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## Effectiveness of Plastic Ordinances in Santa Monica, CA: Do regulations at the municipal level reduce plastic waste?

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# **Effectiveness of Plastic Ordinances in Santa Monica, CA:**

**Do regulations at the municipal level reduce plastic waste?**

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### **Executive Summary**

Plastic is a cheap, robust and versatile material with numerous practical uses that contribute to the convenience of modern day life. However the very same properties that make it uniquely diverse and hardy also contribute to the hazards it poses to the ecosystems and human health. If current consumption and manufacturing practices remain unchanged, there will be hundreds of millions of additional tons of plastic introduced into the environment over the coming decades. To mitigate this issue, some cities, such as Santa Monica, have implemented ordinances and policies directly aimed at this growing problem, albeit with ambiguous results. To better understand the relationship between waste reduction and local ordinances, the City of Santa Monica was selected as a case study for this topic.

This study specifically analyzed descriptive quantitative data according to yearly trendlines in debris collection and recycled plastic tonnage reports as well as a comprehensive list of California plastic ordinances to determine if any correlation or causation existed between plastic regulations at the municipal level and waste/litter quantities. Additionally, interviews with city officials and recycling experts were also conducted to provide further insights into city policies and their perceived outcomes.

After extensive analysis, only a significant reduction in plastic straws and stirrers could be established from the years 2015-2019. There were some decreases in plastic takeout containers, cups and plates in and around Santa Monica, but their trendlines were nearly flat. Furthermore, the interviews with policy and recycling experts yielded four major common themes regarding plastic ordinances: Impact of Regulations from State and Federal Legislation, the Lack of Incentives in a circular economy for plastics, the need for increased Producer Responsibilities, and more emphasis on Educating the Public in terms of plastic recycling, reuse and reduction methods.

Consequently, while local ordinances do have a limited influence on plastic waste reduction, a more comprehensive solution will entail a unified effort at the state, federal and international levels if significant results are to be achieved. The most likely path to significant results are policies that create and foster a circular economy for plastics such as minimum content laws.

### **Introduction of Policy Issue**

Plastic is an incredible man-made material that helps make modern life possible. Its various forms and unique properties have directly contributed to major developments in medical advances, food preservation, along with cheap consumer goods from cellphones to cars and construction materials. It is also relatively cheap and easy to manufacture, being a byproduct of the oil and natural gas industry. Plastic in all its variations is truly a modern invention which is hard to imagine being without.

However, the same characteristics that make it an incredibly diverse and hardy material with numerous applications, are also what makes it such a hazard to the global environment and to public health. It is a pervasive problem that can be found at the bottom of the ocean to inside your own body in the form of microplastics. Millions of tons of discarded plastic float in the ocean in great patches that kill and sicken aquatic animals from the smallest fish to the largest whale.

If current consumption norms and manufacturing remains unchanged, there could be 710 million metric tons (Simon, 2020) that will be introduced into the environment over the next 20 years. Just as in the ocean, on land plastic waste piles up in landfills (26.8 million tons in 2017) (EPA, 2017) due to the very property that makes it so sought after, it's incredible durability. Some plastics are so long-lasting that it takes an estimated 400 years (Parker, 2018) to breakdown naturally. Just as important, plastic pollution has become inescapable and extensive contributing to widespread sickness and cancer across the globe in both developed and developing countries.

Recognizing this growing issue, major cities to such as Santa Monica have steadily implemented taxes and other policies to try and reduce consumption of plastics, usually at the consumer level. However, the cost of these taxes on single use items such as plastic bags, straws, lids and other goods mostly fall on consumers and businesses. It is also unclear if a significant reduction in plastics pollution has been achieved through these regulations.

### *Justification for Study*

For decades, the City of Santa Monica has tried to address the growing problem of plastic waste by crafting ordinances and fees that encourage consumers to reuse, recycle or reduce consumption of many single-use plastic products. In 2007, it banned polystyrene food service containers, going so far as to also advocate for a single-use plastic bag ban by the year 2011 (Santa Monica Staff Report, 2018). In August 2018, the Santa Monica City Council revised the existing ordinance to require all food and drink service providers to only use marine degradable straws, lids, plates, bowls, trays, containers, straws, utensils, stirrers, cups, and lid plugs. The ordinance went into effect on January 1<sup>st</sup>, 2019.

Clearly, city officials in Santa Monica recognize the increasing concern of plastic waste and, like other municipalities around the world, have taken action to persuade or mandate consumers to reduce consumption or reuse items when possible. However, the cost of these fees on single use items such as plastic bags, straws, lids and other goods has consistently fallen on consumers and businesses while not significantly impacting the producers of virgin plastic materials.

Furthermore, it is unclear if these specific taxes employed in Santa Monica have truly resulted in a significant reduction of the consumption and waste of single-use plastics. While some cities have commissioned studies to evaluate environmental pollution levels before and after

similar policies, no definitive study has been produced for Santa Monica that examines this relationship to identify if there is a correlation or causal relationship between such local policies and plastic waste. .

By analyzing when ordinances went into effect along with waste collection data for the City of Santa Monica, in addition to conducting interviews with sustainability policy experts, this study will examine the relationship between plastic taxes at the municipal level and the resulting amount of plastic waste. In doing so, the study will determine if any meaningful relationship exists between the two factors. In short, and excluding the outlier impact of COVID-19, the study will use Santa Monica and the surrounding localities to conclude if these taxes and fees actually reduce plastic waste and, if so, to what degree, for how long and are the gains to the environment worth the cost to consumers? Lastly, this project will identify what other policy solutions could be implemented by the city of Santa Monica and other localities to reduce plastic waste and foster more sustainable consumer behavior.

Based on the accompanying research, I hypothesize that the plastic ordinance fees in Santa Monica have indeed decreased plastic waste. To what degree is still uncertain. Further study of collected waste data from 2011-2019 along with expert opinions will either prove or disprove this theory while adding further insights into the overall issue.

### **Literature Review**

This section analyzes a wide selection of published works and articles dealing with plastic waste and the policies localities are using in an attempt to mitigate or prevention this issue from worsening. The section starts with a broad look at plastic manufacturing, recycling and economic trends before moving on to examine how effective targeted approaches (i.e. such as plastic bag fees and bans) are at eliminating waste or changing consumer actions. It concludes with a brief

look at the international perspective of regulating plastic in addition to potential policy obstacles US based localities may face when implementing ordinances related to plastics.

### *Plastic Manufacturing and Recycling Trendlines*

Santa Monica is far from the only city or entity aware of this problem or to consider adding a ban or fee to single-use plastic goods as a way to encourage more sustainable consumer behavior and protect the environment. According to National Geographic Society researchers, roughly 6.3 billion metric tons of the 8.3 billion metric tons of plastic ever manufactured has become trash. It was one of the first global analyses of its kind and noted that plastic production is doubling every 15 years. The same group posits that recycling will not be the soul solution to this major environmental and health crisis, finding that only 9% of all plastic has been successfully recycled with the rest either being burned, buried or dumped in the oceans. (Parker, 2018).

The myth of recycling plastic was further scrutinized and exposed by journalists and researchers from NPR and PBS Frontline when they analyzed oil and gas industry documents along with interviewing former officials that had promoted recycling policies for decades. These investigators point out how large oil and gas companies encouraged recycling campaigns and public awareness since the mid 1970s, even though they knew it was largely misleading (Sullivan, 2020). Recycling plastic is tedious, time consuming and expensive. Additionally, some plastic types degrade with each cycle so that it can only be reused a finite number of times unlike other materials such as glass or aluminum. Virgin plastic, of which the oil industry derives approximately \$400B a year from, is cheaper to produce and is of higher quality than most used plastics.

Regardless of this fact, many officials, economists and scientist still argue for a circular economy that would foster economic and technical solutions needed to make plastic waste a



valuable commodity. In a 2019 study, researchers evaluated potential market driven solutions to plastic waste as an alternative to Australian governmental regulations (Forrest, Giacobazzi, & Dunlap, 2019). They argued that producers were not being held accountable for the negative externalities caused by their products over their entire existence, especially after it was discarded. The researchers favored an industry-led, volunteer approach believing that the program would be most effective if taxes or fees were implemented at the resin production point in the supply line.

To further explore the cost and feasibility of a plastic circular economy, a UK study analyzed the impacts that a potential plastic packaging tax would have on average households (Voulvoulis, Kirkman, 2019). The proposed packaging tax would apply to all plastics with less than 30% recycled content manufactured in the UK. The study determined that the incidence of the tax transferred to households would be roughly 16 pence (appx. \$0.22) per week per household. The researchers also estimated that the tax would stimulate the value of recycling as well as spur new investment in domestic recycling.

#### *Plastic Bag Fees and Bans*

In 2017, researchers from New York University and the Energy & Environment lab studied Chicago's municipal fee on single-use plastic bags. This policy followed an earlier failed attempt in 2016 to ban plastic bags outright, which led to retailers substituting thicker bags that were considered "reusable" instead of the flimsier variety. They compared shopping bag use for 14,168 customers at large grocery stores in and around the Chicago area months before and after the bag tax was applied in a "difference-in-difference" model (Homonoff, 2017).

Using raw, unadjusted data and controlling for various demographic and neighborhood factors, the study concluded that the bag tax significantly reduced disposable bag use and increased reusable bag use at retail grocery stores. Before the additional fee, 82% of monitored customers

used at least one disposable bag per trip; after the tax, their regression model concluded that there was a 28% decrease in bag usage and 13% increase of customers switching to reusables.

A similar “difference-in-difference” study was conducted by researchers from the University of Ottawa, focusing on a Toronto disposable bag levy. Using longitudinal data of the National Households and the Environment Survey (HES) the team concluded that the plastic bag fee of \$0.05 Canadian dollars resulted in a modest 3.4% increase in the propensity of consumers to regularly use reusable shopping bags (Rivers, Shenston-Harris & Young, 2017). Even though they controlled for temporal, geographic, income and other demographic measures, the researchers declared that there were potential limitations in the data, namely that the survey is self-reported instead of being administratively recorded.

Overall, the study concluded that the attempt by the Toronto municipality to encourage reusable bags was most effective on those already doing so while having negligible impact on those that did not or did so infrequently. Impacts were also largely concentrated in households with high socio-economic statuses.

Taken together, these two studies imply that there is at least a correlational relationship between fees on plastic bags and reduction in use or utilization of reusable substitutes. The examples also imply that any change in behavior may have a positive link to household income and education levels as well as accessibility of substitute goods. Conversely, similar policies may be unpopular with lower socio-economic households that pay a higher fee relative to their income.

This belief is further strengthened by researchers examining New York City Council’s 2013 proposed carryout bag ordinance, Bill No. 1135-2013 (Romer, Tamminen, 2014). In their examination they conclude that charges/fees have a more lasting and greater impact than outright bans because consumers are required to make a conscious decision to purchase or not purchase a

bag. This could be determined as the “loss-aversion” theory. The conscious experience of paying more for a bag incentivizes consumer to change their behavior to adapt to the new situation. They also recommended that any fee for bags be kept by the retailer so that charges are technically not taxes collected by the government, with 10 cents being the optimal amount. Interesting, this is the current fee for most plastic bags at retail grocery stores in Santa Monica.

Furthermore, both studies created models and analyzed data based off of real-world experiments of municipalities in either the US or Canada to determine feasibility, issues, failures, and successes as a way to prepare municipalities for future implementations. Neither one, however, examined if less waste was actually being produced. How long the change in behavior lasted was also not identified in the long-term due to either the charge being repealed or the study ending.

One study that did measure pollution levels originated in the city of San Jose, California. A city commission tasked researchers to measure plastic bag accumulation in storm drains and other waterways before and after a ban on single-use plastic bags. This ban also included a 10 cent fee for paper bags. To measure the effectiveness of this ban, litter surveys were taken before and after the implementation of the ordinance using regularly collected data. Teams found an 89% reduction in bag litter in storm drains and the city’s environmental and transportation committee reported a similar drop to 60% in creeks and rivers and 59% in city streets and neighborhoods when compared to 2010-2011 data (Zeitlin, 2019). The city of San Jose also measured consumer bag use as part of the study. By the end of their research, they concluded that reusable bag use jumped from 4% of consumers to 62%. In addition, those using no bags at all doubled.

*The International Response*

It is important to be aware that adding fees or taxes to single-use plastic items is a growing trend around the world. A comprehensive study of 291 policies created by 43 national governments from 2000-2019 was recently compiled in to the Global Plastics Policy inventory database (Karasak, Vegh, & Diana, 2020). From this collection, researchers examined the different means employed to prevent plastic pollution and concluded that the major categories could be divided into either regulatory, economic, or informational policies.

After an extensive analysis, it was determined that there was an accelerating upward trend over the last decade in international policies specifically targeted at minimizing plastic pollution. This was true at all levels of government. Furthermore, regulatory measures (i.e. bans) were the most common policy type followed by economic disincentives.

#### *Obstacles to Plastic Regulations in the U.S.*

In the U.S., however, there has been a growing divide between some cities wishing to implement a tax on certain plastic goods and State Legislatures trying to block them. One study found that as of 2017 there were 271 local governments in the US that had some type of plastic related ordinances. This amounted to 9.7% of the country's total population (Wagner, 2017). The same study also noted that while many municipalities were attempting to enact these measures, 11 state governments were considering laws to prohibit local government regulation of single-use plastics, primarily shopping bags. This was in part a response to the lobbying efforts from plastic and shopping bag manufacturers that claim economic and job loss from decreases in plastic consumption. The impact to the environment was not clearly assessed, however.

A similar study from 2019 raises the idea of Federal action under the Commerce Clause as a way to resolve conflicting issues between states and cities (King, 2019). It found that many states such as Oklahoma, North Dakota, Texas, Idaho, and Florida have passed laws preempting

any city or municipality from regulating plastics and thus preventing bans, fees, or recycling programs not endorsed by the state itself. Conversely, about eight states are mandating plastic reduction and recycling efforts on the part of cities. This divide suggests that the Federal level may eventually have to step in on one side or the other. This specific problem does not currently directly apply to Santa Monica due to it being in a state that also largely supports reduction, recycling and other similar policies. However, other municipalities wishing to implement similar measures may have to factor in this particular consideration accordingly.

## **Methodology**

### **Descriptive Data**

The main objective of including the following data is to observe any general trendlines that might support the hypothesis that plastic waste ordinance laws in Santa Monica (as well as neighboring localities) have had a measurable impact. In other words, did plastic waste collected decrease, increase or remain relatively constant after certain laws were implemented? The descriptive data gathered for this study consisted of three separate statistical sources.

The first came from the Ocean Conservancy's Trash Information and Data for Education Solution or "TIDES" website. TIDES is an open public data set compiled by volunteers that contains one of the world's largest reports of material related to recovered trash, mainly along coasts or water fronts. Each annual data set includes information such as the location, date, number of volunteers, how many miles were covered, the number of pieces found and the total poundage of trash that was collected as well as numerous highly specific categories of waste. A complete list of categories used in this study can be found in Appendix A.

This study will use reports taken from Los Angeles County (where Santa Monica is located) along with Ventura County to the North and Orange County to the South to be used for

comparison. These locations share many similar geographic and demographic features with Los Angeles County while also having notable differences in city laws as well as population sizes. For instance, only LA County has a plastic bag ban which was implemented in 2012 for some major retailers and restaurants. LA County also has the largest population at 10.4 million in 2019 compared to 846,000 and 3.1 million for Ventura and Orange County, respectively.

Nevertheless, all three counties have a partial polystyrene ban applying to government facilities but with different implementations dates as follows: Ventura in 2004, Orange in 2005 and LA in 2008. Moreover, Santa Monica has enacted total plastic bag (2011) and polystyrene (2007) bans in place for restaurants and most major retailers.

Secondly, while the data from this source only extends from the present to 2015, it can still be vital in formulating and extrapolating any general trends. Through a time-series analysis, an approximate trendline can be established that supports or disputes any possible correlation between plastic waste reduction or prevention measures and their effectiveness.

Further comparisons can be made between the three counties' data sets to determine if any single county has had any measurable impact in reducing the amount of trash within its borders. The results might alternatively suggest the spread and movement of waste and other negative externalities that cannot be mitigated through targeted municipal measures. Instead, clearer results might be discernable when similar laws are applied to an entire county or state. If so, this will have considerable implications for current and future policy measures.

It is important to note that for LA County, the Amount of Participants and Mileage Covered metric tends to increase from year to year. This is opposed to Ventura and Orange Counties which record both increases and decreases for each variable in different years (See Figure 2 for detailed comparisons). This difference in variables could be a result of a higher population in LA County

or growing familiarity of the collection system. Thus, the indicators of increasing Participation and Mileage Covered will be carefully scrutinized in the following analysis section to ensure these factors are not skewing the data disproportionately. A proportionality ratio from year to year will also be conducted to ensure systemic bias is not being reported. Additionally, because the data from this source is self-reported, there are potential issues with its overall validity. Data that is compiled and verified by certified organizations or researchers would be more ideal, but after scrutinization and evaluation of the data, there did not appear to be numerous outliers that would suggest dishonest input or mistakes in submission.

Moreover, after controlling for both Participation and Mileage Covered, the calculated Ratio of waste collected per year will offer deeper insights into the question of plastic ordinances' impact. If proportions between Waste Collected and Participants and Mileage Covered are decreasing, then the hypothesis is supported. If proportions are the same or increasing, the hypothesis is not supported.

The second data source used in this study was supplied by the City of Santa Monica's Resource, Recovery and Recycling Division. Until a recent change in internal policy, the division maintained monthly reports that included measuring the tonnage of various types of recycled material before being hauled away to a private recycling business. This is the reason this particular data source ends in May of 2019. However, from January 2011 to May 2019, these reports were combined into yearly spreadsheets managed by city personnel (See Appendix B for full reports). Along with specifying the calendar year and month of collection, the data provides detailed tonnage weights of numerous recycled materials to include Aluminum cans, steel, E-Waste, and four different types of plastics. These plastic categories are the following:

- PET (ex: soda bottles)
- HDPE – Colored (ex: shampoo and other chemical containers)

- #2 HDPE (ex: milk jugs, detergent bottles, etc)
- Miscellaneous Plastics.

Also of note, the data for Miscellaneous Plastics was only available for the first six months of 2018. After this time, input for this category stops being recorded with no specified reason was given. Apart from this relatively little missing information, the overall data depicted the total amount of material that was recycled in Santa Monica on a month-to-month basis for 7.5 years.

This data offers a unique opportunity to extrapolate any direct correlation between when ordinance measures were implanted and their impact on plastic waste amounts within the municipality. Not only does this source potentially reveal recycling trends within the city, but it can also indicate general overall levels of plastic refuse. This can be achieved by using recycled tonnage as a proxy measure for the total level of plastic consumption. If there is less waste being recycled, then that might suggest that there is less plastic consumed overall and ordinance laws are having a positive impact. On-the-other-hand, if the analysis reveals that increased amounts of waste is being recycled, then this could indicate that municipal ordinance measures are not having the desired outcome. Other reasons and exogenous factors could also be contributing to either outcome such as a decrease in the price of recycled plastic driving down collection efforts, or increases in the city's emphasis on recycling.

While the reliability of this data can be evaluated to be fairly dependable in that it comes directly from Santa Monica officials, there are limitations and issues. The collection method and protocols in place for measurement of tonnage were not clearly described. Additionally, more detail on the specific categories of plastic waste and number of pieces would have been useful. Nevertheless, this source provides vital information about plastic waste and recycling for Santa Monica. In conjunction with this data, specific city ordinances and when they were enacted can



be analyzed to determine if any rough correlation exists with the level of plastic waste in the municipality.

The last data source employed in this study was compiled from a non-profit environmentalist research and advocacy organization named “Californians Against Waste.” The data itself consists of county and municipal public record ordinances throughout the state that have enacted some version of either a polystyrene or plastic bag ban. These bans can consist of a wide spectrum from either a full or partial ban along with additional caveats. As previously noted, both plastic bag and polystyrene bans commonly have many such stipulations such as only applying to certain types of vendors (i.e. restaurants) while leaving others unaffected (i.e. commercial retailers). Thickness of plastic bags is also another frequent quantifier with thicker plastic bags frequently being classified as “reusable,” usually if the thickness is 2.5mm or greater. This particular compilation is useful because not only does it identify the locality of the ban (specifying the city or county) and the years they were implemented, it also details a brief summary of the ordinance laws that identify any caveats or special exemptions. The cumulative information thus details 147 different localities at either the city or county level throughout California and the full converted spreadsheet with additional regulations can be viewed in Appendix C.

For this study, the locality and time of implementation of each type of ban will be the most important factors. This information will be employed to identify if any time clusters related to the data exist. If such clusters do occur, they may help explain trendlines in the previous data relevant to any spikes or drops in various plastics. More detailed policy bans of numerous other categories would be ideal for this research, but the grocery bag and polystyrene bans will be employed as proxies to determine overall waste reduction trends and environmental priorities of the localities. For instance, if rates of recycling or waste collection begin to fall soon after an ordinance was

passed, then that could signal the effectiveness of the measure. Lastly, it is vital to realize that even a stabilization of waste or recycling during a period of time might signify a moderate successful ban or fee.

### **Qualitative Data**

To provide further insights into current issues and city policies, a series of interviews and surveys were also conducted with recycling subject matter experts as well as Santa Monica city officials. The specific purpose of these surveys and interviews includes the following:

1. Determine the most significant challenges faced by city officials when determining policies to reduce plastic waste.
2. Learn what these experts believe are the most and least successful policies in preventing, mitigating, or responding to plastic waste/litter.
3. Ascertain what policies or actions they would recommend in the future to deal with this growing problem at the local, state or even federal level.

In total, eight policy experts ranging from sustainability analysts to recycling company employees were contacted in regards to this research project. Most of these individuals were sought out due to their connection and familiarity with the City of Santa Monica's sustainability initiatives, sometimes having worked decades in their department or similar fields. Others had expertise in either the local recycling industry or familiarity with the wider impacts of plastic waste.

All eight experts were contacted via publicly listed emails that introduced the research project, the author and a list of questions that could be either answered in a return email or via the phone (see Appendix D). Of the eight, six individuals responded back, five answering the concurrently sent survey questions outright with only one requesting a telephonic interview which was conducted in a semi-structured format and recorded using Microsoft Word during the roughly 50 minute meeting. The six experts represented three Sustainability Analysts or Planners with the

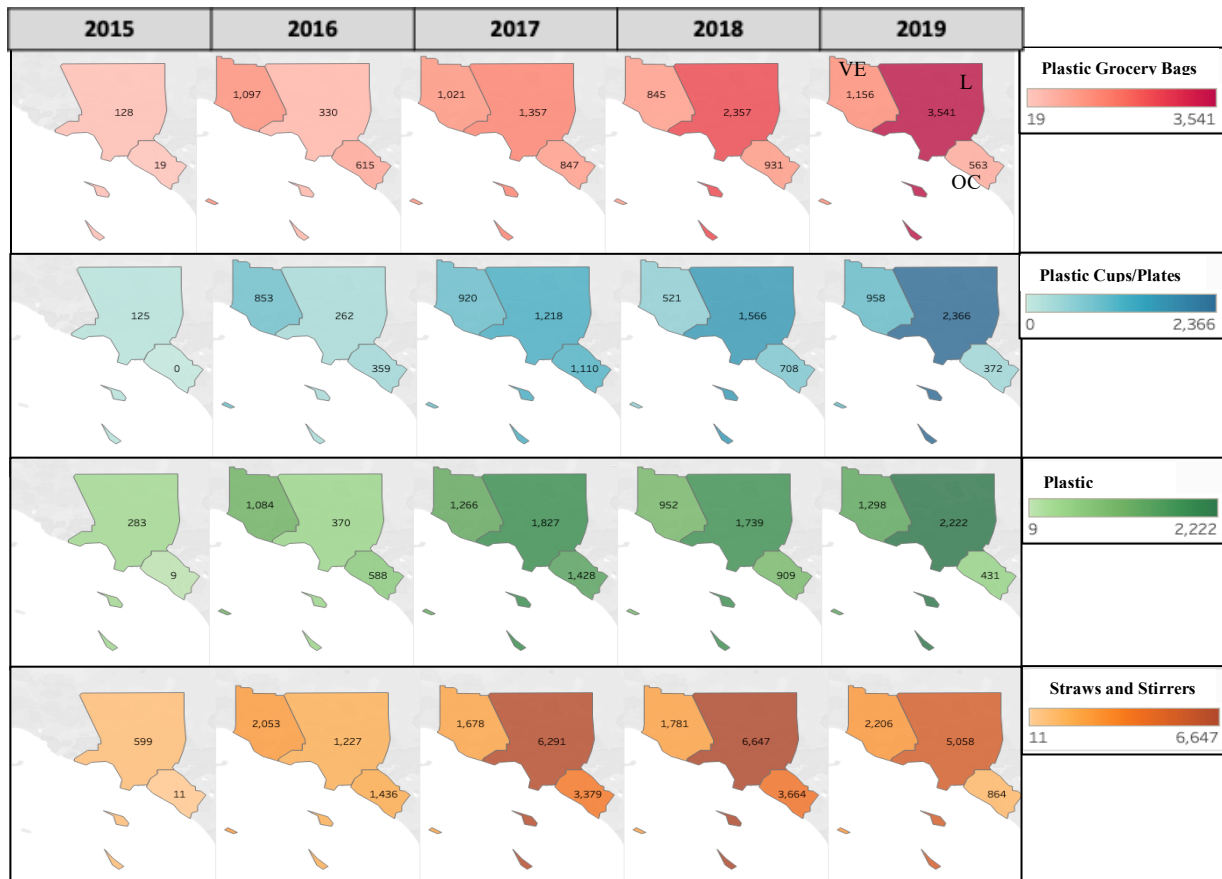
City of Santa Monica, a program assistant with the Ocean Conservancy non-profit organization, a policy analyst from the Californians Against Waste organization and a senior analyst with a local recycling company. All experts were informed that no personal or identifiable information would be recorded in the research project and were free to share their personal opinions regarding this issue.

### Quantitative Data Analysis

#### Regional Plastic Waste Overview

The data from the TIDES source was used for determining overall trendlines of debris collection in southern California, specifically the counties of Los Angeles, Orange and Ventura. Figure 1 is a visual comparison between the individual counties and the total amount of five different types of trash recovered between 2015 and 2019. The darker the color, the more trash was found and removed. To further quantify this representation, the number of individual pieces of each item are also included in the figure.

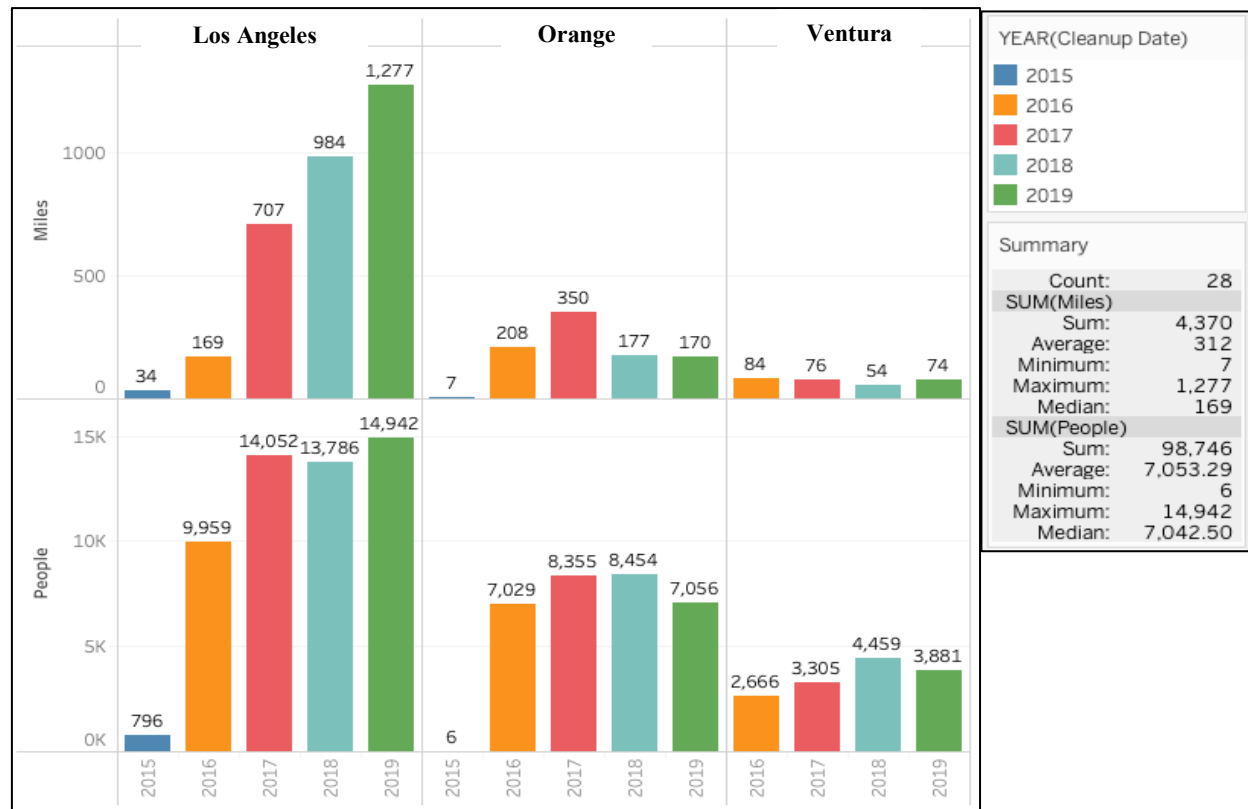
**Figure 1:** Plastic Waste Collection Comparisons of LA, OC, Ventura (VE) Counties, 2015-2019



As demonstrated in the above figure, LA County reported an increase in nearly every category of debris each year (not just in the 4 examples shown). Only “Straws and Stirrers” saw a decline in LA County from 2018-2019. While this could seem like an insignificant outcome, California State Law could be at play in this particular result. This is because Assembly Bill 1884, signed by California Governor Jerry Brown in September of 2018 (Bruek, 2018), “prohibited dine-in restaurants from automatically providing plastic straws” to customers unless they specifically asked for them. While this law only went into effect in late 2018 and did not apply to take-out orders, the case for a loose correlation can be made. Nevertheless, Orange and Ventura Counties experienced a more mixed outcome for each material. Additionally, fluctuations in the Participation Rate and Mileage Covered variables may be impacting this outcome, which is further examined and mitigated below.

Because Santa Monica falls within Los Angeles County, any ordinance laws created by the municipality would ultimately be aggregated within the greater LA area. In essence the City of Santa Monica’s policymakers are competing with the different waste prevention measures, techniques and priorities (if any) of not only all the localities within LA County, but also those of nearby counties due to high mobility rates of individuals and spillover externalities caused by ocean tides and wind which can influence accumulation. As seen in Figure 1, LA county goes from relatively light levels of reported waste in 2015 to nearly exponentially higher amounts by 2019. The Counties of Orange and Venture also increase in waste collection amounts in some areas. When viewed out of context, one interpretation of this outcome would suggest that ordinance laws are not having the desired impact in the targeted areas. However, as previously stated, the variables of Amount of Participants and Mileage Covered also need to be considered when analyzing these results. These variables are depicted in greater detail in Figure 2 below.

**Figure 2: LA, OC and Ventura Mileage Covered and Participation, 2015-2019**



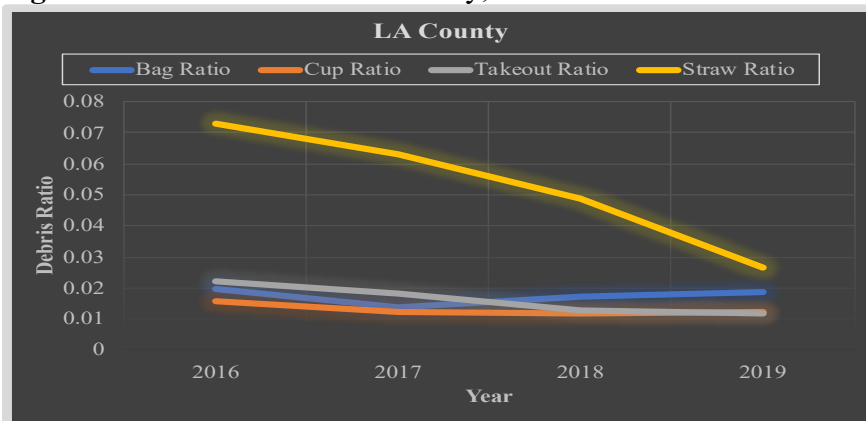
As seen in Figure 2, the Mileage Covered level in LA County rises with each year going from 34 miles in 2015 to 1,277 by 2019. The Participation levels also increases between 2015 (796 people) and 2017 (14,052 people) but then levels off from 2017 to 2019. Comparatively, in Orange County there is little data for 2015 with only moderate increases in Mileage Covered and Participation levels between 2016 and 2017 with a slight dip and then stabilization in the latter years. For Ventura County there was zero Participation and thus Mileage Covered in 2015 with only relatively slight fluctuations in both variables in the remaining years. This could suggest that the overall familiarity or popularity of the TIDES systems is less in both Orange and Ventura County or that the higher population demographics of LA tilt the data to reflect this outcome. Regardless, when not properly mitigated, these specific variables for each county in each year can

distort the overall information. Thus, a ratio that clarifies how much waste was collected per person per mile per year, needs to be established. That formula is as follows:

$$[\text{Debris Ratio} = (\text{Amount of Debris} / \text{Participants} / \text{Mileage}) \times 100^*]$$

Using this formula, the ratio of each debris collected can be applied according to each year by each person per mile, which makes comparisons without distortion possible. An increasing ratio would either mean that individual people are becoming more efficient at collecting waste (more pieces per person) or that there is more overall waste to collect. A decreasing ratio would mean that worse collection methods were being used or that there was less trash to find per person. Because the collection system has been in place for 5 years, it is reasonable to suspect that, while not 100% certain, collection methods and data entry would either improve or stay the same each year, while the amounts of debris would act as the dependent variable. This formula is applied to Figure 3 which depicts the ratio for four different types of plastics in LA County between 2016 and 2019 (2015 was removed due to extremely low Participation and Mileage Covered skewing the data.)

**Figure 3:** Debris Ratio in LA County, 2016-2019



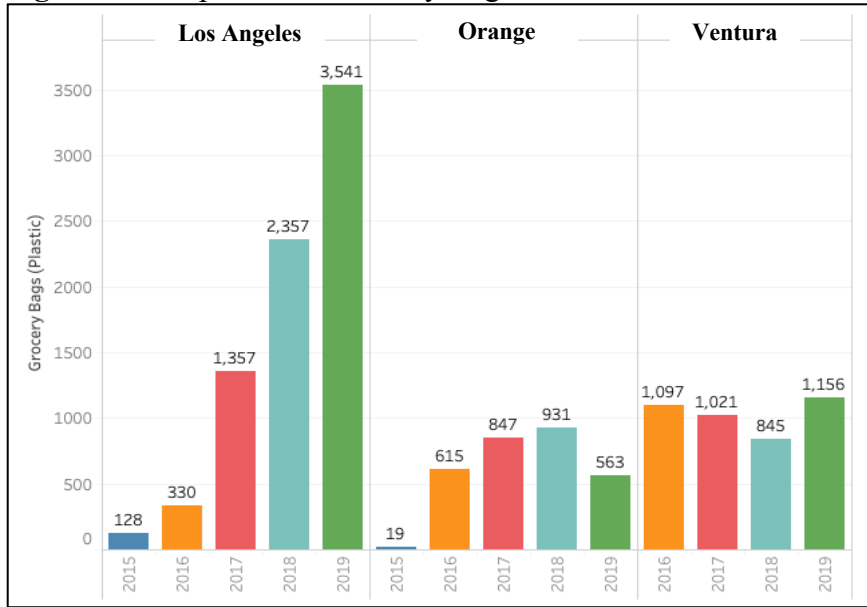
As previously mentioned, and evident from the above figure, only “Straws and Stirrers” Ratio have had a noticeable decline in LA County. There were slight decreases in “Plastic Takeout

\*Multiplying by 100 is used to make comparisons of the fractions more apparent.

Containers” as well but not nearly as significant. For both “Plastic Cups/Plates” and “Plastic Bags” the trendline was nearly flat. The charts for Ventura and Orange County (Appendix E) also depict similar declines in “Straws and Stirrers” between 2016 and 2019 while modest, if any, decreases in the other ratios. This particular outcome could establish correlation between this particular kind of plastic debris and the State Law AB 1884 as mentioned before. The AB 1884 law applies to all of California and has only recently been enacted in 2019, thus consequences are just now starting to materialize. Moreover, this highlights the impact of timing of laws. Both Los Angeles County and Santa Monica have adopted a plastics bag ban (with some major caveats) in 2012 and 2011 respectively. Because the TIDES data was only recorded years later, there may indeed have been an unrecorded initial drop in plastic bag waste similar to the new legislation regarding straws. Even if this was the case, though, current data implies that besides “straws and stirrers,” plastic waste is generally increasing or remaining the same. Therefore, the relevant ordinances of Santa Monica are either maxed out or no longer having the desired effect due to other factors.

To provide additional perspective to this analysis, Figure 4 and 5 respectfully show the amount of “Plastic Grocery Bags” and “Straws/Stirrers” recovered in each county relative to each other from 2015-2019. The trend in Figure 4 for LA County in “Grocery Bags” is relatively steep and increasing. Orange County, also depicts an increasing amount but at a much slower rate and even a decrease from 2018 to 2019. Ventura County is essentially flat from 2016 to 2019.

**Figure 4:** Comparison of Grocery Bags Collected in LA, OC and Ventura Counties, 2015-2019

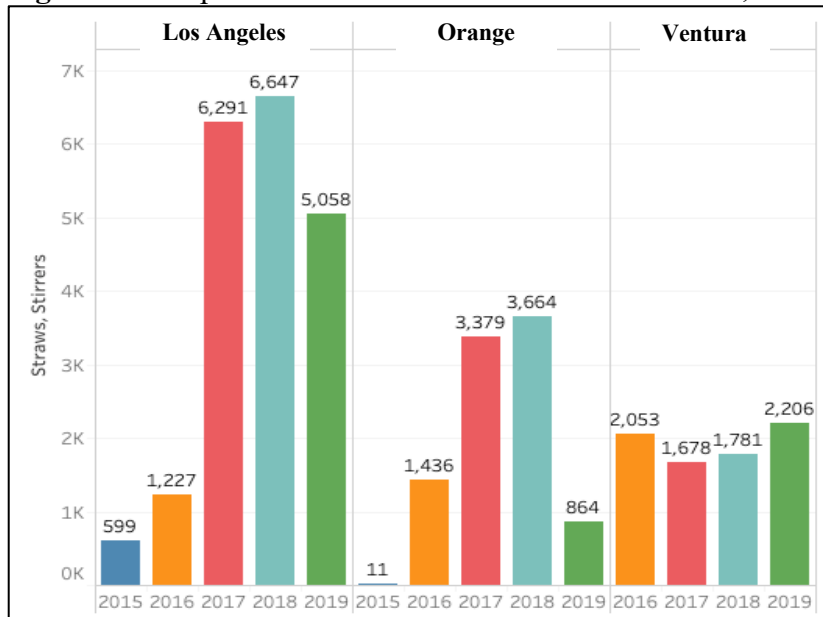


In Figure 5, each county shows a more mixed outcome with “Straws and Stirrers.” LA and Orange County depict steady inclines until 2018, after which they both experience drops in 2019. For LA County, the drop is modest from 6,647 to 5,058. But Orange County experiences a drastic decrease from 3,665 in 2018 to 864 in 2019. The Debris Ratio also reflect similar outcomes. LA County’s “Straws and Stirrers” Debris Ratio, or DR, was 0.073 in 2016 and falls to 0.027 in 2019. For Orange County, the DR drops from 0.098 to 0.045 in the same timespan suggesting that there was indeed less waste to be collected per person in the last year compared to earlier ones. Again Ventura is approximately the same for each year with only a range of 528 collected bags between the lowest and highest years and a deviation of 0.140 between 2016 and 2019.

This is a good demonstration of why a “Ratio of Debris” was needed to be established in order to properly compare the data outcomes. Without it, the full story of the varying Participation, Mileage and Collection amounts between different years would not be clearly told.



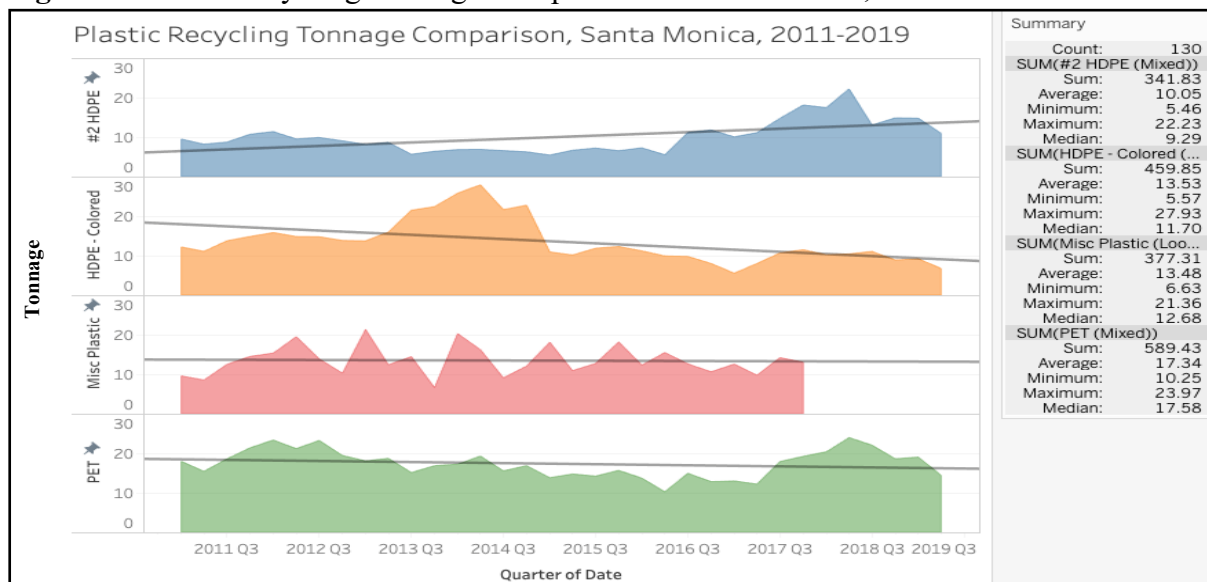
**Figure 5:** Comparison of Straws/Stirrers Collected in LA, OC and Ventura Counties, 2015-2019



*Santa Monica Plastic Waste Overview*

For a more detailed account of plastic waste within Santa Monica alone, an area chart was created from the recycling tonnage reports (i.e. the weight in tons of each material collected for recycling) focusing on the four listed types of plastic waste. This graph can be seen in Figure 6 below. This chart depicts the four types of plastics that were weighed and recorded by the city on a monthly basis along with their approximate trendlines. To illustrate the information, the figure itself is on quarterly instead of yearly time scale.

**Figure 6:** Plastic Recycling Tonnage Comparison in Santa Monica, 2011-2019



This was done to depict the data in a way that clearly visualizes the changes over time and categorical differences. A chart on a yearly scale was not chosen because it misrepresented the last year of the data in which only six months' worth of figures were collected, making it appear to be the lowest and consequently trending down for most of the categories.

From this chart, it can be determined that the Trendline for #2 HDPE is positive, meaning the amount of waste being recycled is increasing with each quarter. For HDPE-Colored, the opposite is true. Lastly, for both PET and Miscellaneous plastics, the trendline is down, but with a slope that is nearly flat, indicating the recycling rate has remained relatively constant during the last 7.5 years.

What are the implications of this information as well as the data earlier in the section? One possibility, as specified earlier, is that Santa Monica's ordinances are having mixed results. For #2 HDPE Plastics, the growth rate is positive which implies they are positively correlated. What is not clear, though, is if more material is being collected to be recycled or if there is just more material overall. If more material is being collected, then the city could have implemented better collection methods, seen higher participation rates, or a higher demand from recyclers. It could also mean there was more material to recycle due to an increasing amount of overall waste. Because the price of and demand for recycled plastic has remained extremely low for numerous years and collection methods for the city have also remained relatively unchanged, the last option is a more realistic one. In other words, the desired outcome of less waste is not being achieved.

HDPE-Colored, which is used in thicker, chemical containers is declining overall, though. Accordingly, some inverse correlation might be attributed to plastic waste ordinance laws except there hasn't been a specific Santa Monica Ordinance which targets this type of plastic waste. Other exogenous or endogenous variables are more likely to be the cause of this decline. For the

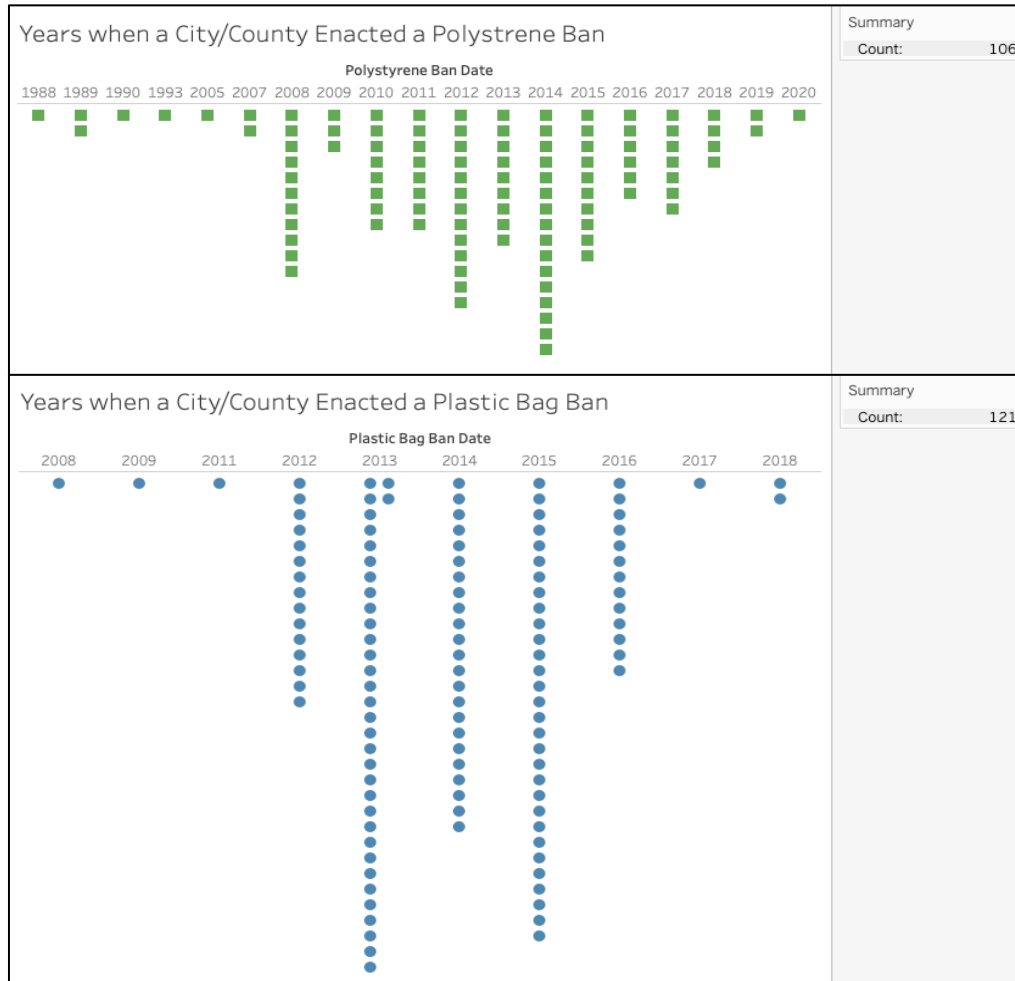
remaining two plastics the relationship is even more ambiguous. However, numerous exogenous shocks such as a brief increase in the price of recycled plastic, a temporarily more engaged public due to a PR campaign, or less plastic due to seasonal or other reasons could also be a factor in this outcome.

### *Plastic Waste Ordinance Clusters*

As previously mentioned, another major influence to plastic waste recycling and collection can be determined by surrounding ordinances from other cities and counties as well as State Legislation. To help determine if such a phenomenon is occurring, Figure 7 was created. This figure is a graphical representation that shows when a city or county enacted either a Plastic Bag or Polystyrene ban. For this study, all partial bans were also incorporated into the data along with the partial state wide ban for thin, “single-use” grocery bags.

Two key insights can be extrapolated from this information. The first, there was a relatively large spike of polystyrene bans beginning in 2008. In the previous 20 years, only eight laws had been applied compared to 11 in 2008 alone. Polystyrene bans were being implemented most commonly in the years from 2012-2015 after the initial spike in 2008. In this relatively short period of time, 48 separate counties or cities enacted such ordinances. Secondly, a similar cluster occurred with plastic bag bans from roughly the same time between 2012 and 2016, which incorporates the bulk of all the bans.

**Figure 7: Polystyrene and Plastic Bag Bans Enacted by City/Counties in CA, 1988-2020**



It is important to note that the California Legislative passed similar measures in 2011 and 2014 respectively. The 2011 bill, CA S 567, prohibited “the sale of plastic products labeled as compostable, home compostable, or marine-degradable unless it meets standard specifications.” (NCSL, CA S 567). Furthermore, SB 270 of 2014 limited certain large retail stores from providing thin, single-use plastic carryout bags to customers, unless the bag included a \$0.10 added fee along with other certain conditions. This \$0.10 fee was reflected in many city and county ordinances as well, in some cases being as much as \$0.25. While the spirit of the goal of the State Law, as well as many city and county ordinances, was to limit plastic bags, some retailers were either exempt

or simply switched to providing thicker bags upon checkout or sale which were deemed to be “re-usable” due to this quality even if they were not used in the intended capacity.

These bans were enacted within an approximately short timeframe and could be in response to several things. For instance, increased public pressure for better management of waste. Environmental lobbying, which has grown steadily in California over the past decade, could also have greatly influenced policy makers to adopt these new directives. Regardless, the overall results show a slight improvement at best or an additional burden to businesses and consumers at worst, especially in Santa Monica. Mostly, though, the results are ambiguous.

This could be for a number of reasons. First, much of the legislative has only recently been applied, thus they may be working but have haven’t had enough time to show positive results. Secondly, the data itself may be incomplete and thus not reflecting the actual outcome of events. This was partially mitigated for by removing outliers and using a simplified Debris Ratio to determine increasing or decreasing amounts of collected plastics in the TIDES data. Still, more information over a longer period of time would have been preferred as well as more specific details of recycled material from the Santa Monica Tonnage reports. Regardless, the general theme of the results indicates that city ordinances are having little if any correlated impact on preventing plastic waste. Remarkably, it was only a State Law (AB 1884) prohibiting superfluous use of straws which yielded some measurable positive impact in the year it was implemented. This possibly infers that only high level laws produce consequential outcomes and is further explored in the next section.

### **Qualitative Data Analysis**

All survey responses and interviews with the subject matter experts were compiled and coded using the RADaR (Rigorous and Accelerated Data Reduction) qualitative analysis

processing technique (Watkins, 2017). Survey responses and interview notes were condensed and analyzed for similar themes and categories regarding plastic prevention, reduction as well as effectiveness of city, state and federal level policy initiatives. The most commonly cited themes regarding plastic pollution and city policies were the following: the Impact of Regulations from State and Federal Legislation, the Lack of Incentives in a circular economy for plastics, the need for increased Producer Responsibilities, and more emphasis on Educating the Public in terms of plastic recycling, reuse and reduction methods. The additional themes of Waste Management Infrastructure, Environmental Protection, Policy Enforcement and Pollution were also noted as important factors by multiple experts, although to a less consistent degree.

**Table 1:** Common Themes Cited by Experts

<b>Theme</b>	<b>Expert 1</b>	<b>Expert 2</b>	<b>Expert 3</b>	<b>Expert 4</b>	<b>Expert 5</b>	<b>Expert 6</b>
<b>Economic Incentives</b>	X	X		X		X
<b>Legislative Impact</b>	X	X	X		X	X
<b>Producer Responsibility</b>	X	X	X	X	X	X
<b>Public Education</b>	X		X	X	X	

#### *Lack of Economic Incentives*

Experts 1 and 2 repeatedly mentioned how the economics around plastic waste either did not support recycling programs or provide very little incentive to many individuals or even recycling companies to collect, process and produce new products. Expert 1 was particularly adamant about how policy makers should approach this issue from a market prospective by stating that currently there is, “not enough economic incentive to promote recycling” and thus create the conditions needed to promote a sustainable circular economy for plastics of all types. Furthermore, Expert 2 was primarily concerned with pervasiveness of virgin plastic products used by our

modern society to promote a high standard of living. Plastics used in medicine, transportation, manufactured products and other technologies provide an extremely high quality of life and thus viable alternatives need to be developed and promoted if our dependence on this oil by product is to be reduced.

Expert 4 echoed the assessment that there needs to be greater incentives from policy makers to encourage recycling by saying, “good policy [is] incentivizing use of highly recyclable plastic materials, discouraging unnecessary single-use plastic products, requiring clear labeling and recycling instructions...are all essential pieces of an effective solution.” This would help establish a circular economy for plastics by increasing the value of discarded material, similar to aluminum products.

#### *Increased Producer Responsibility*

Producer Responsibility, better product design and simplified materials were themes mentioned by all 6 experts during the survey or interview process. Expert 5 stated that one of the best methods for preventing plastic waste was to keep it out of the consumption stream as much as possible. This means creating products that are easy to recycle while also holding producers accountable for the total cost of an item throughout its entire existence, also known as Extended Producer Responsibility or EPR. EPR ordinances along with Minimum Content Laws were repeatedly cited by Experts 1 and 6 as an effective way to prevent waste and increase incentives to recycle. Expert 6 specifically noted that, “the biggest challenge, and biggest opportunity, is to hold plastic producers and manufacturers accountable for their products at the end of life.” Minimum Content laws, which are a form of EPR, require producers to manufacture products that contain a percentage of recycled plastic. This in turn increases the demand for waste plastics.

Essentially, Minimum Content Laws creates value out of formerly valueless plastic waste which provides a foundation for the circular economy.

This sentiment was restated by Expert 3 who insisted that the obligation to reduce, reuse and recycle should not be on the end consumer alone. Producers have an equal (if not greater) economic and moral responsibility to make and design products that are easily recyclable. Additionally, Expert 2 also suggested that manufacturers of plastic goods should be encouraged to produce items that are easier to recycle either by using less types of plastics or producing items that contain more recycled materials. Less diverse plastic materials would also make sorting and collecting plastics less difficult and thereby more economic for recyclers.

#### *Impact of State and Federal Legislation*

Legislation at all levels of government (city, state and federal) was another common theme mentioned by nearly all the experts to some degree. Bottle Bills, or ordinances which require a refundable deposit on certain beverage containers, were of particular importance to Expert 1, citing that these bills had the, “biggest impact in creating high quality feedstock for the recycling economy and producers.” With these bills, not only is plastic recycling actively encouraged via a profit incentive, but it also creates opportunities for clean “feedstock” plastics to be collected and then reused by manufactures in future products. Thus, with effective regulations, policy makers can actively guide the market through consumer and producer actions to establish a sustainable economy.

Expert 2 also noted that California is such a large economy that it can shape the national market through policies which limit waste and encourage more responsible behavior, from both consumers and producers. Effective and lasting city and state ordinances can push the market away from harmful plastic products to more sustainable alternatives, as was the case with plastic



straws and plastic bags to some degree. Expert 3 agreed with this statement citing the adoption of a state-wide ban on some plastic bags to be a partial success due to legislation. However, while Experts 5 and 3 asserted that ordinances and laws were vital to achieving lower levels of waste and higher amounts of recycling, they both stated that enforcement of these policies would have to be widespread and realistic if lasting changes in consumer and producer behavior were to be achieved.

#### *Emphasis on Public Education Regarding Plastic*

Changing behavior through public messaging campaigns to educate the public to the dangers of plastic waste (similar to anti-smoking campaigns) as well as how to better recycle was eagerly suggested by Expert 5. An educated population is one of a city's greatest weapons in shifting demand to a more sustainable economy, as pointed out by Expert 1 when asked what localities can specifically do to prevent waste. The promotion of better materials, a circular economy and awareness of the environmental and health dangers of plastics to the general public was also supported by Experts 3 and 4 who also listed businesses as a target for educational programs, especially those in the food industry and construction which tend to use a large amount of plastics.

#### *Infrastructure Management/Development*

Lastly, the importance of building out the recycling infrastructure was another identified theme, although not nearly as common as the previous ones. If a robust and efficient circular economy is to be created for plastic, one of the first objectives would be to ensure that plastic products can easily be collected for recycling. According to Experts 4 and 2, this means investing in waste management infrastructure at the city and state levels (supported in part by producers)

through increased access to collection points, clearer labeling of plastic products, and more efficient methods of sorting various types of plastics.

### *Obstacles to Policy Changes*

Both Experts 1, 2 and 5 clearly emphasized the importance of Public and Political Will in establishing new regulations or incentives to promote more sustainable practices. The plastic and oil industries have incredibly powerful and influential lobbies as well as financial and legal resources. Thus, without the Will to implement and enforce change to promote a circular economy through increased education and more accountable economic practices, policy makers at any level will be faced with a continuation of the status quo.

### **Policy Analysis**

The problem of plastic pollution is a complex and entrenched issue, socially, economically and politically with no fast or simple solution. There are numerous stakeholders that include not only elected officials and the general public, but also environmentalist organizations, businesses and large Petro-chemical manufacturers. Each of these groups also have various levels of political lobbying power or ability to bring attention to certain agendas or potential policies. Consequently, this issue will not be fixed by a single, large solution but by many small ones over time. More importantly, policy makers will have to craft and legislate solutions that address all of these competing priorities and concerns while also being realistic, practical, economic and, most importantly, effective at reducing waste.

### *Criteria*

Such potential solutions will have to account for multiple criteria in order to produce effective and lasting results. These criteria include the following: political feasibility, cost, efficiency in reducing plastic waste, timeliness and overall sustainability. If a policy is not

politically feasible or generally popular, then it will fail to pass at any level of government. This has been the case for numerous bag bans, increased fees and recycling initiatives not only in California but across America and even the world. This is in part because of the cost to businesses and consumers (another vital criterion) as well as potential disruptions in supply chains and manufacturing process.

Just as important as cost, the criteria efficiency in technological, economic and health benefits or harm must be evaluated. Virgin plastic is extremely cheap, robust, versatile and fundamental in terms of healthcare and food preservation. Recycling technology is also limited to some degree due to the difficulty in sorting through waste and diverse types of plastics with different chemical properties and uses. The negative externalities not captured by these products, however, are equally if not more harmful when considering prolific ecosystem, human health and food chain contaminations that have been occurring for decades at exponential rates with unclear dangers. Lastly, because the rates of plastic manufacturing and pollution are increasing each year, any solution must also be readily applicable to today's world in addition to being effective at reducing waste. If a policy does not result in lower levels of waste in a long-term, sustainable manner, then all previous criteria becomes irrelevant.

### *Alternatives*

*Alternative 1: Increased Regulations/Fees.* This potential solution has been tried multiple times across many localities and regions with various levels of success. Thus, it's political feasibility largely depends on the priorities and influences of those making policies. The cost of this policy is also potentially burdensome to both business and consumers with limited proven success. The cities of San Jose and Chicago, as previously stated, did see some reduction in plastic bag pollution after adding a fee, which favors the criteria of effectiveness. However, as

demonstrated in the literature, this outcome tended to be short-lived as consumers adapted to new prices or sellers switched to other products that technically did not apply to the regulation, i.e. thicker bags that were “reusable.” Thus, while a larger fee could produce the desired results, the sustainability of this option is uncertain and while adding additional costs and dead-weight-loss to manufacturers and retailers as well as consumers.

*Alternative 2: Encouraging better Recycling Programs and Waste Prevention Methods.* This second option is currently ongoing in many localities, including Santa Monica, thus it has some political feasibility. Increased public understanding of how certain products can or cannot be recycled would help limit the complexity and costs for recyclers, helping to increase efficiency. Currently, many recyclables are contaminated with other materials so much that they have to be sent to a landfill (Carrier & Horne, 2020 p.5) which further reduces standard recycled commodity prices. Single-stream recycling initiatives, such as the kind used in Santa Monica, have also had mixed results. This process does tend to increase the rate of household recycling, but also increases the difficulty in sorting with some materials disrupting or damaging processing machines. A public awareness campaign would help alleviate some of these issues, but would also be potentially costly to implement and might leave industrial procedures for disposal largely unchanged which is a significant source of pollution. The questions of timeliness and sustainability would also be indeterminate as consumers adopt these habits with various levels of enthusiasm and commitment. This approach also fails to account for market fluctuations in the price of plastics, which drive the overall demand for recyclables in the first place.

*Alternative 3: Extended Producer Responsibility (EPR) via Minimum Content Laws.* This last method is becoming more common in many European countries such as the U.K. and Germany with little historical use in America, although that may be changing soon. Extended Producer

Responsibility regulations require manufacturers to factor in the costs of disposal for plastic products and Minimum Content Laws would act as a type of EPR. How this works is that producers would be required to include some percentage of recycled material into the production of its products. Doing this would have many immediate and long-lasting effects. First, the market for recyclables would be strengthened via increased demand from producers to meet these requirements or face financial penalties. Secondly, the amount of waste would most likely reduce as increased demand would make what was once an unwanted liability into a potential financial asset. Essentially, a predictable circular economy for plastic waste would be created as soon as the regulations went into effect.

However, while this option would most likely produce a sustained level of decreasing waste due to the creation of a new market, political feasibility and increased costs to manufacturers is a major obstacle. However, the introduction of numerous bills into the Californian State Legislature in recent years suggest this obstacle might not be as insurmountable as previously thought. Bills SB 54 and AB 1080, both introduced in 2019, “sought to eliminate 75% of single-use containers by 2030 to reduce the glut of unmarketable plastics statewide and lay the groundwork for a revamped California recycling industry.” (McDaniel, 2019). Unfortunately, after millions of dollars lobbied by the plastics industry, AB 1080 was vetoed by Governor Newsom and SB 54 (originally introduced by State Senator Ben Allen of Santa Monica) was sent back to committee for additional review in late 2020. However, AB 793 was signed into law by the Governor on September 24<sup>th</sup>, 2020. This new regulation is essentially a minimum content law in that it requires plastic bottles sold in California to, “contain at least 15% post-consumer resin (PCR) by 2022, 25% by 2025 and 50% by 2030. Both chambers of the legislature passed the bill in August without any votes in opposition.” (Paben, 2020). These and other similar laws suggest that

the priorities and considerations of lawmakers regarding innovative and effective plastic waste prevention practices are becoming practice, regardless of incremental cost increases.

### **Recommendations**

Any policy that is adopted by Santa Monica or other localities to combat this growing issue must do so in a cost-effective, sustainable and efficient manner. However, the need to decrease plastic waste is essential and is thus the primary criterion used in this study to evaluate potential policy proposals. Currently, the majority of the negative externalities are not being fully captured at either the consumer or producer level. This is due to a lack of integration of the full product cost in the manufacturing process. Additionally, this is a global issue with overlapping jurisdictions and complexities caused by mobility, socioeconomic status and cultural norms. Expecting Santa Monica's policymakers to solve this problem at the local level is akin to expecting them to solve deforestation or CO<sub>2</sub> emissions alone. Cooperation and higher levels of regulatory oversight and enforcement are needed to truly produce desired results. With those considerations in mind, the following recommendations are presented:

*Recommendation 1: Extend Producer Responsibility by Supporting Minimum Content Laws for all Plastic Products at the State level.* For an effective policy aimed at reducing plastic waste to work, it needs to recognize and use basic economic principles. Requiring plastic manufacturers to factor in the full life-cycle cost of their products would be a more efficient means of preventing negative externalities due to discarded plastics, especially single-use items. Additionally, with the creation of a plastic circular economy, there would be greater incentive by businesses and the general public to properly dispose of or even collect plastics (similar to aluminum recycling) leading to less waste in the environment. Prices of some plastic products would most likely increase to some degree, but would be balanced out or even marginalized due

to the benefits of cleaner ecosystems, waterways and food chains as well as less demand for landfill space. Lastly, the recent passage of legislature that establishes this type of regulator market to plastic drink bottles, suggests that the political feasibility for similar regulation is a distinct possibility in the near future.

*Recommendation 2: Apply Uniform Fees on Plastics Statewide and Reduce Loopholes.*

As noted earlier, the problem of plastic waste is not isolated to Santa Monica, Southern California or even North America. It is a global problem that will require cooperation and support at all levels. One way to promote this is by mandating a uniform ban of certain single-use plastic items. AB 1884, which prohibited the use of straws at restaurants unless asked for or in take-out meals, is a successful example of this approach, as evident from the data analysis of this study. By creating the rules at the state level, there would be less confusion or unintended spillover of numerous different ordinances due to the mobility of people and goods. Standardization of rules, if properly evaluated, would also help decrease loop-holes which distort the intended outcomes of such policies such allowing the sale of “re-usable” plastic shopping bags if they a few millimeters thicker than flimsier types.

*Recommendation 3: Encourage Alternatives to Plastics along with Increased Reuse and Reduction Practices.* This last recommendation is very similar to the current status quo and has been gaining traction in recent years. However, this limited approach may not be enough to stem the increasing flow of plastic waste even if all citizens of a locality actively participated on a regular basis. Some plastic goods cannot be easily substituted (i.e. Covid-19 response supplies and other medical necessities) and the amount of global manufacturing is rapidly increasing. Moreover, fostering good reduction/recycling practices in the general public, while seeming like good idea, might actually lead to a moral hazard, inclining more people to readily use plastics if

they believe it will be recycled. This is already a common problem in many developed countries. Nevertheless, awareness campaigns could be a possible approach for a policy maker if crafted in an efficient manner while simultaneously continuing to gather and analyze data to properly assess results.

### **Conclusion**

The majority of issues stemming from plastic waste are not decreasing. In fact, the negative externalities associated with plastic pollution such as waterway and ecosystem contamination, food chain proliferation and human health concerns are steadily increasing. Yearly plastic production is predicted to triple by 2050 unless significant changes in markets or policies occur. The city of Santa Monica along with many others are taking action to prevent and mitigate this problem, but the current strategies are proving to not be enough. A concerted and unified effort is needed at not only the local level, but also at the state, federal and even international if significant and lasting results are to have any chance of success. One way of partially achieving this is with the creation of a more stable market for recycled plastics through Minimum Content Laws that limit the production of virgin plastics while also increasing the value of plastic waste. However, there is no single policy action or decisions that will alleviate this issue completely. Instead, just as there are numerous types of plastics used for different purposes, it will take an equal number of solutions and strategies for this problem to be solved.



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## Appendixes

**Appendix A:** Cleaned TIDES Data 2015-2019 (LA, Orange & Ventura Counties) [**Attached**]

**Appendix B:** Cleaned 2011-2019 Tonnage Reports for Plastics in Santa Monica [**Attached**]

**Appendix C:** CAW, California Plastic Ordinance Laws [**Attached**]

**Appendix D:** Interview/Survey Guide

**Procedure:** Introduction of Author and Capstone Project via email. Request for expert insight into the issue of plastic waste according to specific questions. Notification that name and any identifying information will be excluded from the final draft of the capstone.

### Survey/Interview Questions

From your unique vantage point, please answer the following questions to the best of your ability and as descriptively as you see fit. Thank you very much for providing feedback regarding this topic!

1. In your opinion, what are the biggest challenges to reducing plastic waste, especially at the local level? (Economic, behavioral, political obstacles, lack of information, etc) What makes you believe this?
2. What policies/programs have produced the largest and most sustained successes in reducing or preventing plastic waste? The least successful outcomes? (Recycling initiatives, fees or bans of certain plastics types, minimum content laws, etc).
3. What policies or actions would you recommend to city, state and federal leaders wanting to mitigate or prevent plastic waste in the future? What advice would you give to individuals or businesses wanting to do the same?
4. Do you have any general comments regarding the issue of plastic waste or what could be done about it?

**Appendix E: Debris Ratio in LA, Orange and Ventura Counties, 2016-2019**

