Cities 171 (2026) 106757

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities

Do zero waste pledges and goals increase municipal waste diversion rates?

Ashpreet Kaur [b], Mary Alice Haddad [a,*]

[a] John E. Andrus Professor of Government, United States of America
[b] Panjab University, Chandigarh, India

ARTICLE INFO

Keywords:
Zero waste
Waste diversion
Climate commitments
Universities
International city networks

ABSTRACT

Why are some municipalities diverting nearly 80 % of their municipal solid waste while others are putting everything into landfills? This article seeks to investigate the factors that explain variation in municipal solid waste diversion rates among cities that have publicly committed to ambitious climate action goals. It finds that cities that make a public commitment to reducing emissions, such as joining Cities Race to Zero, Global Covenant of Mayors for Climate and Energy, ICLEI, or C40, commonly have zero waste plans and goals. Many of these cities are also home to universities and are often located in states with beverage container and food waste laws. However, none of these factors had a measurable influence on the extent to which cities diverted their waste from landfills. Using an original dataset of the 132 cities in the United States that had signed the Cities Race to Zero challenge (a global initiative in which participating municipalities pledge to reach net zero emissions by 2040 or sooner), we used OLS regressions to test which factors affected a city's waste diversion rates. We found that having a higher per capita income, proximity to the ocean, and being in California were the only factors that had a statistically significant effect on increasing a municipality's waste diversion rate.

1. Introduction

Municipal solid waste (MSW) emissions are a major contributor to climate change, with one 2020 study estimating that the world's two billion metric tons of MSW are contributing approximately 5 % of overall greenhouse gas emissions (Gautam & Agrawal, 2021). That is nearly equivalent to the combined emissions of the 27 EU countries (European Commission, EDGAR-Emissions Database for Global Atmospheric Research, 2024). The U.S. Environmental Protection Agency estimates that MSW contributes almost 3 % of total GHG emissions in the United States (United States Environmental Protection Agency, 2023). Recognizing the significant environmental impact of waste on emissions, the United States Conference of Mayors adopted a resolution in 2015 to support Zero Waste (ZW) principles (United States Conference of Mayors, 2015), underscoring the urgency and importance for cities to reduce waste and associated emissions.

This article seeks to investigate the factors that are leading some municipalities to engage in higher levels of waste diversion. With the proliferation of international city networks focusing on climate change (Davidson, Coenen, & Gleeson, 2019; Gordon & Johnson, 2018; Miller, 2020), cities around the world are committing to waste diversion as a component of their broader emission reduction goals. Research on environmental behavior suggests that making public commitments can effectively encourage pro-environmental behavior (Lokhorst et al., 2013). Taking this research one step further, we are interested in the factors that enable cities that have publicly committed to emission reduction principles to successfully reduce the volume of their municipal solid waste that ends up in landfills. By focusing on these cities, we seek to understand how public commitments by local leaders translate into tangible waste diversion outcomes in their municipalities.

Cities are particularly vulnerable to the negative consequences of climate change, and they are increasingly networking with one another across national boundaries to put climate change on the international political agenda (Bouteligier, 2013; Davidson, Coenen, & Gleeson, 2019; Lee, 2013; Miller, 2020; Lin, 2018). There is growing anecdotal and case study evidence that cities are learning from one another to develop and implement better urban policies (Davidson, Coenen, Acuto, et al., 2019; Haddad, 2023; Kosovac et al., 2021; Pejic & Sevin, 2020). However, larger-n studies that investigate the connections between international city networks and concrete policy change are much fewer, and thus far they have generally focused on broader climate policies rather than waste management (Heikkinen et al., 2020; Rashidi & Patt, 2018). This paper seeks to examine whether participating in these international climate networks and making public commitments to sustainability as

* Corresponding author.
E-mail addresses: ashpreetkaur767@gmail.com (A. Kaur), mahaddad@wesleyan.edu (M.A. Haddad).

https://doi.org/10.1016/j.cities.2025.106757
Received 27 November 2024; Received in revised form 28 July 2025; Accepted 9 December 2025
Available online 5 January 2026
0264-2751/© 2025 Elsevier Ltd. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

part of these networks facilitates higher waste diversion rates in cities.

The most common factor discussed in the literature on waste diversion is wealth, but the findings are mixed. On the one hand, waste is a problem of affluent societies (Siniawer, 2018). As communities gain higher incomes, they consume more and throw away more (Verma et al., 2020). On the other hand, as cities grow richer, their land becomes more valuable, and they have more resources to invest in costly waste diversion technologies and policies (Gradus et al., 2019; Ichinose et al., 2015).

Population size and growth can also influence waste diversion rates, although evidence about how those factors affect waste diversion rates is once again mixed. Many studies have found that population size and growth are key predictors of waste creation and diversion (Abdoli et al., 2011; Tahir et al., 2015). However, some scholars have found that population size and growth have not influenced waste diversion rates (Grazhdani, 2016; Pan et al., 2019).

As cities seek to reduce their waste, more of them are implementing a variety of policies to promote waste diversion. These can include food waste laws that require food waste to be separated from other MSW so it can be composted, and beverage container laws that offer financial incentives for consumers to collect and return recyclable containers for a monetary refund. Some studies have found that these kinds of consumer-oriented policies can increase waste diversion rates (Benyathiar et al., 2022; Treadwell et al., 2018), but other research has found that their effectiveness is highly dependent on context (e.g., policy alignment across enforcement mechanisms (Magrini et al., 2020), or presence of incineration facilities in nearby towns (Mazzanti et al., 2009)), or that the programs are not effective (Lakhan, 2016).

In addition to demographic characteristics and policies, some cities have access to higher levels of expertise and management capacity. In particular, universities can often be important partners for cities as they seek to improve their climate action (Bery & Haddad, 2023), or promoting ZW through efforts such as donating surplus material to the community, advocating for waste reduction policies through research outreach, or organizing workshops and conferences on sustainability in collaboration with local communities and NGOs (Leal Filho et al., 2019; Zhang et al., 2011)). Although the relationship between city staff capacity and waste diversion has been less well examined, in the energy sector, several studies have found that having a dedicated energy manager (or sustainability officer or similar official) can improve a city's energy conservation efforts (Homsy, 2018; Roseval, 2019).

2. Methodology

The main goal of this study is to investigate the factors enabling cities to successfully reduce the volume of their municipal solid waste that ends up in landfills. By focusing on cities that have indicated a commitment to address climate change we seek to examine the conditions under which public commitments by local leaders translate into tangible waste reduction outcomes in their municipalities.

We begin with the 132 cities in the United States that have joined the international Cities Race to Zero. Cities Race to Zero is a city-focused partner of the United Nations Race to Zero campaign to rally non-state actors to reduce global emissions by half by 2030. By signing the pledge, cities commit to a range of climate actions intended to move the communities closer to net zero carbon emissions (Cities Race to Zero Pledge Form). Up until August 2024, 1143 cities and local governments around the world had signed the Cities Race to Zero pledge, with 132 of these located in the United States.

We use these 132 U.S. cities as the cases in our study since their participation in Cities Race to Zero signaled their commitment to broader climate goals. This study does not examine overall compliance, nor does it document how closely these cites come to accomplishing Zero Waste. Rather, our study seeks to discover why some of these cities—all of which have made public commitment to address climate change—have higher waste diversion rates than others. We have made our data public via FigShare (Zero Waste in U.S. Cities).

The dependent variable in the study is a city's waste diversion rate. We were able to find waste diversion rates for 89 of the 132 cities (67 %). In most cases (78 cities) the waste diversion rate was publicly available on the municipality's website. In a few cases (10 of the 89), the city was part of a regional waste collection system, so we counted the publicly disclosed waste diversion rate of the larger geographic area as the rate for the city. Three of those ten had their waste collected by the same entity as a larger, neighboring municipality that was already in our dataset (Boynton Beach is near West Palm Beach, and Eden Prairie and St. Louis Park are near Minneapolis). Therefore, these three smaller municipalities were removed from the analysis, leaving us with 86 communities that (a) had signed the Cities Race to Zero climate pledge and (b) had publicly disclosed waste diversion rates that were collected independently from any other community in the dataset.

We coded several independent and control variables in our effort to discover the factors that mattered the most for the city's waste diversion rate. Population and per capita income data were collected from the U.S. Census Bureau (2022 data). We used membership in three of the most prominent international environmental city networks—ICLEI, Global Covenant of Mayors for Climate and Energy, and C40—as measures of a city's participation in international city network membership (coding membership in each organization as 1 and non-membership as 0). These networks represent collective city commitments to sustainable development, emissions reduction, and resilience, with ICLEI focusing on local sustainability, the Global Covenant of Mayors supporting emissions tracking and transparency, and C40 prioritizing climate action through collaborative urban policies and reduced emissions. Including these memberships allows us to examine whether membership in these organizations and networks influenced a city's waste diversion rates.

We performed a Google search for "city name + university" to discover if there were any universities located in the city. When a university was found, we checked the Database of Accredited Post-secondary Institutions and Programs maintained by the U.S. Department of Education to find out whether the institution was accredited. If the city had an accredited university, it was coded as 1, cities without accredited universities were coded as 0.

We combed city websites to discover if the city had staff dedicated to ZW efforts. This staff capacity variable was coded as 0 if there were no full-time paid city staff and no volunteers dedicated to waste reduction and minimization practices; 1 if the city had volunteers dedicated to waste reduction and minimization practices (e.g., a Zero Waste association or committee collaborating with the city) but no paid city staff; 2 if there was a paid city staff member with waste diversion and minimization as a part of their other duties (such as when the city had a Public Works department that included responsibility for sanitation). It was coded as 3 if the city had a full-time staff dedicated to ZW.

We also coded the strength of a city's ZW plan: cities with no plan and no indication that they were creating one were coded as 0. Cities that had no plan on record but were actively engaged in creating one (e.g., we found records of public meetings and/or news articles related to plan development) were coded as 1. Cities that had a ZW plan as a component of another plan (e.g., climate action plan, sustainability plan, or solid waste management plan) were coded as 2. Cities that had a separate ZW plan were coded as 3.

Since many cities did not have concrete plans, we searched city and public websites to code the existence and strength of their ZW goals. Cities that had no public ZW goal (other than the one that was a component of the broader Cities Race to Zero pledge) and indicated no intention to create one were coded as 0. Cities that had no concrete, public ZW goal, but we were able to find evidence that they were in the process of creating one (e.g., officials had made public statements that they were developing zero waste goals for the city) were coded as 1. Cities that had a waste diversion target of less than 50 % by 2030 were coded as 2. Cities with waste diversion targets of more than 50 % but less than 90 % by 2030 were coded 3. The most ambitious cities, with targets

of achieving 90 % or more waste diversion by 2030, were coded 4.

Since state-level requirements and incentive programs could influence the likelihood that a city would divert more of its waste, we coded beverage container laws and food waste laws. Beverage container laws, also known as bottle bills or container deposit laws, require consumers to pay a deposit when purchasing beverages in containers like plastic, glass, or aluminum. This deposit is then refunded when the container is returned to a designated recycling or collection center. States with beverage container laws include California, Connecticut, Hawaii, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont (National Conference of State Legislatures (NCSL), 2020). Cities located in states with beverage container laws were coded as 1, and those located in states without these laws were coded as 0.

Similarly, some states mandate or encourage the diversion of food waste away from landfills toward more sustainable alternatives like composting, anaerobic digestion, or food recovery programs. The primary goal of these laws is to reduce the environmental impact of food waste, particularly the methane emissions that result from decomposing organic matter in landfills, and to promote more sustainable waste management practices. States with food waste laws are: California, Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Oregon, Vermont, and Washington (US Composting Council, n.d.). While all nine states referenced have passed policies intended to divert food waste, the mechanisms and scopes vary significantly. For example, Vermont's Universal Recycling Law mandates full household and commercial organics separation, while New Hampshire's ban is conditional on facility proximity. Cities located in states with food waste laws were coded as 1, and those located in states without these laws were coded as 0. A full list of the beverage container and food waste laws can be found in Appendix B.

After performing our initial descriptive statistical analyses, we discovered that most of the cities with the highest waste diversion rates were located on the coast. Since location near beaches and the coast could affect waste diversion rates because of local economies reliant on eco-tourism (Karimov et al., 2024) or due to higher levels of environmental education and awareness among coastal residents (Towata & Ursi, 2017), we went back and used the pin drop function on Google Maps to estimate how far a city was from the ocean. Cities that abutted the ocean directly or bordered a state/national park abutting the ocean were coded as 0. Those located less than 10 miles (16 km) from the ocean, but not adjacent to it, were coded as 1. Those that were 11–100 miles (16–161 km) away from the coast were coded as 2, those that were more than 101–500 miles (161–805 km) were coded as 3, and those that were more than 500 miles (805 km) from the ocean were coded as 4.

Because many of the highest-performing cities were in California, we also added a dummy variable to indicate whether the city was in California (0 for cities not in CA, 1 for cities in CA). Finally, we created a dummy variable for cities that contained or abutted a significant body of water (ocean, lake, or river), in case it was the location near water, rather than the ocean that mattered. These cities were coded as 1, while cities that contained or abutted no significant body of water were coded as 0. Additional details on the keywords used to collect data for certain variables via Google search are provided in the coding protocol in Appendix A.

Once we had created our dataset, we cleaned, coded, and analyzed our data using version 17.0 of STATA/SE. Given the continuous nature of the dependent variable, we applied Spearman's rank correlation, which revealed strong correlations (above 0.5 with a significance level of 0.05) of food waste diversion and C40 with other variables. Due to the potential multicollinearity issues, we excluded them from further analysis. After removing these two variables, we assessed multicollinearity using the Variance Inflation Factor (VIF) method after running a full model regression (Thompson et al., 2017) and found no significant multicollinearity issues. We then performed sets of Ordinary Least Squared (OLS) linear regressions to identify which factors influenced a city's waste diversion rate. To address potential heteroscedasticity in the model, robust standard errors were applied using the robust command in STATA. This adjustment provides consistent standard errors even when the homoscedasticity assumption is violated, ensuring the reliability of hypothesis tests and confidence intervals.

3. Results

The 132 cities in the United States that signed the Cities Race to Zero pledge were diverse in many ways. They were located across the country (See Fig. 1). They represented communities with a wide range of populations—from 468 (Mosier, Oregon) to 8.3 million (New York City) and per capita income levels—from $15,722 in Boone, North Carolina to $243,594 in Ardsley, New York. A large majority (89 %) hosted universities, and most were part of transnational municipal climate networks in addition to the Cities Race to Zero campaign: 97 (73 %) were members of ICLEI, and 86 (65 %) had signed the Global Covenant of Mayors for Climate and Energy.

Although all 132 U.S. cities that signed the Cities Race to Zero Pledge made public commitments to publicly disclosing and increasing their waste diversion rates as part of that pledge, a third of them (44 cities) did not publish their waste diversion rate. As shown in Fig. 2, of the 86 cities that disclosed independent waste diversion rates, only 7 (8 %) of them were diverting over 75 % of their MSW, while 55 (64 %) of them were diverting less than 50 % of the MSW from landfills.

When we ranked the 86 cities by how much waste they diverted, we saw that many (18 of 20) of the top performers were on or near a coast, with a large proportion of them (11 of 20) located in California. In contrast, we found no clear patterns among the cities with the lowest diversion rates or those that did not report their waste diversion rates. Table 1 lists the top and bottom twenty cities in our dataset according to their waste diversion rates.

In order to figure out which factors were most responsible for enabling climate committed cities to increase their waste diversion rates, we ran a linear OLS regression that included a city's waste diversion percentage as the dependent variable and all of the independent variables that we thought might matter: population, per capita income, Global Covenant of Mayors for Climate and Energy signatory, ICLEI member, strength of their ZW plan, ZW city staffing, ZW goal, city present in California, state beverage bill, distance from the ocean, and presence of significant body of water in or next to the city. Most of the variables were statistically insignificant at the significance value of $p < 0.05$, with the exception of the distance from the coast variable, which indicated that cities far inland (those more than 100 miles (161 km) from the coast) had lower waste diversion rates than those on the coast. We refined our regression by eliminating statistically insignificant variables until we had a parsimonious model that enabled us to identify specific factors that together explained a significant proportion of the variation in waste diversion rates among cities.

In the end, the best model, which explained one-third of the variation in city waste diversion rates (Adjusted R^2 of 0.3500), was one containing just four variables: city population, per capita income, California, and distance from the ocean. Of these, city population and the two closest-to-the-ocean measures were not statistically significant. Cities had higher waste diversion rates as their per capita incomes rose if they were located in California, and if they were not located far from the ocean.

4. Discussion

The results were surprising and diverged from our initial expectations. We went into this research expecting to find, in line with previous work related to city climate action plans (Bery & Haddad, 2023) and university programs related to ZW that universities and dedicated city staff would play important roles in helping cities be ambitious in their ZW efforts. We thought that having ZW plans and making public commitments about climate and ZW ambitions would promote higher levels of waste diversion (Bi et al., 2024; Ma et al., 2024; Saldivia-Gonzatti

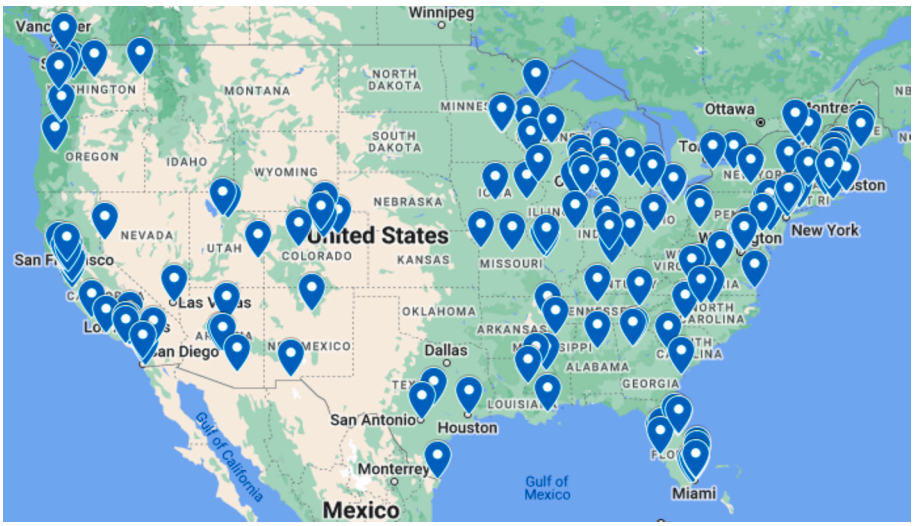


Fig. 1. U.S. participants in Cities Race to Zero Campaign (Google Maps).

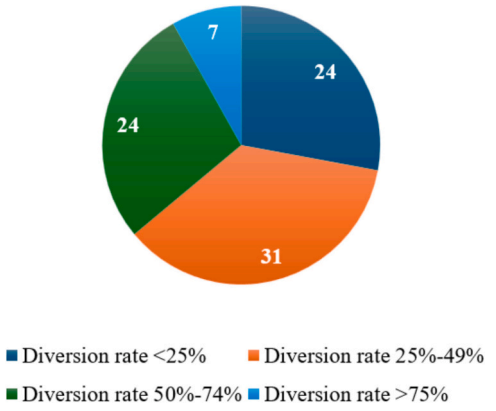


Fig. 2. Distribution of 86 cities based on their waste diversion rates.

Table 1
Best and worst 20 cities by waste diversion rate.

Top 20	Diversion rate	Bottom 20	Diversion rate
Palo Alto, CA	84 %	Tucson City, AZ	4 %
Portland, OR	81 %	Detroit, MI	4 %
San Francisco, CA	80 %	Indianapolis, IN	4 %
Boca Raton, FL	80 %	New Orleans, LA	5 %
West Palm Beach, FL	80 %	Albuquerque, NM	5 %
Los Angeles, CA	76 %	Dayton, OH	8 %
Honolulu, Hawaii	76 %	Columbia, MO	8 %
San Jose, CA	74 %	St. Louis, MO	11 %
Cupertino, CA	73 %	Mesa, AZ	14 %
Philadelphia, PA	72 %	Lakewood, CO	16 %
San Diego, CA	71 %	Ferndale, MI	16 %
Sacramento, CA	71 %	Santa Fe, NM	16 %
Tampa, FL	70 %	New York City, NY	17 %
Hayward, CA	66 %	Providence, RI	18 %
Chula Vista, CA	61 %	Pittsburgh, PA	18 %
Takoma Park, MD	61 %	Hallandale Beach, FL	19 %
Lexington, MA	60 %	Cincinnati, OH	20 %
Glendale, CA	60 %	Dallas, TX	20 %
Madison, WI	60 %	Fayetteville, AR	20 %
Lexington, MA	60 %	Saint Paul, MN	23 %

et al., 2022). We anticipated that participating in transnational city networks would help cities learn effective strategies to manage their MSW, thus leading to higher waste diversion rates (Davidson, Coenen, & Gleeson, 2019).

To our surprise, none of these variables had any statistically significant relationship with the level of waste diversion among the cities in our dataset. Many—117 of 132 (89 %)—cities in the study hosted universities, and a large majority were actively participating in international city networks and climate-related commitments: 100 % were part of the Cities Race to Zero, 65 % had signed the Global Covenant of Mayors for Climate and Energy, and 73 % were members of ICLEI. These findings suggest the uncomfortable possibility that universities and transnational city networks might be good at getting cities to sign climate-related pledges but much less effective at enacting real change on the ground in their communities, at least with respect to waste diversion.

Demographic features of a city did not affect its waste diversion rates very much. The population size of the city did not have a statistically significant relationship with its waste diversion rate. Having a higher per capita income was positively associated with waste diversion rates but only by a very small amount. Increasing a city's per capita income by $1000 resulted in a waste diversion rate that was only 0.3 % higher. Cities would need to raise their average per capita incomes by more than $30,000 in order to gain even a 10 % increase in their waste diversion rate. Although the influence was relatively small, its positive direction is consistent with research suggesting that wealthier communities have more resources available for waste management infrastructure and education, which in turn can lead to improved diversion rates (Satterthwaite, 1997).

In contrast to population and income, which had very small effects, being located on or near the ocean had very large effects on waste diversion rates. Cities located adjacent to the ocean had much higher waste diversion rates than those located further inland, diverting around 12 % more waste than cities located less than 10 miles (16 km) but not adjacent to the ocean and those that were more than 100 miles (161 km) from the coast. Our model did not detect a statistically significant effect of distance from the ocean for the cities that were 10–100 miles (16–161 km) from the ocean, although that may have been because of the comparative few (7) cities in the dataset that were in that group. In fact, if we limit the regression analysis to only the distance from the ocean variable, this factor alone was extremely statistically significant ($p = 0.000$) and could explain approximately 25 % of the variation in waste diversion rates among the cities in our dataset.

Looking again at Table 1 of the table of best and worst performing cities, only one (#19, Madison, WI) of the top twenty cities with the highest waste diversion rates was more than 500 miles (805 km) from the coast, while nine of the top ten cities were directly on the ocean. In contrast, nine of the ten cities with the worst waste diversion rates were

inland. Although there has not yet been any research studying the direct links between coastal location and waste diversion rates, these findings are consistent with research on ecotourism and environmental education, which suggest that residents in coastal communities may be more environmentally educated and be more concerned about litter than people living farther from the ocean (Karimov et al., 2024; Towata & Ursi, 2017).

Similarly, being in California mattered a lot. In the model shown above in Table 2, Californian cities had waste diversion rates that were 15 % higher, on average, than cities elsewhere. California as a predictor variable by itself (removing the per capita income, population size, and distance from the ocean variables from the OLS regression) had very high statistical significance ($p = 0.000$) and alone could explain around 28 % of the variation in waste diversion rates among our cities. According to this CA-only OLS regression, cities in California had waste diversion rates that were 28 % higher than the average. Returning to Table 1, eleven of the top twenty cities with the highest waste diversion rates were located in California, while none of the worst-performing cities were in that state. Our findings of a significant "California effect" is likely related to the state's comprehensive regulatory framework, community engagement, and robust infrastructure for recycling and waste diversion. This finding is consistent with other research that has found California to be a leader in a variety of environmental policies in the United States (Vogel, 2018).

5. Conclusion

Why are some climate committed municipalities diverting very high proportions of their municipal solid waste while others are putting everything into landfills? This article has examined how different factors influenced city waste diversion rates among U.S. cities taking part in the United Nation's Cities Race to Zero campaign.

To the surprise of the authors, many of the factors that we anticipated would matter—a city's population size, the presence of a university, city staff dedicated to zero waste, state container and food waste laws, a city's zero waste goals and plans, and even its membership in international city networks focused on sustainability—had no statistically measurable influence over waste diversion rates. Even per capita income, which was statistically significant, did not influence a city's waste diversion rates very much—a $1000 increase in a city's per capita income improved its waste diversion by less than a percentage point.

The two factors that mattered the most had to do with the city's geographic location: how far it was from the ocean and whether it was in California. Those two factors, along with per capita income, were able to explain 40 % of the variation in waste diversion rates among U.S. cities that had signed the Cities Race to Zero pledge. Cities in California, those located closer to the ocean, and those with higher per capita incomes tended to have significantly higher waste diversion rates.

Perhaps we should have anticipated these results. California has long been a leader in environmental policy, although much of the public and scholarly focus has been on the state's land conservation, water, and energy rather than its waste (Vogel, 2018). Similarly, while there have been rising concerns about the role of coastal cities in contributing to the problem of plastics and other garbage in the oceans (Law et al., 2020), there has been very little written about the effect of the ocean, or being near the ocean, on waste management inside cities.

These findings suggest that we need much more research about the effect of the ocean on public attitudes and municipal behavior related to waste and municipal solid waste management policies. Scholars and practitioners have been studying how urban areas and the mountains of waste that they generate are harming the ecosystems of the oceans (Pawar et al., 2016), forests (Parrot et al., 2009), and deserts (Aljaradin & M Persson, 2012). Scholars have found that communities that rely on ecotourism industry have better MSW policies (Karimov et al., 2024), and students near the coast tend to have higher levels of environmental education (Towata & Ursi, 2017). These findings suggest that considerably more scholarly attention should be devoted to the mechanisms by which ocean proximity may promote better urban waste management.

Our final conclusion is not what we had anticipated (or had hoped) to find in this study: universities and transnational city networks appear to be more talk than action on Zero Waste. Universities have been expanding their ZW action plans and mayors around the world have been holding press conferences to celebrate their cities joining various international coalitions promoting climate action. So far, these efforts are not amounting to much positive action on the ground, even among cities that have made public commitments to climate and ZW goals. Universities and cities need to do a much better job of turning their big talk and grand plans into measurable actions. For the sake of our planet and our communities, we hope they do so quickly.

Table 2
OLS regression of factors influencing city MSW diversion rates.

Independent variable	Beta coefficient	Robust standard error	*P*-value
Population	−3.62 × 10–7	2.41 × 10–6	0.881
Per capita income	0.0003	0.0001	0.015
City in California	14.99	5.37	0.007
Ocean Cities adjacent to ocean (coded 0, reference category)			
Cities located 0–10 miles from the ocean (coded 1)	−12.72	6.84	0.067
Cities located 11–100 miles from the ocean (coded 2)	6.77	5.55	0.226
Cities located more than 101–500 miles from the ocean (coded 3)	−13.07	6.57	0.050
Cities located more than 500 miles from the ocean (coded 4)	−10.61	6.54	0.109
Number of observations = 86			
Degrees of Freedom = 7			
R-square = 0.4035			
Dependent variable = Waste Diversion Rate.			

CRediT authorship contribution statement

Ashpreet Kaur: Writing – review & editing, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Mary Alice Haddad:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Coding protocol

Project summary

The project collected data on zero-waste plans, their goals, the presence of designated personnel overseeing zero-waste initiatives, and current waste diversion rates in various cities. The data collection process involved searching for relevant information through Google, primarily focusing on city websites or other sources such as news articles, journals, and interviews. If specific references to zero-waste plans are not found, alternative keywords related to sustainability, climate action, or waste management are used to locate relevant documents.

Data collection procedure

1. Conduct Google search- Collect through Google search either by going to the city website such as "www.gainesvilleefl.gov" or looking through a mention of a zero waste plan on other avenues such as news, journals, interviews, etc.

Potential keywords when searching can include *"city name state name zero waste plan" Example- "Miramar Florida zero waste plan"*.

Example- "Miramar Florida waste reduction".

2. If nothing specific to zero waste is found, then search other sources for mentions of zero-waste plans or goals within sustainability, climate action, or similar plans.

Example- "Miramar Florida sustainability plan".
Example- "Miramar Florida climate action plan".
Example- "Miramar Florida solid waste plan".
Example- "Miramar Florida waste management plan"

1. Once a zero-waste plan or goal is identified, code the information according to the coding protocol below.
2. Add the url of the link to the plan (pdf or webpage) to the "additional details" tab on the datasheet.
3. While on the website, collect data on the individual responsible for zero-waste activities or waste diversion initiatives, including their email address, following the provided coding protocol below for professional email addresses. Add the information to the "additional details" tab on the datasheet. Look for departments such as the solid waste department, public works department, recycling department, etc.
4. When possible, code how much waste diversion is actually taking place (not just part of the plan) currently. In the "notes" column, indicate the date of the diversion (i.e., if the data fare from 2021 and the indication is that 40 % of waste is being diverted, put that in)
5. Record any notes about the city/plan that you think would be worth paying attention to (e.g., it is part of a state-wide campaign, the mayor appears to be a key champion, etc.). Do not look for additional details to fill in this column. This column is just a place to put in additional information that you think is worth noting about the city and its zero-waste efforts.

Coding procedure

City Zero Waste Plan:
- 0: No plan and no apparent intention to create one.
- 1: Currently have no plan but in the process of creating one.
- 2: ZW plan included in climate action plan, solid waste management plan, or sustainability plan.

County Zero Waste Plan:

- 0: No indication that city is included in county plan or no plan at county level.
- 1: City is included in county climate action plan, solid waste management plan, or sustainability plan. Does not have a separate zero waste plan.
- 2: City is included in county's separate ZW plan.

Zero Waste Goal followed by the City (Strength of ZW Plan):
- 0: No goal and no apparent intention to create one.
- 1: ZW goal with less than 50 % waste diversion (WD) aspiration by 2030.
- 2: ZW goal with less than 90 % WD aspiration by 2030.
- 3: ZW goal with 90 % or more WD aspiration by 2030.

Zero Waste Person:
- 0: No full-time paid staff dedicated to waste diversion and minimization practices.
- 1: Volunteer staff dedicated to waste diversion and minimization practices.
- 2: Staff with waste diversion and minimization as a part of their duties.
- 3: Full-time city staff person dedicated to waste diversion and minimization.

The dataset is avaliable on Figshare: https://doi.org/10.25438/wes02.28987853.

Appendix B. Summary of organics diversion policies across the nine U.S. States where it is required.

State	Type of policy	Scope	Key features / thresholds
California	Statewide Mandatory Collection	All generators	SB 1383: Requires jurisdictions to offer organics collection and generators to comply.
Connecticut	Disposal Ban (Commercial only)	Generators ≥0.5 tons/week	Ban applies if a composting facility is within 20 miles.
Massachusetts	Disposal Ban (Commercial only)	Generators ≥0.5 tons/week	Strict enforcement by MassDEP; no proximity clause.
New Hampshire	Conditional Disposal Ban	Generators ≥1 ton/week	Effective Feb 2025; applies only if a facility is within 20 miles and has capacity.
New Jersey	Generator Recycling Requirement	Large food waste generators	Mandated separation and recycling; no formal statewide landfill ban.
New York	Food Donation + Recycling Law	Generators ≥2 tons/week	Applies if a recycling facility is within 25 miles. Exempts NYC.
Oregon	Regional mandates; pending statewide	Currently urban areas; future statewide	HB 3018 proposes phased statewide mandates from 2027.
Vermont	Universal Disposal Ban	All residents and businesses	Act 148 bans landfilling of food scraps for all generators since July 2020.
Washington	Phased Collection + Generator Rules	Businesses by size & locality	HB 1799: Phased requirements depending on generator size and access to service.

Data availability

Data will be made available on request.

References

Abdoli, M. A., Falahnezhad, M., & Behboudian, S. (2011). Multivariate econometric approach for solid waste generation modeling: Impact of climate factors. *Environmental Engineering Science, 28*(9), 627–633.

Aljaradin, M., & M Persson, K. (2012). Environmental impact of municipal solid waste landfills in semi-arid climates-case study–Jordan. *The Open Waste Management Journal, 5*(1).

Benyathiar, P., Kumar, P., Carpenter, G., et al. (2022). Polyethylene terephthalate (PET) bottle-to-bottle recycling for the beverage industry: A review. *Polymers, 14*(12), Article 2366.

Bery, S., & Haddad, M. A. (2023). Walking the talk: Why cities adopt ambitious climate action plans. *Urban Affairs Review, 59*(5), 1385–1407.

Bi, S., Du, J., Yan, Z., & Appolloni, A. (2024). Can "zero waste city" policy promote green technology? Evidence from econometrics and machine learning. *Journal of Environmental Management, 370*, Article 122895.

Bouteligier, S. (2013). *Cities, networks, and global environmental governance: Spaces of innovation, places of leadership*. New York: Routledge.

Davidson, K., Coenen, L., Acuto, M., et al. (2019). Reconfiguring urban governance in an age of rising city networks: A research agenda. *Urban Studies, 56*(16), 3540–3555.

Davidson, K., Coenen, L., & Gleeson, B. (2019). A decade of C40: Research insights and agendas for city networks. *Global Policy, 10*(4), 697–708.

European Commission, EDGAR-Emissions Database for Global Atmospheric Research. (2024). 2024 Report. https://edgar.jrc.ec.europa.eu/report_2024.

Gautam, M., & Agrawal, M. (2021). Greenhouse gas emissions from municipal solid waste management: A review of global scenario. In S. S. Muthu (Ed.), *Carbon footprint case studies: Municipal solid waste management, sustainable road transport and carbon sequestration* (pp. 123–160). Springer.

Gordon, D. J., & Johnson, C. A. (2018). City-networks, global climate governance, and the road to 1.5 C. *Current Opinion in Environmental Sustainability, 30*, 35–41.

Gradus, R., Homsy, G. C., Liao, L., et al. (2019). Which US municipalities adopt pay-as-you-throw and curbside recycling? *Resources, Conservation and Recycling, 143*, 178–183.

Grazhdani, D. (2016). Assessing the variables affecting on the rate of solid waste generation and recycling: An empirical analysis in Prespa Park. *Waste Management, 48*, 3–13.

Haddad, M. A. (2023). City networks in Asia: Finding solutions to climate change and global health. In *World scientific reference volume III: Environment, sustainability, and human security in Asia* (pp. 15–28). New York: World Scientific.

Heikkinen, M., Karimo, A., Klein, J., et al. (2020). Transnational municipal networks and climate change adaptation: A study of 377 cities. *Journal of Cleaner Production, 257*, Article 120474.

Homsy, G. C. (2018). Unlikely pioneers: Creative climate change policymaking in smaller US cities. *Journal of Environmental Studies and Sciences, 8*(2), 121–131.

Ichinose, D., Yamamoto, M., & Yoshida, Y. (2015). The decoupling of affluence and waste discharge under spatial correlation: Do richer communities discharge more waste? *Environment and Development Economics, 20*(2), 161–184.

Karimov, N., Kulmetov, M., Safarova, N., Jumaev, K., Fayzullaev, M., Sultanov, S., … Yakhshieva, Z. (2024). The ecotourism industry's role in environmental stewardship. *Natural and Engineering Sciences, 9*(2), 293–308.

Kosovac, A., Hartley, K., Acuto, M., et al. (2021). City leaders go abroad: A survey of city diplomacy in 47 cities. *Urban Policy and Research*, 1–16.

Lakhan, C. (2016). The relationship between municipal waste diversion incentivization and recycling system performance. *Resources, Conservation and Recycling, 106*, 68–77.

Law, K. L., Starr, N., Siegler, T. R., et al. (2020). The United States' contribution of plastic waste to land and ocean. *Science Advances, 6*(44), Article eabd0288.

Leal Filho, W., Vargas, V. R., Salvia, A. L., Brandli, L. L., Pallant, E., Klavins, M., … Vaccari, M. (2019). The role of higher education institutions in sustainability initiatives at the local level. *Journal of Cleaner Production, 233*, 1004–1015.

Lee, T. (2013). Global cities and transnational climate change networks. *Global Environmental Politics, 13*(1).

Lin, J. (2018). *Governing climate change: Global cities and transnational lawmaking*. New York, NY: Cambridge University Press.

Lokhorst, A. M., Werner, C., Staats, H., et al. (2013). Commitment and behavior change: A meta-analysis and critical review of commitment-making strategies in environmental research. *Environment and Behavior, 45*(1), 3–34.

Ma, Q., Zhang, Y., Hu, F., & Zhou, H. (2024). Can the energy conservation and emission reduction demonstration city policy enhance urban domestic waste control? Evidence from 283 cities in China. *Cities, 154*, Article 105323. https://www.sciencedirect.com/science/article/abs/pii/S0264275124005377.

Magrini, C., D'Addato, F., & Bonoli, A. (2020). Municipal solid waste prevention: A review of market-based instruments in six European Union countries. *Waste Management & Research, 38*(1_suppl), 3–22.

Mazzanti, M., Montini, A., & Nicolli, F. (2009). The dynamics of landfill diversion: Economic drivers, policy factors and spatial issues: Evidence from Italy using provincial panel data. *Resources, Conservation and Recycling, 54*(1), 53–61.

Miller, D. (2020). *Solved: How the world's great cities are fixing the climate crisis*. University of Toronto Press.

National Conference of State Legislatures (NCSL). (2020). State beverage container deposit laws. In *National conference of state legislatures*. Available at: https://www.ncsl.org/environment-and-natural-resources/state-beverage-container-deposit-laws.

Pan, C., Bolingbroke, D., Ng, K. T. W., et al. (2019). The use of waste diversion indices on the analysis of Canadian waste management models. *Journal of Material Cycles and Waste Management, 21*, 478–487.

Parrot, L., Sotamenou, J., & Dia, B. K. (2009). Municipal solid waste management in Africa: Strategies and livelihoods in Yaoundé, Cameroon. *Waste Management, 29*(2), 986–995.

Pawar, P. R., Shirgaonkar, S. S., & Patil, R. B. (2016). Plastic marine debris: Sources, distribution and impacts on coastal and ocean biodiversity. *PENCIL Publication of Biological Sciences, 3*(1), 40–54.

Pejic, D., & Sevin, E. (2020). City diplomacy: Current trends and future prospects. *The Hague Journal of Diplomacy, 16*(2–3), 381–384.

Rashidi, K., & Patt, A. (2018). Subsistence over symbolism: The role of transnational municipal networks on cities' climate policy innovation and adoption. *Mitigation and Adaptation Strategies for Global Change, 23*(4), 507–523.

Roseval, M. E. (2019). *Sustainability vanguards: A study of the sustainability manager position and its role within city government*. State University of New York at Binghamton.

Saldivia-Gonzatti, L. I., Jannes, G., & Barreal, J. (2022). Factors influencing the rate of sorted solid waste collection: An empirical analysis towards local management in Catalonia (NE Spain). *Cities, 131*, Article 104038.

Satterthwaite, D. (1997). Environmental transformations in cities as they get larger, wealthier, and better managed. *Geographical Journal*, 216–224.

Siniawer, E. M. (2018). *Waste: Consuming postwar Japan*. Cornell University Press.

Tahir, M., Hussain, T., & Behaylu, A. (2015). Scenario of present and future of solid waste generation in India: A case study of Delhi mega city. *Journal of Environment and Earth Science, 5*(8), 83–91.

Thompson, C. G., Kim, R. S., Aloe, A. M., et al. (2017). Extracting the variance inflation factor and other multicollinearity diagnostics from typical regression results. *Basic and Applied Social Psychology, 39*(2), 81–90.

Towata, N., & Ursi, S. (2017). Perception and connectedness with marine and coastal environments: The perspective of basic education and undergraduate students from two Brazilian cities. *Conexão Ciência, 12*(2), 256–363.

Treadwell, J. L., Bennett, E. M., & Clark, O. G. (2018). The role of management instruments in the diversion of organic municipal solid waste and phosphorus recycling. *Facets, 3*(1), 896–919.

United States Conference of Mayors. (2015). Resolution in support of municipal zero waste principles and a hierarchy of materials management. https://www.usmayors.org/the-conference/resolutions/?category=b83aReso050&meeting=83rd%20Annual%20Meeting.

United States Environmental Protection Agency. (2023). US GHG Inventory. Chapter 7, Waste. https://www.epa.gov/system/files/documents/2023-04/US-GHG-Inventory-2023-Chapter-7-Waste.pdf.

US Composting Council. Organics disposal bans and mandates. US Composting Council. Available at: https://www.compostingcouncil.org/page/organicsbans, Accessed date: Dec. 15, 2025.

Verma, M.v.d. B., de Vreede, L., Achterbosch, T., et al. (2020). Consumers discard a lot more food than widely believed: Estimates of global food waste using an energy gap approach and affluence elasticity of food waste. *PLoS One, 15*(2), Article e0228369.

Vogel, D. (2018). *California greenin' how the golden state became an environmental leader*. Princeton University Press.

Zhang, N., Williams, I. D., Kemp, S., & Smith, N. F. (2011). Greening academia: Developing sustainable waste management at higher education institutions. *Waste Management, 31*(7), 1606–1616.