribute to the discrepancy in results at each university.

ARGUMENTS FOR THE BOTTLED WATER BAN

Washington University in St. Louis

Washington University in St. Louis was the first university to ban the sale and use of bottled water in administrative offices, dining services and vending machines. Because of concerns about the environmental impact of bottled water, the University ended sales of the product, and administrative offices were no longer able to offer bottled water at events or meetings. Students and faculty were encouraged to drink tap water especially through the student-led campaign of “Tap it” on campus.³⁰

On January 1, 2009, the university stopped selling bottled water in all retail outlets and vending machines on the primary campus, the Danforth Campus, and administrative West and North Campuses.³¹ The University published an update on the policy in 2015, reporting that “since the 2009 bottled water ban went into effect, both bottled beverage purchases and fountain drink purchases have significantly decreased during a time when the University’s population has continued to increase”.³² The data indicate an overall 39.4% decrease of all bottled product purchases in the academic year 2014-2015 compared to the academic year 2008-2009. This decrease in plastic bottles confirms the effectiveness of the policy. The Washington University update shows that the single-use plastic bottles are associ-

“Bottled water production uses 17 million barrels of oil per year and requires triple the amount of water to make a bottle as it does to fill it.”

ated with a number of major environmental and public health issues. These issues stem from the production, storage, and transportation of the bottles. In response to these negative effects, the university enacted their plan to stop selling bottled water.

According to Figure 5, the purchases of all bottled beverages declined significantly since the beginning of the ban. Carbonated beverages had the most significant decrease of almost 50%.³³ The only category of bottled product purchases that increased was called “Other,” which consisted of specific brands of energy drinks, flavored water, sparkling water, coconut water, and lemonade. Previously, bottled water cases made up 10% of purchases, but as of the 2014-2015 academic year, bottled water purchases represented 2%³⁴ of the total bottled purchases.³⁵ The initial goal was to decrease the number of single-use plastic bottles consumed, and the significant drop in total purchases of bottled beverages confirms the success.

Another positive result of the Washington University policy is that it allowed the school to plan for the long-run and enact new initiatives to continue to help the environment.

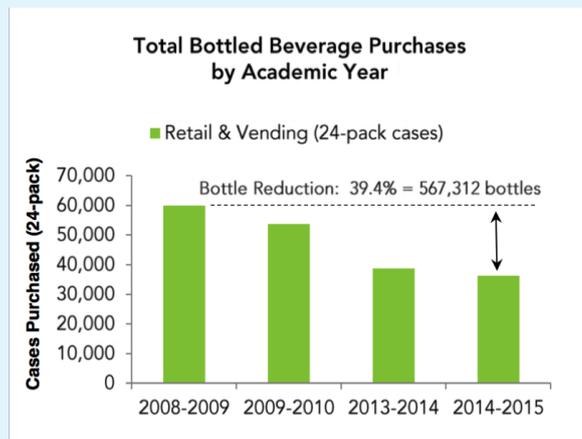


FIGURE 5. WASHINGTON UNIVERSITY IN ST LOUIS BOTTLED BEVERAGE PURCHASES, 2008-2015³¹ (COURTESY OF WASHINGTON UNIVERSITY)

For example, the school has invested time and money to retrofit approximately 108 water fountains, and plans to retrofit 170 more. Additionally, the school added drinking fountain areas with refill stations in all newly constructed buildings.³⁶ The University also installed 20 Elkay Filling Stations.³⁷ New students have the chance to learn about the bottled water ban through Washington University’s team of 30 Green Ambassador peer-educators.³⁸

The ban of bottled water produces an estimated net benefit of \$337,030 each year for the University of Washington. According to Curtis-Murphy and Sessions, the benefits of the bottled water ban include decreased recycling costs and student expenditures, along with environmental benefits.³⁹ The upfront costs of this ban include new and retrofitted water fountains and administrative costs. The ongoing yearly costs include increased water usage, lost revenue to food services, maintenance of new water fountains, administrative costs, and health costs.⁴⁰ The “Kaldor-Hicks Tableau” in Table 1, clearly shows there are winners and losers of this ban, and the students/faculty/staff benefit far more than the administration. Why then would the administration choose to implement a ban like this? It is likely

Kaldor-Hicks Tableau		
	Administration	Students/Faculty/Staff
Yearly Costs		
Increased Water Usage	\$38,610	\$0
Water Fountain Maintenance	\$6,790	\$0
Loss in Revenue From Sale of Water Bottles	\$233,760	\$0
Administrative Costs	\$2,950	\$0
Health Costs from Substitution	\$.001	\$0.001
Yearly Benefits		
Decreased Recycling Costs	\$37,270	\$0
Saved Expenditures	\$0	\$593,940
Environmental Benefits	\$0.0006	\$0.0006
Yearly Net Benefits	-\$244,880	\$593,940

TABLE 1. COST-BENEFIT ANALYSIS OF BOTTLED WATER BAN AT WASHINGTON UNIVERSITY³⁷ (COURTESY OF WASHINGTON UNIVERSITY)

that the university would receive reputational benefits far exceeding the monetary costs.

ARGUMENTS AGAINST THE BOTTLED WATER BAN

University of Vermont

The most surprising consequence from a bottled water ban occurred at the University of Vermont, where the ban was initiated in 2012. The University of Vermont enacted a two phase program to study the effects of a plastic water bottle ban. In August 2012, phase one of the plan required all campus locations to provide a 30% healthy beverage ratio in accordance with the Alliance for a Healthier Generation's beverage guideline.⁴¹ By January 2013, phase two required campus locations to remove bottled water while still maintaining the 30% healthy beverage ratio.⁴² The study used shipment data as a means for calculating calories, sugars, and total consumption under the assumption that the university only ordered drinks that consumers were buying, and people on campus purchased only beverages that they intended to consume. Shipment data was collected one semester before any changes were made (Spring 2012), the semester when beverage offerings were changed to meet the health guidelines (Fall 2012), and the semester when bottled water was removed while still meeting the health guidelines (Spring 2013). Per capita shipments of bottled beverages did not change significantly between Spring 2012 and Spring 2013, but they did increase sig-

Variable	Spring 2012	Fall 2012	Spring 2013
Bottles	24.21 ^{a,b}	21.82 ^a	26.27 ^b
Calories, kcal	3248.91 ^a	3106.19 ^a	3957.93 ^b
Total sugars, g	714.11 ^a	675.77 ^a	863.97 ^b
Added sugars, g	528.45 ^a	492.26 ^a	638.12 ^b

Note. In spring 2012 the baseline campus population = 16 582. In fall 2012, when the minimum healthy beverage requirement was enacted, campus population = 16 968. In spring 2013, when bottled water was banned, the campus population = 16 220. Values in a row with different superscripts were significantly different ($P < .05$).

TABLE 2. UNIVERSITY OF VERMONT PER CAPITA SHIPMENTS OF BOTTLED BEVERAGES, SPRING 2012-SPRING 2013 (BAN ENACTED FALL 2012)⁴² (COURTESY OF UNIVERSITY OF VERMONT)

nificantly from Fall 2012 to Spring 2013 shown in Table 2. Once the ban of bottled water was enacted, the number of bottles shipped to campus increased. This contradicts the purpose of the policy. The university made several efforts to increase the use of reusable water containers on campus, but bottled water consumers instead decided to purchase other plastic bottled beverages.

As a result of phase one of the plan, the percentage of bottled water shipped to campus decreased significantly from 17.6% of total shipments to 13.2% as seen in Table 3. Table 3 also shows sugar-free drinks and sugar sweetened drinks increased from Spring 2012 to Fall 2012. Once bottled water was banned, the consumption of these other beverages continued to increase.⁴³ Along with an increase in the shipments of bottles to campus, there was an increase in calories, total sugars, and added sugars according to Table 2. This unintended negative consequence could have damaging effects on the student population and potentially lead to higher rates of obesity.

Although there are many causes of excess weight gain, many studies have shown that sugar-sweetened beverages (SSBs) are large contributors.⁴⁴ "A 20-ounce soft drink has nearly 17 teaspoons of added sugars, far exceeding the American Heart Association's recommended limit of 6 teaspoons per day for women and 9 teaspoons per day for men."⁴⁵ They also reported on other intervention studies that found limiting the consumption of SSBs by providing only bottled water or low-calorie beverages reduces the

Beverage	Spring 2012, %	Fall 2012, %	Spring 2013, %
100% juice	15.3 ^a	13.6 ^a	15.1 ^a
Sugar free (≤ 10 kcal/8 oz)	11.9 ^a	14.5 ^a	21.2 ^b
Low calorie (≤ 50 kcal/8 oz)	11.2 ^a	8.4 ^b	9.4 ^{a,b}
Sugar sweetened (> 50 kcal/8 oz)	28.2 ^a	32.2 ^{a,b}	35.3 ^b
Milk and protein drinks	17.3 ^a	20.6 ^a	20.2 ^a
Water	17.6 ^a	13.2 ^a	0.0 ^b

Note. In spring 2012 the baseline campus population = 16 582. In fall 2012, when the minimum healthy beverage requirement was enacted, campus population = 16 968. In spring 2013, when bottled water was banned, the campus population = 16 220. Percentages in a row with different superscripts were significantly different ($P < .05$).

TABLE 3. PERCENTAGE OF VARIOUS BEVERAGES SHIPPED TO 8 CAMPUS LOCATIONS AT THE UNIVERSITY OF VERMONT⁴² (COURTESY OF UNIVERSITY OF VERMONT)

body mass index, skin-fold thickness, and fat mass of children compared to a control group with no intervention.⁴⁶ According to Block et al., “one major determinant of weight gain among adolescents and young adults is the consumption of sugar-sweetened beverages.”⁴⁷ Young adults consume the most calories from sugar sweetened sodas of any age group, about 230 calories per day.⁴⁸ A study was performed to see how college students respond to intervention messages encouraging them to make healthier choices. The main result of the study regarding SSBs is that the major factors in beverage choice are taste and price. Health and nutritional content of beverages were of limited interest for the young adults.⁴⁹ It was also discovered that water is mostly only consumed for hydration.⁵⁰ Therefore, it is reasonable based on this study to assume that college students will substitute water with SSBs. The only other way to avoid the increased consumption of sugary drinks would be to raise the prices.

Other objections

One major objection to the policy is that bottled water is crucial for certain situations. Bottled water, for example, serves as the emergency source of drinking water when the public water system becomes contaminated.⁵¹ Under the Safe Drinking Water Act, the utility must notify residents of such contamination so that they can switch to bottled water or purify their tap water.⁵² For example, in Flint, Michigan, the city’s water supply was contaminated with “toxic levels of lead and iron,” making unfiltered water unsafe to drink.⁵³ In an effort to help the community of Flint, organizations were sending shipments of bottled water. Convoy of Hope has donated and distributed more than 100 truckloads of bottled water to the city.⁵⁴ The policy enacted in Concord did adjust the bylaw to resolve any issues by declaring that there is an exemption for an “emergency adversely affecting the availability and/or quality of drinking water to Concord residents.”⁵⁵ This exemption was of extreme importance to the city because residents and tourists were purchasing plastic-bottled beverages by the truckload to cope with the extreme drought and record-breaking temperatures in August.⁵⁶

Additionally, the complete ban of bottled water is simply not realistic for larger venues that prohibit individuals from bringing in open containers containing any liquid beverage. According to San Francisco’s ban, for events on public property with 100 or more attendees, it is prohibited to sell plastic water bottles if there is an alternative city potable supply. The provision will eventually impact the venues for sporting teams such as the San Francisco Gi-

ants at AT&T Park as well as other major sports teams in the city. However, it will not happen for decades, because it is not feasible or cost efficient for the businesses.⁵⁷ Even at Washington University in St. Louis, the school made the decision to provide bottled water at a very limited number of special events where other methods of water access proved especially “challenging or costly.”⁵⁸ Clearly this issue is a realistic and reasonable aspect of the policy or else the policymakers would not be writing in provisions to their bans.

The policy to ban bottled water is strongly opposed by the American Beverage Association, which represents the nonalcoholic beverage industry. According to spokeswoman for the American Beverage Association, Kate Krebs, “The consumers should have a choice on how they drink their water.”⁵⁹ The policy decision to ban plastic bottles limits the freedom of choice for the residents and visitors to those cities and schools.

POLICY OPTIONS

Is there anything better that can be done to solve the environmental concerns? Some other policy options have been to restore the public’s trust in tap water, incentivize recycling, or simply add a bottle tax. Many of the studies mentioned above have noted that bottled water is strictly preferred to tap water partially because of health concerns. Parag and Roberts suggest a five stage plan to restore the trust in tap water.⁶⁰ Stage one is to create public awareness. Media often highlights the trust-destroying events such as water contamination like the case of Flint, Michigan, but the media does not display the positive events such as reports of good tap water. Stage two is to analyze and explore new tap-water quality standards. Stage three is to ensure transparent decision-making procedures to contribute to building trust. The “Consumer Confidence Reporting Rule” is one example of a policy with the potential for trust building. It ensures the public is informed annually about the quality of tap water. Stage four involves policy implementation and enforcement, both critical aspects of the plan. Finally, stage five is continual policy evaluation.

Another policy worthy of consideration is to implement recycling laws and deposit policies. Water bottles are made completely of recyclable PETs, so why does society not recycle? The national recycle rate for PETs is only 23 percent, which means \$1 billion worth of plastic that should end up in the “recycling stream” is lost.⁶¹ There are

two principal policy instruments that promote water bottle recycling: bottle deposits and recycling laws.⁶² The bottle deposits provide a financial incentive to recycle, while the recycling laws reduce the time costs by providing curbside recycling and convenient recycling centers. Most states do not include plastic water bottles on their deposit bills.⁶³ Oregon and Connecticut both added water bottles to their deposit bills in 2009, right around the same time as the bottled water ban. In both of these states, the laws proved to be effective.⁶⁴ To investigate the effect of the recycling laws and deposit policies, Viscusi et al. examined data on recycling behavior for Oregon and Connecticut both before and after they each implemented their expanded bottle bills.⁶⁵ In each case, individual consumers shifted from not recycling at all to becoming committed recyclers. They found that recycling and deposit policies have their greatest effect on those who would not already choose to recycle.⁶⁶ This is a key aspect of human behavior that needs to be considered when instituting a new public policy.

In early 2010, Washington Governor Christine Gregoire proposed taxing bottled water, both because of a need for tax revenue and because “products that negatively impact our environment or public health should be taxed to pay the costs of their effects.”⁶⁷ By knowing the tax elasticity of water bottle demand, it is possible to know how best to reduce the purchasing of the product. Berck et al. estimated that a 2.8% to 5.9% drop in bottled water consumption will occur in response to a tax of between 6.5% and 9.5%.⁶⁸ Unfortunately, this policy is unable to drastically change

the behavior of the consumer. The growth rate of bottled water has been far above 5.9% over the past decades as mentioned above, so this drop would not make the difference that the policy makers intend to achieve. Because of the low price elasticity of bottled water, a tax much greater than 6.5%-9.5% would be necessary to change the behavior of buying bottled water.⁶⁹ A Pigouvian tax, a tax levied on any market activity that generates negative externalities, would be most appropriate in the case of plastic bottled beverages.⁷⁰ It would be implemented in order to eliminate the negative externality plastic bottles impose on the environment. According to Figure 6, the optimal level of bottles would be found where the marginal social cost equals marginal benefit. Unfortunately, a critique of the the Pigouvian tax is that it would reduce willingness to produce. For the tax to prevent unwillingness to produce, it would have to be imposed on the polluting aspect of the factory rather than directly imposed on output levels, which can be difficult to do. This leads us back to wondering if the complete ban is really the best option.

CONCLUSION

To answer the question posed in the beginning of this paper, the outcomes of the bottled water bans have not been the same in all cases. Some studies have shown that the ban of bottled water has led to a decrease in consumption of bottled beverages, whereas other studies have shockingly displayed that the ban of bottled water has led to an increase in sugar sweetened beverages which is a main contributor to weight gain. Based on these results, what really is the best policy option? Many policymakers, politicians, and even economists have analyzed the pro and con list of this policy ban, and after reading this list, this paper would advise against a complete ban of bottled water. Although Washington University found that students reduced usage of plastic bottles, it cannot be assumed that all universities and even cities will act in the same manner. This policy is very clearly related to consumer preferences, and it is impossible to predict the behaviors of people in different age groups and regions.

This paper believes the problem is not what is in the bottle, but the bottle itself. The best policy option would therefore be a plastic bottle tax. The governor of Washington has proposed taxing bottled water, but what about taxing all beverages sold in plastic containers? Increasing the price of all of these beverages, should result in a decreased demand and a reduction in the number of plastic bottles being used. This paper believes a Pigouvian tax is the best

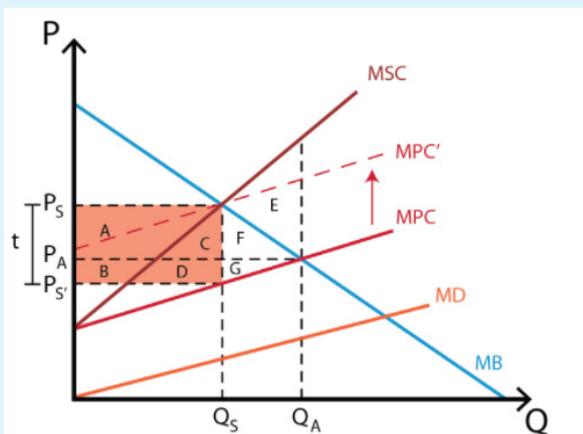


FIGURE 6. PIGOUVIAN TAX MODEL AS POSSIBLE SOLUTION TO REDUCE BOTTLED BEVERAGE CONSUMPTION (COURTESY OF POLICONOMICS)

choice. There are flaws with all of the policy options, but it is important to find the option that will best achieve the goal with the fewest negative externalities.

In a world concerned with global climate change, more must be done to completely eliminate the production of PETs. It should not matter what people choose to drink. There should be efforts in place that ensure all options are not damaging to the earth.

ENDNOTES

1. Figure 1 shows that the per capita consumption of bottled water in the U.S. has more than doubled since 2000.
2. Parag and Roberts. "A Battle Against the Bottles: Building, Claiming, and Regaining Tap-Water Trustworthiness." *Society & Natural Resources* (2009).
3. Viscusi, et al. "Discontinuous behavioral responses to recycling laws and plastic water bottle deposits" No. w15585. Cambridge, MA: *National Bureau of Economic Research* (2009).
4. Ward, et al. "Health beliefs about bottled water: A qualitative study". *BMC Public Health*, 9 (2009)
5. The total volume of carbonated soft drinks shrank in 2014, as it has done every year since the mid-2000s (Rodwan, 2014). This reduction decreases the gap between soft drinks and bottled water. Huerta-Saenz, et al., "Tap or bottled water: drinking preferences among urban minority children and adolescents." *Journal of Community Health*, (2012).
6. Ward, et al. "Health beliefs about bottled water: A qualitative study". *BMC Public Health*, 9 (2009)
7. Bottled water is considered a Giffen good because it is a product that people consume more of as the price rises. It is often viewed as a symbol of status especially when looking at how consumers will choose the more expensive brand of bottled water, such as choosing Smart Water instead of Poland Spring. Parag and Roberts. "A Battle Against the Bottles: Building, Claiming, and Regaining Tap-Water Trustworthiness." *Society & Natural Resources* (2009).
8. Huerta-Saenz, et al., "Tap or bottled water: drinking preferences among urban minority children and adolescents." *Journal of Community Health*, (2012).
9. Rodwan. "Bottled Water 2014: Reinvigoration." *U.S. and International Developments and Statistic* (2014).
10. The sample used for the analysis was taken from the author's survey administered through the Knowledge Networks(KN) Web-based panel in October 2009. The KN panel is regarded as the highest quality Web-based panel. 1,639 panelists were invited to participate (Viscusi et al., 2015).
11. Viscusi, et al. "Discontinuous behavioral responses to recycling laws and plastic water bottle deposits" No. w15585. Cambridge, MA: *National Bureau of Economic Research* (2009).
12. Ward, et al. "Health beliefs about bottled water: A qualitative study". *BMC Public Health*, 9 (2009)
13. Karlstrom and Dell'Amore. "Why Tap Water is Better than Bottled Water." *National Geographic* (2010).
14. Rodwan. "Bottled Water 2014: Reinvigoration." *U.S. and International Developments and Statistic* (2014).
15. Parag and Roberts. "A Battle Against the Bottles: Building, Claiming, and Regaining Tap-Water Trustworthiness." *Society & Natural Resources* (2009).
16. O'Connor. "Bottled Water Ban In San Francisco Would Be One of Nation's Strictest." *The Huffington Post* (2013).
17. Schriever. "Plastic Water Bottles Causing Flood of Harm to Our Environment." *The Huffington Post* (2013).
18. Parag and Roberts. "A Battle Against the Bottles: Building, Claiming, and Regaining Tap-Water Trustworthiness." *Society & Natural Resources* (2009).
19. Palliser. "Banning the bottle." *Science Scope* (2010).
20. Schriever. "Plastic Water Bottles Causing Flood of Harm to Our Environment." *The Huffington Post* (2013).
21. Palliser. "Banning the bottle." *Science Scope* (2010).
22. Ibid.
23. Boston College has not officially implemented a ban of plastic water bottles. However, bottled water is not available in the main dining halls of Carney, Corcoran, and Lyons. Bottled water may only be bought in vending machines, On the Fly markets, and Hillside, which all require the use of the flex meal plan. In an effort to decrease bottled-water consumption, Boston College has promoted awareness of recycling and use of local water supplies. Carapezza. "Better Bring your Own: University of Vermont Bans Bottled Water." *National Public Radio* (2013).
24. The bans only limit the sale of non-sparkling, unflavored drinking water in single-service PET bottles. According to Figure 4 seltzer/sparkling/mineral water is a much smaller percentage of bottled water sales in the US. Sales are only \$1.9 billion compared to those of bottled water which are \$10.6 billion. In the initial stages of the bottled water ban, it is not worth the extra costs to also ban the less popular sparkling water.
25. "Massachusetts General Laws." Chapter 40, §32
26. An infraction is when a store is caught selling single-service PET bottles of 1 liter or less (Massachusetts General Laws, 2012).
27. Timm. "San Francisco bans sale of plastic water bottles on city property." *MSNBC* (2014).
28. Curtis-Murphy and Sessions. "Ban the Bottle: Implementing a Ban on the Sale of Plastic Water Bottles at the University of Washington." *The Evans School Review* (2014).
29. Daues. "Washington University in St. Louis ends sales of bottled water." *The Source, Washington University in St. Louis* (2009).
30. Ibid.
31. Vasquez, et al. "Bottled Water Ban: Update 2015." *Washington University in St. Louis* (2015).
32. Ibid.
33. Ibid.
34. The remaining bottled water purchases were for the School of Medicine and special events. Due to concerns about limiting water access to medical patients, the School of Medicine continued to sell bottled water (Vasquez et al. 2015).
35. Ibid.
36. Ibid.

37. Curtis-Murphy and Sessions. "Ban the Bottle: Implementing a Ban on the Sale of Plastic Water Bottles at the University of Washington." *The Evans School Review* (2014).
38. Ibid.
39. Ibid.
40. In the economic analysis of the policy, Curtis-Murphy and Sessions (2014) found that there could possibly be a very small long-term health cost as a result of some students switching to sugar-sweetened beverages. While the health impacts are important to be considered, the actual cost incurred is negligible (Ibid.).
41. The guideline presents a table of proper sized containers of different beverages that should be distributed at different school levels. The categories of beverages include plain water, low fat milk, non fat milk, 100% fruit or vegetable juice, no calorie beverages that are flavored and/or carbonated, and low calorie beverages that are flavored and/or carbonated.
42. Berman, and Johnson. "The unintended consequences of changes in beverage options and the removal of bottled water on a university campus." *American Journal of Public Health* (2015).
43. Ibid.
44. Ibid.
45. Ibid.
46. Ibid.
47. Block et al. "If it tastes good, I'm drinking it': qualitative study of beverage consumption among college students." *Journal of Adolescent Health* (2013)
48. Ibid.
49. Ibid.
50. Ibid.
51. Viscusi, et al. "Discontinuous behavioral responses to recycling laws and plastic water bottle deposits" No. w15585. Cambridge, MA: *National Bureau of Economic Research* (2009).
52. Ibid.
53. Gulledege. "How to help with the Flint water crisis." *CNN* (2016).
54. Ibid.
55. "Massachusetts General Laws." Chapter 40, §32
56. Although there have been no official records published regarding the effectiveness of the ban in Concord, town officials said the ban has produced no measurable reduction in plastic waste. The stores in town responded to the original ban by stocking their shelves with 1.5-liter water bottles, instead of the banned one liter bottles, and flavored beverages in plastic bottles. Assistant Public Health director of Concord, Stanley Soshicki, proposed that a statewide ban could have much more significant results. Cline. "Town that banned bottled water now can't get enough of it." *AMI Newswire* (2016).
57. Sabatini. "Supervisor proposal seeks to ban plastic water bottle sales on SF property." *The San Francisco Examiner* (2013).
58. Vasquez, et al. "Bottled Water Ban: Update 2015." *Washington University in St. Louis* (2015).
59. Sabatini. "Supervisor proposal seeks to ban plastic water bottle sales on SF property." *The San Francisco Examiner* (2013).
60. Parag and Roberts. "A Battle Against the Bottles: Building, Claiming, and Regaining Tap-Water Trustworthiness." *Society &*

Natural Resources (2009).

61. Schriever. "Plastic Water Bottles Causing Flood of Harm to Our Environment." *The Huffington Post* (2013)
62. Viscusi, et al. "Discontinuous behavioral responses to recycling laws and plastic water bottle deposits" No. w15585. Cambridge, MA: *National Bureau of Economic Research* (2009).
63. The unit price deposit raises the price paid at the time of purchase, but for every bottle returned to a recycling location or stores that accept the bottles, the recycler is paid the deposit amount (Viscusi et al., 2009).
64. Ibid.
65. Viscusi, et al. "Discontinuous behavioral responses to recycling laws and plastic water bottle deposits" No. w15585. Cambridge, MA: *National Bureau of Economic Research* (2009).
66. Ibid.
67. Berck, et al., "Measuring Consumer Responses to a Bottled Water Tax Policy." *American Journal of Agricultural Economics* (2016).
68. Ibid.
69. Ibid.
70. Polinsky and Shavell. "Pigouvian taxation with administrative costs." *Journal of Public Economic* (1982).

REFERENCES

Berck, Peter, Jacob Moe-Lange, Andrew Stevens, Sofia Villas-Boas. "Measuring Consumer Responses to a Bottled Water Tax Policy." *American Journal of Agricultural Economics* (2016).

Berman Elizabeth R. and Rachel K. Johnson. "The unintended consequences of changes in beverage options and the removal of bottled water on a university campus." *American Journal of Public Health*, 105(7) (2015):1404-1408.

Beverage World. (n.d.). Bottled water sales in the United States in 2015, by segment (in million U.S. dollars). In *Statista - The Statistics Portal*. <https://www.statista.com/>.

Block Jason P., Matthew W. Gillman, Stephanie K. Linakis, and Roberta A. Goldman. "If it tastes good, I'm drinking it': qualitative study of beverage consumption among college students." *Journal of Adolescent Health*, 52(6) (2013): 702-6.

Carapezza, Kirk. "Better Bring your Own: University of Vermont Bans Bottled Water." *National Public Radio* (2013, January 14).

Cline, Andrew. Town that banned bottled water now can't

get enough of it. *AMI Newswire* (2016, August 17).

Curtis-Murphy, Megan and Caroline Sessions. "Ban the Bottle: Implementing a Ban on the Sale of Plastic Water Bottles at the University of Washington." *The Evans School Review*, 4(1) (2014).

Daues, Jessica . "Washington University in St. Louis ends sales of bottled water." *The Source*, Washington University in St. Louis (2009, February 20).

Gulledge, Jacqueline. How to help with the Flint water crisis. *CNN* (2016, October 31).

Huerta-Saenz Lina, Matilde Irigoyen, Jorge Benavides, and Maria Mendoza. "Tap or bottled water: drinking preferences among urban minority children and adolescents." *Journal of Community Health*, 37 (2012):54-8

International Bottled Water Association. (n.d.). "Per capita consumption of bottled water in the United States from 1999 to 2015 (in gallons)." In *Statista - The Statistics Portal*. <https://www.statista.com/>.

International Bottled Water Association. (n.d.). "Consumption share of beverages in the United States in 2015, by segment." In *Statista - The Statistics Portal*. <https://www.statista.com/>.

Karlstrom, Solvie and Christine Dell'Amore. "Why Tap Water is Better than Bottled Water." *National Geographic* (2010, March 13).

"Massachusetts General Laws". Chapter 40, §32, "Drinking Water in Single-Serve PET Bottles Bylaw" adopted under Article 32 (2012).

Nestlé. (n.d.). "Bottled water consumption worldwide from 2007 to 2017 (in billion liters)." In *Statista - The Statistics Portal*. <https://www.statista.com/>.

O'Connor, Lydia. Bottled Water Ban In San Francisco Would Be One of Nation's Strictest. *The Huffington Post* (2013, December 17).

Palliser, Janna (2010). "Banning the bottle." *Science Scope*, 34 (2): 8-11.

Parag, Yael and J. Timmons Roberts. "A Battle Against the

Bottles: Building, Claiming, and Regaining Tap-Water Trustworthiness." *Society & Natural Resources*, 22(7) (2009):625-636, DOI: 10.1080/08941920802017248

Polinsky, A. Mitchell, and Steven Shavell. "Pigouvian taxation with administrative costs." *Journal of Public Economic*, 19(3) (1982):385-394

Rodwan, John G. "Bottled Water 2014: Reinvigoration." *U.S. and International Developments and Statistics* (2014). bottledwater.org.

Roth, Sara and Pat Dooris. "State approves next step for Nestle water bottling plant despite country vote." *KGW News* (2016, November 3).

Sabatini, Jashua . "Supervisor proposal seeks to ban plastic water bottle sales on SF property." *The San Francisco Examiner* (2013, December 12).

Schriever, Norm. "Plastic Water Bottles Causing Flood of Harm to Our Environment." *The Huffington Post* (2013, July 29)..

Timm, Jane C . "San Francisco bans sale of plastic water bottles on city property." *MSNBC* (2014, March 13).

Vasquez, Marisa, Jen Carter, and Phil Valko. "Bottled Water Ban: Update 2015." *Washington University in St. Louis* (2015).

Viscusi, W. Kip, Joel Huber, Jason Bell, and Caroline Cecot. "Discontinuous behavioral responses to recycling laws and plastic water bottle deposits" No. w15585. Cambridge, MA: *National Bureau of Economic Research* (2009).

Viscusi, W. Kip, Joel Huber, and Jason Bell. "The Private Rationality of Bottled Water Drinking", *Contemporary Economic Policy*, 3(3) (2015):450-467.

Ward, L. A., Cain, O. L., Mullally, R. A., et al. "Health beliefs about bottled water: A qualitative study". *BMC Public Health*, 9 (2009): 196.