HiMCM 2019 Problem B
9536

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Summary

The town of Concord, Massachusetts became the first town in the United States to place a ban on the sale of single-serving Polyethylene terephthalate (PET) bottles less than or equal to 1 liter (34 ounces) containing plain water. We have been tasked with determining if the positive effects of these bans are significant enough to justify enacting the ban in the first place

After creating a list of the positive and negative impacts of a ban on the sale of plastic bottles, our team divided the effects into three main categories: economic, environmental, and health. Next, we determined the main factors involved with each of the categories and assigned each to a variable. By addressing each of these factors, we were able to create a model that compared each category before and after the ban. Our model could be applied to any town or city across the United States by using data and information from their own records, such as the census and business expense reports. The decision to apply the ban would be made by using a series of inequalities that when evaluated to true, show that the ban will be effective in that situation. Ideally, the ban would be most effective when all the inequalities are true, but this might not occur in every situation. However, the towns will need to determine which factors are most important to them, and incorporate that into their decision.

Our model could also be applied to airports with some adjustments, since they have different priorities than towns and cities. They will continue to pay the same amount for waste removal services for both before and after the ban, so that can be assumed to not be a factor. The amount of waste would depend on visitors to the airport every year rather than a town or city's population. The cost of the ban to an airport would be dependent on the number of fountains they would have to add, since we assumed the airport had no fountains beforehand.

The most effective ban, taking into account economic, environment, and health effects, would be to ban all sales of plastic bottles less than or equal to one liter, including both water and sugary drinks. As a result of this, consumption of sugary drinks will decrease in comparison to if they were not included in the ban, therefore increasing overall health. Overall waste will be reduced as well, ultimately causing less damage to the environment and costing the city less to remove it.

Article

Should Bans on Plastic Water Bottles be Made Universal?

By: Team 9536

A number of bans on plastic water bottle usage and distribution have been sweeping through the United States, with one of the very first occurring in Concord, Massachusetts in 2013. These bans typically ban all bottles made from Polyethylene terephthalate (PET) that are less than or equal to one liter in volume. These bans have been met with both support and protest. Some of the most popular reasons for enacting the ban are in regards to concerns about fossil fuel usage, rapidly increasing amounts of garbage and litter, and the opinion that private businesses should not be able to profit on the sale of a resource that is otherwise free to the public. Those in opposition to the ban claim that some negative impacts of this may outweigh the benefits, as access to bottled water is incredibly important in emergency situations. Such bans have also been shown to increase consumption of sugary drinks and negatively affect small businesses.

A recent study of this ban using mathematical modeling attempted to address both sides of this argument to determine if the positive effects of these bans are significant enough to justify enacting the ban in the first place. The team addressed three separate categories of impact (environmental, economic, and health), and created a system of conditions that must be met in order for the ban to be most effective for the town or city. Some of the factors that were taken into consideration were population, recommended water intake, fossil fuel usage, cost of plastic water bottles and public water fountains, and the amount of waste that is produced by PET bottles.

Based on the team's findings, the ban is most effective when the overall cost to the town is decreased, the overall amount of waste produced by the town is decreased, and the amount of water consumed in comparison to sugary drinks is greater than before the ban. In order to meet these conditions, which will maximize the positive impact of the ban, the team recommended that in addition to banning plastic water bottles of a volume less than or equal to 1 liter, the ban should extend to soda and other similar flavored sugary drinks of the same volume. By also banning these products, both the environmental and health aspects of the model will be affected. It would decrease the overall amount of waste that the town would produce, and ensure that consumption of sugary drinks will decrease in comparison to if they were not included in the ban, since easily accessible small bottles would no longer be available.

Overall, a ban on plastic bottles is something that should be considered by every town and city. However, the individual conditions for each location need to be taken into consideration in order to determine whether it would effectively make a change to their overall structure, whether that be economically, environmentally, or regarding overall health.

Problem and Interpretation

Ever since Concord, MA placed a ban on the sale of plastic water bottles that carry 1 L or less of regular, unflavored water in 2013, many other locations across the country, including the city of San Francisco, have begun making and putting in place their own bans and regulations of single use plastic water bottles. With there being much disagreement on whether or not these bans should be established, the goal for our team is to develop a model of the impacts, both positive and negative, of these bans. The ban can be adjusted, along with our model, to produce the best results. We should also evaluate the impacts of placing a similar ban in airports and alter our model to this new environment.

Assumptions

1. All members of a population consume the same amount of water
Justification: All people living in similar environments and cultures should not have their hydration levels fluctuate significantly. Also, with there being outliers on both sides, drinking more than and less than the average water intake, these will balance out, so the entire population can be held to the same water intake value.

2. Before a ban is put in place, 16.9 fl oz water bottles are the only size bottles that are purchased.
Justification: With 16.9 fl oz being the most common size water bottle sold, we used this to simplify our model, with it still accurately representing the change.

3. People get the entirety of their drinking water supply from bottled water or town water fountains if they are available.
Justification: Some towns do not have tap water that is safe to drink. Even if towns do, bottled water is still heavily relied on.

4. The percentage of bottles recycled out of total bottles, 30%, stays the same after the ban is put into place as it was before.
Justification: In the United States, 70% of all PET water bottles are thrown away instead of recycled [1]. People who do and do not recycle are unlikely to change their habits because of the size of the water bottle they are drinking out of.

5. The price of a water bottle will not change if purchased individually or in bulk.
Justification: With how many water bottles a person purchases at one time being a fluctuant number, assuming the bottles would always be purchased for the same price gave our model concrete values to use.

6. Weight of an empty plastic water bottle is proportional to the volume of water it can hold.
Justification: As volume increases, the size of the water bottle increases meaning the amount of plastic used to make the bottle will increase. With the same plastic being used, the weight will be proportional to the amount of plastic.

Impacts of Ban

Positive

1. Towns will focus on their tap water quality because the sale of bottled water will be decreased.
2. Less plastic will be used every year. In one year alone, Concord reported saving 4000 plastic water bottles by their town water fountains[2]. With 67.3% of water sold in the USA is in a single-serve plastic water bottle [1], providing alternative water access will decrease overall plastic.
3. Landfills will relieve less plastic waste every year. Landfills in the United States are already filled with 2 million tons of plastic from plastic water bottles alone [3], which continues to rise with an additional 48 million bottles being added every year [4]. With plastic having a very slow degradability rate, taking 450+ years to decompose each bottle [5], the amount of plastic in landfills is increasing rapidly because plastic is being added much faster than it can degrade. Decreasing the amount of plastic that is added every year will slow down how fast landfills fill. Also, while degrading, the plastic is releasing toxins from inside of it into the land around it [1].
4. 70% of plastic water bottles aren't recycled, so waste would be greatly reduced. [1]
Even when recycled, the plastic of the bottles is thin, so they cannot be recycled into more bottles. Instead, the cheap plastic is put into things, such as carpets, leading to an increase in plastic production to meet the plastic bottle demands.
5. A nationwide ban on bottled water would eliminate 68 billion plastic water bottles contributing to positive environmental effects.
Successful example: Between 2012 and 2016, a ban on plastic water bottles in 23 of the National Parks stopped the sale of 23 million bottles (That's 111,743 pounds of polyethylene terephthalate (PET)) [1].
6. Negative health effects can result from increased use of plastic water bottles. Bottled water can actually be contaminated by plastic, and is tested less frequently than tap water (bottled water is tested weekly, tap water is tested multiple times a day). 93% of bottles show signs of micro plastic contamination [1].
7. Manufacturing plastic water bottles emits harmful chemicals that are dangerous for surrounding families of the factories. The world's largest PET factory is located at Corpus Christi in Texas, and birth defects there are 84% higher than the national average [18].
8. Since bottled water is expensive to dispose of, a ban would decrease costs to dispose of them because there would be less plastic that would need to be taken care of [1].
9. Less plastic bottles being sold would save the city money since US cities can each spend over 100 million annually on disposing of plastic waste. It would not affect citizens as much if the bottles were banned since there are plenty of public water fountains available for use [1].

Negative

1. Glass bottles have been used as an alternative which have heavy carbon footprint, but when recycled this significantly decreases [9]
2. Leads to more consumption of sugary drinks due to lack of healthy choice. Consumers generally think bottled water is 'safer' than tapped water and tastes better, but with the ban, consumers buy sugary drinks that are in smaller bottles instead of having to buy over a liter of water at a time. [1]
3. Bans don't necessarily reduce waste. Other plastic containers are more harmful to the environment than plastic bottles. The use of other more harmful plastic containers would increase due to the water bottle ban. [1]
4. Bottled water is important to have in emergency situations [1]
5. With lack of smaller and more accessible plastic water bottles, people will turn to sugary drinks just because of the fact that they come in smaller bottles. One example of this is the ban of bottled water sales at UVM, where sugary drink consumption went up by 25%. [1]
6. It is a common misconception that such a ban would save plastic, but that is not always the case. The ban of bottled water sales at UVM was not eco-friendly; the number of plastic water bottles went up by 8.5% [1]

Model

Goals of Model

Establish whether or not the implantation of the ban is justified in a particular town based off of:

-Financial aspects (town and resident)

-Environmental aspects

-Health aspects of a resident

Variables

p : population

c_s : cost per small water bottle (16.9 oz|0.5L)

c_L : cost per large water bottle (50.7 oz|1.5 L)

n_s : number of small bottles used in a town in a year

n_L : number of large bottles used in a town in a year

c_f : cost of fountain (installation and maintenance and water supply)

n_f : number of fountains

a_f : amount of water 1 fountain produces in one year (oz)

a_b : amount of water consumed per person in one day before ban (oz)

a_a : amount of water consumed per person in one day after ban (oz)

r : % of recycled bottles

c_w : cost to take care of waste per 1 lbs of plastic waste ($/lb)

m_s : weight of 1 small bottle (pounds)

m_L : weight of 1 large bottle (pounds)

o_s : oil per small bottle (barrels)

o_L : oil per large bottle (barrels)

s_b : amount of soda bought before ban per person per year (oz)

s_a : amount of soda bought after ban per person per year (oz)

v : visitors in the airport

Assigning Values:

In[63]:=
```
cs = 1.00;
cL = 1.99;
r = 0.3;
cw = 2.00;
ms = 10.31 * 0.0022;
mL = 30.93 * 0.0022;
os = (ms * 0.000454) * 17;
oL = (mL * 0.000454) * 17;
```

c_s and c_L are based on the average price of water bottles of those sizes [26] [27].

R was found by taking the opposite value of the percent of bottles that are thrown away every year [1].

c_w was found based on the fact that plastic costs $4000 per ton to take care of the waste [20].

$m_s$and m_L were found from taking the mass in grams of empty plastic water bottles [28] and converting it to pounds.
o_s and o_L were found by taking the weight of an empty water bottle and converting it to metric tons. Then, it was multiplied by the amount of oil barrels needed to make 1 metric ton of plastic [4].

Financial aspect:

Town:

The ban would be most effective for the town if their cost of operations is decreased. Their cost before the ban is made up of the cost to take care of all of the waste created by plastic water bottles. Their cost after the ban is made up of both the cost to take care of all the waste created by plastic water bottles as well as the price to install and maintain all public water fountains.

Before:

Finding the weight of waste created by a town in one year exclusively in water bottles can then be used to find the total cost to take care of waste created by plastic water bottles in a town over a year.

In[71]:=
$$((1 - r) * n_s * m_s) * c_w;$$

1-r will give the percent of bottles that go to waste
$(1 - r) \times n_s \times m_s$will give the weight of waste created by a town before the ban in one year exclusively in water bottles.
This weight can be multiplied by the cost to take care of one pound of waste to produce the cost to take care of all the waste created by plastic water bottles before the ban by a town in a year.

After:

Finding the weight of waste created by a town in one year exclusively in water bottles can then be used to find the total cost to take care of waste created by plastic water bottles in a town over a year. The cost to maintain and install all public water fountains can be found by taking the number of water fountains installed in a town and multiplying it by the number of fountains that are in a town.

In[72]:=
$$((1 - r) * n_L * m_L) * c_w;$$

1-r will give the percent of bottles that go to waste
$(1 - r) \times n_L \times m_L$will give the weight of waste created by a town after the ban in one year exclusively in water bottles.
This weight can be multiplied by the cost to take care of one pound of waste to produce the cost to take care of all the waste created by plastic water bottles after the ban by a town in a year.

In[73]:=
$$f_c * n_f;$$

This expression will represent the total cost to maintain all fountains across a town for a year.

Finding Number of Fountains in a Town

For a town to calculate the number of water fountains they should build, they should take look at the amount of water people are drinking daily and subtract the amount of water people are drinking from plastic water bottles they purchase. They then should divide this number by the amount of water they expect one fountain to produce a year.

In[74]:= $$n_f = \frac{(a_a * p * 365 - n_L * 50.7)}{a_f};$$

$a_a \times p \times 365$ will give the amount of water the population of a town consumes in a year

$n_L \times 50.7$ will give the amount of water the population of a town consumes from plastic in a year

When these are subtracted, the result is the amount of water the population consumes in a year from just fountains

If this is divided by the target water output per fountain in a year, a number of fountains the town should install should be achieved

Estimated water output from a fountain

A town is installing fountains with the assumption that residents will refill their reusable water bottles with the water.

Our team made a target output for each fountain. This target output was used by using the following values.

The average reusable water bottle holds 32 oz.

1000 people should be able to fill their water bottle every day.

Using these values we created the following equation:

In[75]:= $$a_f = 1000 * 32 * 365$$

Out[75]= 11 680 000

11,680,000 oz of water should be produced by each fountain in one year.

Comparing costs

If a town spends more money before the ban then after the ban, the ban is financially beneficial for the town.

In[76]:= $$((1 - r) * n_s * m_s) * c_w > ((1 - r) * n_L * m_L) * c_w + f_c * n_f;$$

Individual

The ban would be most effective for the residents of a town if the cost they were paying for water was decreased after the ban. Their cost before the ban is made up of the cost of the amount of small water bottles they buy multiplied by the price. Their cost after the ban is made up of the cost of the amount of large water bottles they buy multiplied by the price. This number would decrease by them using more water the town produces than water they are purchasing. Our team decided this was not an important or accurate comparison to look at because an individual would end up paying for the town`s expenses through taxes.

Environmental aspect:

The ban would be most effective for the environment if the amount of plastic being used through plastic water bottles decreases after the ban is put in place.

In[77]:= $$(1 - r) * n_s * m_s > (1 - r) * n_L * m_L;$$

1-r will give the percent of bottles that go to waste.

This multiplied by the number of specific bottles used and the weight of the specific bottle will give the weight of plastic produced in waste from each specific bottle type.

Health aspect:

Water intake

The ban would be most effective for health if the water intake of a person increases after the ban is established.

In[78]:= $a_b < a_a$;

Soda

The ban would be most effective the amount of soda drank per person before the ban decreased after the ban was put in place.
Soda an unhealthy beverage due to the high amounts of sugar it contains.

In[79]:= $s_b > s_a$;

Comparing aspects of model

The ban is effective if the majority of the models pass. The town should choose its most important aspects and prioritize the results of those when deciding whether or not to implement the ban.

Model Town

We created a model town to show the effectiveness of our model. The results from the model town is not a mirror of an actual town. Therefore, the results of this is not a reflection of the outcomes of other towns since every town is unique based on their own data and priorities. The data was randomly generated, and the values are not real.

Data and Variables

In[80]:=
```
p = 100 000;
n_s = 146 000 000;
n_L = 31 025 000;
c_f = 5000;
a_B = 64;
a_A = 55;
s_A = 912 500 000;
s_B = 620 500 000;
```

Economic

Fountains

In[88]:=
```
n_f = ((a_A * p) − (n_L * 50.7)) / a_f
```

Out[88]= −134.201

Town

This inequality compares town costs per year before and after the ban.

In[89]:=
```
((1 − r) * (n_s * m_s)) * c_w
((1 − r) * (n_L * m_L)) * c_w + (f_c * n_f)
```

Out[89]= 4.6362×10^{6}

Out[90]= 2.28457×10^{6}

Since the cost after is less than the cost from before, the ban would be economically worth it for the model town.

Economic Conclusions

Based on the economic inequalities, the inequality comparing the prices individuals would have to pay for water before and after the ban held true meaning that the ban would be worth it. Likewise, the inequality comparing costs of the town before and after held true and the ban would be worth it since it would cost the town less money after the ban.

Environmental

This inequality compares the amount of plastic waste before and after the ban being thrown away (in lbs.)

In[91]:= $(1 - r)\,(n_s * m_s)$

$(1 - r)\,(n_L * m_L)$

Out[91]= 2.3181×10^6

Out[92]= 1.47779×10^6

Since the waste created after the ban is smaller than the waste created before the ban, the ban is environmentally worth it.

Environmental Conclusions

The ban would be worth it based on the environmental inequality because the inequality comparing the weight of all the plastic water bottles before and after the ban held true. This means that in this case, the amount of plastic, after the ban was placed, was decreased.

Health

Soda

This inequality compares the soda sales before and after the ban.

In[93]:= s_B

s_A

Out[93]= 620 500 000

Out[94]= 912 500 000

The soda sales after the ban are greater than before, so this is not a healthy implementation.

Water Intake

This compares water intake per day (ounces) before and after the ban.

In[95]:= a_B

a_A

Out[95]= 64

Out[96]= 55

People are drinking less water each day after the ban than before. which is unhealthy.

Health Conclusions

In regards to health, the ban would not be worth it because neither of the health inequalities held true. There was more soda and less water being consumed after the ban which is not good for anyone's health.

Results

Based on the results from each category, the ban would be beneficial to the town based on the economic and environmental standpoints. On the other hand, when looking at the model town from a health aspect, citizens of the town start drinking less water and start drinking more soda as a result of the ban. The ban in this model town should continue depending on which category the model town prioritizes. If health of the citizens is not as much of a priority as economics and environmental, the ban should continue. But, if the model town places high priority on the health of its citizens above economics and environmental, the ban should not continue.

Concord Application

Data and Variables

In[97]:=
```
p = 15515;
nf = 23;
fc = 5000;
ns = (((602 * 2000 * 0.0004 / r) / ms) * 52);
nL = (((585 * 2000 * 0.0004 / r) / mL) * 52);
ab = (ns * 16.9 / p) / 365;
aa = (((nL * 50.7) + (nf * af)) / p) / 365;
```

Population is using the Concord, MA population from 2018 [29] and n_f is as of 2019 [29].

n_s and n_L were found using the recycling reports of Concord from before and after the ban [22]. This gave us the tons of total recycling in Concord every week. This was first converted into pounds. From there, we used that 0.04% of total recycling is water bottles [23] to get the weight of water bottles in the recycling. This was the divided by the percent of bottles that get recycled to get the total weight of bottles used in the town. This was then divided by the mass of the bottle to get the number of bottles used by the entire town each week. This number was then converted into the amount of bottles used by the town in one year.

a_b and a_a were found by taking the total annual water intake of the population, and then splitting into one person per day. a_b only dealt with the water in purchased bottled water, where a_a also included water from the public drinking fountains.

Economic

In[104]:=
```
((1 − r) * ns * ms) * cw
((1 − r) * nL * mL) * cw + fc * nf
```

Out[104]= 116 868.

Out[105]= 228 568.

Since the cost after is greater than the cost from before, the ban was not economically worth it for the town to place it.

Environmental

In[106]:=
```
(1 − r) * ns * ms
(1 − r) * nL * mL
```

Out[106]= 58 434.1

Out[107]= 56 784.

Since the waste after the ban is smaller than the waste before the ban, the ban is environmentally worth it.

Health

In[108]:= $\mathbf{a_b}$

$\mathbf{a_a}$

Out[108]= 10.9832

Out[109]= 58.111

Since the water intake per resident is greater after the ban then before, the ban is healthier for the residents of the town.

Overall

The application of the model shows that Concord's water bottle ban is worth it for two out of the three categories (Health and Environmental). The reason that the model didn't pass the Economic inequality is because the town had to spend extra money installing and maintaining the water supply of the public fountains. The possible errors in the application of this model include the challenges in obtaining data for the amount of water bottles used in each town, and tap water is not accounted for. This application does not look at soda intake because the data is very challenging to collect due to the different ways people drink soda (fountain drinks, bottled, etc.) One way that the Concord water bottle ban could be made even better is the banning of plastic soda bottles as well.

San Francisco Application

Data and Variables

In[110]:=
```
p = 884 363;
nf = 37;
fc = 5000;
rb = 0.5;
ra = .47;
ns = (((602 * 2000 * 0.004 / rb) / ms) * 52);
nL = (((602 * 2000 * 0.004 / ra) / mL) * 52);
ab = (ns * 16.9 / p) / 365;
aa = (((nL * 50.7) + (nf * af)) / p) / 365;
```

Population is using the San Francisco, CA population as of 2017 [27].
r_b and r_a are the different recycling rates in San Francisco for 2013 and 2015 [24].
n_s and n_L were found using the recycling reports of San Francisco from before and after the ban [24]. This gave us the tons of total recycling in San Francisco every year. We then followed the same process as with Concord.
a_b and a_a were found by using the same process as with Concord.

Economic

In[119]:=
```
((1 − rb) * ns * ms) * cw
```
Out[119]= 500 864.

In[120]:=
```
((1 − ra) * nL * mL) * cw + fc * nf
```
Out[120]= 749 804.

Since the cost after is greater than the cost from before, the ban was not economically worth it for the city to place it.

Environmental

In[121]:=
```
(1 − rb) * ns * ms
```
Out[121]= 250 432.

In[122]:=
```
(1 − ra) * nL * mL
```
Out[122]= 282 402.

Since the waste after is greater than the waste from before, the ban was not environmentally worth it for the town to place it.

Health

In[123]:= a_b

Out[123]= 1.15612

In[124]:= a_a

Out[124]= 2.56873

Since the water intake per resident is greater after the ban then before, the ban is healthier for the residents of the city.

Overall

The application of the model shows that San Francisco's water ban makes some things better and some things worse. That being said, again, the model assumes that citizens will not be drinking tap water, which makes the situation seem more dire than in actuality. In a real life situation, less large plastic bottles would be drank so there would be less waste. Additionally, the cost of purchasing 37 fountains all at one time is expensive, but over time money will be saved because the purchase is a one time expenditure. On the other hand, disposing of plastic will always be the same cost per amount every year, and this will not decrease.

Airport Application and Modification

Economic

While a town has to pay for disposal of waste, airports only have to pay for garbage expenses. This number would not change before to after the ban because the airport still needs trash services. Based on our economic model and assumptions, the only thing the airport needs to pay for would be to add water fountains. Our economical model would also have to be adjusted because visitors of the airport are not buying all their water they drink in a day from the airport. It is safe to assume all visitors buy one small plastic water bottle which would account for the people who do not buy water and the people who buy extra. Furthermore, the economic model is based on the population of the town, so the population would have to be changed to number of visitors per year at the airport. The expenses of the airport outweigh the ban's effect on water prices for the visitors of the airport. If the airport has to pay more, it will increase other costs the visitors have to pay for so that the airport still makes a profit.

Environmental

Like in a town, the environmental effects would be dependent on the amount of waste produced. In past bans, there has been an 80% decrease from the sale of small plastic water bottles to large plastic water bottles [21]. If the amount of small water bottles sold in an airport is equal to the number of visitors, the number of large plastic water bottles sold after the ban would be 20% of this. From this we wrote an inequality that compared the amount of waste before and after the ban. This same philosophy is used when finding economic factors, such as the number of fountains, the number of small plastic water bottles, and the number of large plastic water bottles.

Health

The health model for towns and airports will stay relatively the same except for the fact that visitors only buy one small water bottle each. This means that to find the amount of water consumed, instead of having the previous inequality that compared total daily water intake, it would be $v_b < 0.2 * v_a$. The inequalities to compare the amount of sugar consumed and the likeliness of someone to choose soda would stay the same.

Changes to the Ban

Based on the model, some changes that could be made to Concord's water bottle ban include extending the ban to all plastic bottles with a volume of one liter or less. This means that water, along with other flavored drinks like soda and juices will not be distributed or available in small bottles. This would impact both the environmental and health aspects of the model, and increase the likelihood that the inequalities regarding these two categories would evaluate to true. By banning products such as these, the overall waste that the town would produce would decrease due to the lack of access to the smaller, more convenient bottles. As a result of the decreased purchases of such products, overall health would increase as well. If only plastic water bottles were banned, sugary drink consumption would increase, but since they are made unavailable by this adjustment to the ban, overall consumption would decrease in comparison. For the health model in particular, the ratio of soda consumption before and after the ban should be equal, if not less than before the ban was put into place.

Model Application

This model should be generalizable to communities on a larger scale, such as bigger cities, regions, states, and countries. By accounting for several different factors that may affect the overall situation, using the model for many different locations and needs should be feasible. The model accounts for differences in population, water usage, number of bottles, and the cost to deal with the waste, as well as fossil fuel usage. Each individual region is also able to determine what factors are most important to them, and ultimately decide for themselves if enacting a ban on plastic bottles is feasible and justified for their situation.

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