University of California, Berkeley: 'Zero Waste' by When, and How?

Anna M. Yip

ABSTRACT

In 2009, the University of California joined the 'zero waste' movement by implementing its system-wide 'Zero Waste by 2020' goal. Unfortunately, with less than four years left to achieve 'zero waste', UC Berkeley has fallen far behind. The campus' current waste setting and necessary next-steps to achieve 'zero waste' had previously been left undefined, as UCB had not created a 'zero waste' plan since 2013. Throughout this study, I produced UC Berkeley's 2017 Zero Waste Plan, which summarized campus' current waste setting and demonstrated the required changes needed to push campus to its goal. I found that campus is currently at a 48% diversion rate and holds the potential to increase this diversion rate significantly through proper sorting. Presently, 83% of all waste sent to landfill could be diverted if sorted properly. With perfect sorting, campus' diversion rate could increase to 91%. Bin distribution and signage was also found to be inconsistent, which could explain the high amount of recyclables and divertables in the landfill stream. Thus, the suggestions made in the 2017 plan focused on creating more downstream solutions to increase diversion. Though this new 2017 plan outlines how UC Berkeley could achieve its daunting goal of nearly doubling its diversion rate, analyzing the 'zero waste' goal also shows that racing to achieve a certain diversion rate might not be the most effective way for campus to manage its waste.

KEYWORDS

recycling, composting, diversion rate, zero waste by 2020, waste reduction

INTRODUCTION

Globally, humans produce an estimated 1.3 billion tons of solid waste annually - a number that is expected to reach 2.2 billion by the year 2025 (Hoornweg *et al* 2013). In the US alone there were approximately 1,900 active landfills in 2009, not counting the over 10,000 closed sites (EPA 2010). These landfills are major emitters of green house gases, contributing significantly to the world's production of methane, carbon dioxide, and nitrous oxide (EPA 2016). Landfills also produce toxic leachate, which pollutes surrounding soil and ground water (Shen *et al* 2011). Individuals, communities, and organizations that have begun to address waste as an issue strive to lower their waste stream by diverting what is typically sent to landfills or incineration plants by refusing, reducing, reusing, recycling, and composting. Some entities have even devoted themselves to the ultimate goal of reaching 'zero waste', or total diversion of their waste stream (Greyson 2007). This relatively new concept does away with the typical linear model of waste management, where products are designed with the assumption that they will be used for a single purpose and then thrown away, shifting instead to a cradle-to-cradle mentality, where items are produced in a way that promotes their reuse over their disposal (McDonough and Braungart 2002). 'Zero waste' interests and efforts are growing across the globe, resulting in a broad spectrum of studies and opinions on the topic.

While it is great that the 'zero waste' movement has gained momentum, participating scholars, researchers, companies and other entities have developed differing definitions and regulations pertaining to 'zero-waste'. For example, Project ZeroWIN, a project aimed to help industrial networks achieve 'zero-waste', defines it as the elimination of "all discharges to land, water or air that may be a threat to planetary, human, animal or plant health" (Curran and Williams 2012). The University of California has also developed its own goal of reaching system-wide zero-waste by 2020 across all of its campuses. Their goal, however, does not consider discharges to the air or water, and instead only focuses on diverting 95% of their municipal solid waste from the landfill (Lam 2012). These differing opinions on what classifies as 'waste' and varying levels of commitment have made creating a definitive definition of 'zero-waste' impossible so far, and has made the process of becoming a 'zero waste' entity confusing and unclear.

Across the UC system, all ten campuses have been working diligently towards a system-wide 'zero waste' goal, however UC Berkeley has been struggling to meet its targets. According to the initial 'Zero Waste by 2020 Plan' put forth by UC Berkeley in 2009, benchmarks of 50% and 75% diversion rates were to be achieved by 2008 and 2012 respectively, to be followed by 'zero waste' by 2020 (Lam 2012). The campus' diversion rate has been increasing, but was most recently recorded at 44% for 2014 (UC Berkeley 2014). Although the campus has been implementing new projects and movements that promote 'zero waste', the campus remains well behind its goals. Prior to this research project, no new plan had been publicized since the second 'Zero Waste by 2020 Plan' was created in 2012, which pushed the 75% diversion rate benchmark back three years to 2015, and no studies have been conducted that analyze the overall effects of campus' goal or compare it to other 'zero waste' goals (Lam 2012).

Goal with Specifics

For my senior thesis, I conducted an in-depth analysis of UC Berkeley's 'Zero Waste by 2020' goal, in efforts to make this pursuit as transparent as possible for all interested campus affiliates. To do so, I focused on the following two main points, which resulted in an updated 'Zero Waste by 2020 Plan' for UC Berkeley and a critique of the campus' goal.

- How far along is campus currently in its journey to reaching 'zero waste', and what more needs to be done to achieve this goal by 2020?
    - How does campus' current status compare to where past goals say it should be in 2017?
    - What are the changes that campus has undergone since the second plan was produced in 2013?
    - What efforts, if achieved properly, would increase campus' diversion rate to the necessary level by 2020?
- Aside from an increased diversion rate, what are the effects of UC Berkeley's 'zero waste' goal?
    - Does campus consider any other effects in its 'zero waste' goal?
    - Does focusing solely on increasing diversion negatively affect other aspects of waste management?

What is 'Zero Waste'?

There are many different ways entities have defined 'zero waste', varying mainly in how they consider waste to be fully diverted, what outputs they address as apart of their waste stream, and how much they believe needs to be diverted to reach 'zero waste'.

When considering how waste can be deemed 'diverted', some declare waste as completely diverted so long as it is taken to compost or recycling facilities, while others choose to consider the fate of discarded items after it has been diverted. For example, while many entities include plastic recycling in their strategies to achieve 'zero waste', others deny that this process can be used in a 'zero waste' system (McDonough & Braungart 2002). Though plastic can indeed be melted down and reshaped for new goods, the value of such recycled plastic goes down as the material becomes less pure, and will eventually degrade to such a point where it must be sent to the landfill (McDonough & Braungart 2002). This process of taking apart a good to be reused in ways less valuable than its original state has been coined as downcycling, and some entities do not allow this in a 'zero-waste' system while others leave it unaddressed (Verfaillie 2000). Another reason for different interpretations of diversion is due to transparency. Some entities who obtain more transparency between themselves and their compost and recycling facilities can communicate over their true diversion rate. Most entities deem waste as diverted so long as a compost or recycling facility accepts it, however more transparent and ambitious entities can try to track down the amount of contaminants in their diversion waste streams that was eventually sent to the landfill as to ensure that this waste is not considered diverted.

Entities have also differed when choosing what outputs to treat as a part of their waste stream. Though most large-scale entities with 'zero waste' goals and proclamations, such as DuPont, Toyota, and Fuji Xerox, only consider their municipal solid waste when determining 'zero waste', others, such as Project Zero WIN, also consider air and water pollution (Greyson 2007, Curran and Williams 2012).

The last major aspect of discrepancy between many 'zero waste' goals is the differing rates of diversion believed to be necessary in order to declare 'zero waste'. The Department of the Environment in San Francisco views 'zero waste' as "sending nothing to landfill or incineration", whereas the Zero Waste International Alliance has set the frequently-used 'zero

waste' diversion rate standard at 90% (SF Environment 2011, ZWIA 2015). While the term suggests complete diversion, many entities consider this to be unreasonable at large scales and instead aim for diversion rates at or above 90% for their 'zero waste' definition. The US Zero Waste Business Council (USZWBC), who offers the first and only third-party 'zero waste' certification for buildings, similarly defines 'zero waste' as 90% diversion with no recycling or composting collections having more than 10% contamination (US Zero Waste Business Council 2016). No third-party organization offers system-wide 'zero waste' certification, so entities not classified as a single building must rely on their own analyses of their waste streams to define and declare 'zero waste'.

Background

In March, 2007, the then-President of the University of California Robert C. Dynes signed a new policy titled *Policy on Sustainable Practices*, which introduced the UC system-wide goal of reaching 'zero waste' by 2020. This was the first UC policy that addressed waste as an issue, with all previous environmentally-themed policies only encompassing aspects of sustainability that related to building design, energy standards, and transportation practices (Dynes 2007). The new "Recycling and Waste Management" section in the *Policy on Sustainable Practices* was included to comply with the "State Agency Integrated Waste Management Plan" and to support the California integrated Waste Management Board's goal for a "zero waste California" (Dynes 2007). The section set goals for waste reduction (50% by June 30, 2008, 75% by June 30, 2012, ZW by 2020) and called on all campuses to produce Integrated Waste Management Plans (Dynes 2007). Though the section offered clear interim and final goals with hard deadlines, it was also the shortest section in entire Policy on Sustainable Practices, and failed to offer any sort of detailed plan for the UC campuses. Instead, it only offered vague statements like: "Waste reduction and recycling elements shall be integrated into campus operations as they are developed" (Dynes 2007). The section also failed to offer any definition of 'zero waste', which had to be later developed by the UC System. Analyzing this initial policy, it is perhaps not very surprising that UC Berkeley has not met any of their benchmark goals. (UC Berkeley).

METHODS

Study System Description

This study focused on the University of California, Berkeley and their "Zero Waste by 2020 Goal". The central UC Berkeley campus is located in downtown Berkeley and is 178 acres in size. Including the campus-owned residential halls, family housing, and offices not located on the central campus, UC Berkeley is 1,232 acres in size. In 2015, there were 27,496 undergraduate and 10,708 graduate students enrolled, for a total enrollment of 38,204 (US News 2017). There are also 8,988 full-time equivalent employees on campus (University of California 2015).

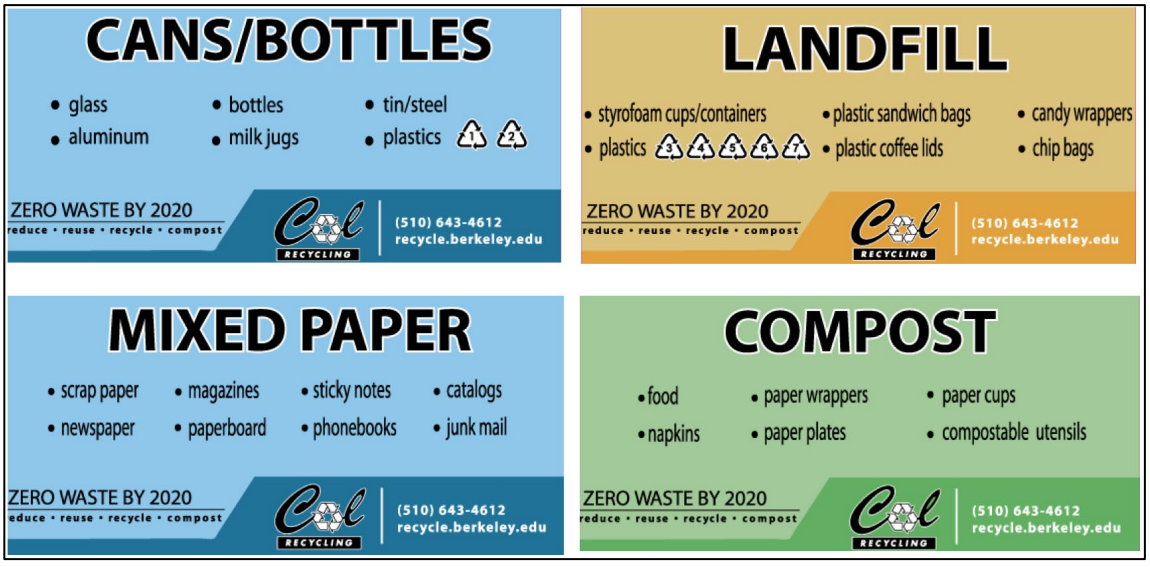
Data Collection Methods

To create UC Berkeley's 2017 Zero Waste Plan, I needed to collect data to illustrate the campus' current waste setting. I first documented the distribution of waste collection services being offered across campus. Cal Zero Waste had on record which buildings were being serviced for composting, paper recycling, and metal/bottle recycling. I then visited the 10 largest buildings that offered both types of recycling and composting (classified as "Zero Waste Buildings" by Cal Zero Waste) and recorded how many of the common-space waste areas had the appropriate bins. Common-space waste areas are the waste-collection spots within buildings that are in public hallways or lobbies (not in classrooms or offices).

To collect information on the bin signage being used across campus, I also recorded the different types of labeling found at these common-space waste areas. According to Cal Zero Waste, there are two different approved types of labeling for on-campus waste collection sites (images 1 and 2). When visiting the common-space waste areas, I recorded the percentage of bins that had approved labeling, unapproved labeling, or were unlabeled.

Image 1. Type 1 Cal Zero Waste approved signage.

Image 2. Type 2 Cal Zero Waste approved signage.



To understand UCB's 2016 waste profile, I collected the numbers of tons sent from campus to the three different types of waste processing facilities: recycling, composting, and landfill. To better understand the campus' landfill waste stream, I organized and helped conduct five waste audits for different campus buildings that are serviced for composting and recycling. For each audit, my team and I collected all landfill bags produced by the audited building in a given day. We ensured that there were no abnormal activities or events going on that would skew our results. We then thoroughly went through the bags and properly re-sorted all items that could be recycled or composted. The leftover waste that was non-divertable (still had to go to the landfill after proper sorting) was classified as 'true-waste'. We recorded the items that made up this true-waste, and classified their source as either:

- On-campus eateries
- Off-campus eateries
- Classroom/office supplies
- Electronics
- Laboratory supplies
- Personal items
- Other

The information from these waste audits was compiled to illustrate how much landfill reduction potential campus currently has from proper sorting. This landfill reduction potential illustrates how much diversion could be achieved on campus if waste were simply sorted properly.

To offer an update on the campus' progress since the 2013 ZW Plan, I also had to collect data from current and past waste-related projects and goals mentioned in the 2013 plan. Each upstream service/program (reducing materials, green purchasing, contracts, new construction and renovation) and downstream service/program (recycling, compost, reuse, special event approaches, basic laboratory approaches) listed in the plan, along with education and incentives, had corresponding near and short-term goals to improve waste-reduction practices. Thus, to display campus' progress over the past four years and to gauge the effectiveness of the 2013 Plan, I followed up on all of the measurable goals listed.

Data Analysis Methods

To produce a plan to get the campus to its definition of 'zero waste' within three years, I had to analyze its current waste-status and calculate steps necessary to take to get UCB to its end goal. I used the data I collected on the campus' waste profile to predict where efforts should be targeted for the most effective change. The materials that were most prominent in the landfill stream would be most effective to eliminate upstream, and the waste reduction potential data was used to illustrate the diversion that would be achieved with total access to recycling and compost and with proper sorting practices. Bin placement and signage information was used to demonstrate downstream strengths and weaknesses.

The data from the progress report on the 2013 long-term and short-term goals was used to demonstrate progress made by campus that is not clearly evident in diversion rates. Though work towards these goals likely did increase the campus' diversion rate, I used the progress report to better account for all of the work done on campus towards the ZW goal. I also used the progress report to measure the effectiveness of the 2013 plan.

RESULTS AND DISCUSSION

Section I: Current Setting

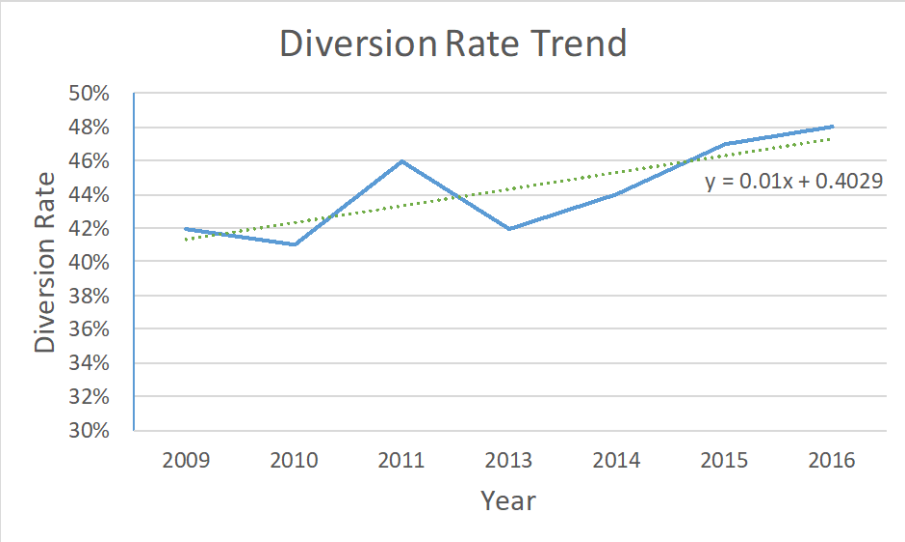
I found that Berkeley averaged a 48% diversion rate during the 2016 calendar year. Thus, campus still needs to increase its diversion rate by 47% to reach it's 'Zero Waste by 2020' goal. By comparing this diversion rate to those since 2009, I found that UC Berkeley is, on average, increasing their diversion rate by 1% every year (Table 1, Figure 1). I chose to build this trend beginning in 2009 because that was the first year that UC Berkeley made any effort toward the UC's 'zero waste' goal. These data represent the waste stream to which the campus goal applies (construction and demolition excluded).

Table 1. Annual Material Stream Data (diversion)

UC Berkeley Waste Profile

	2009	2010	2011	2013	2014	2015	2016
Waste to Landfill (tons)	4,913	5,001	4,782	4,620	4,360	4,271	4,098
Diverted to Recycling (tons)	2,316	1,962	2,195	1,978	1,844	1,669	1,959
Diverted to Composting (tons)	1,218	1,326	1,675	1,308	1,481	2,039	1,630
Diversion Rate (%)	42%	41%	46%	42%	44%	47%	48%

Figure 1: Annual Diversion Graph with Trend



I found that in buildings that are serviced for composting and both types of recycling (and thus should have the appropriate bins in all common-space waste areas), an estimated 60% have composting bins, 72% have bottle and can recycling bins, 78% have paper recycling bins, and 100% have landfill bins (Figure 2). Thus, an estimated 40% of all common-space waste areas in buildings serviced for composting do not have composting bins available for use, 22% do not have the appropriate paper recycling bins, and 28% do not have the appropriate bottle/can recycling bins. Overall, 76% of all bins were labeled with approved signage, 3% were had some sort of unauthorized labeling, and 21% were unlabeled (Figure 3)

Figure 2. Bin Distribution in Common Space Waste Areas. In an ideal world, all recycling and composting bars would show 100% distribution in CSWAs.

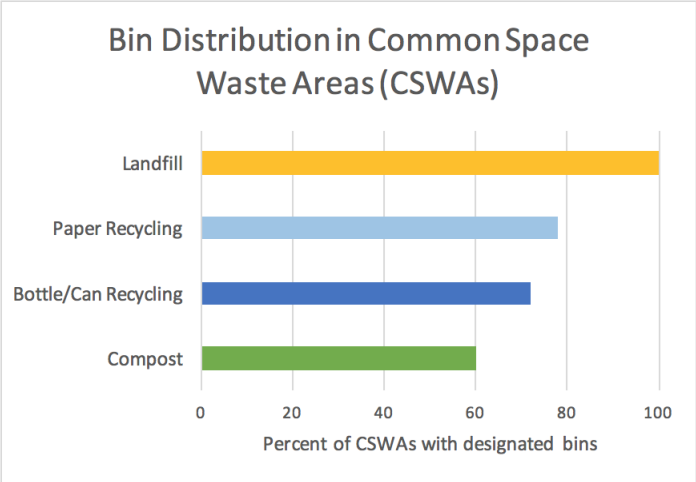
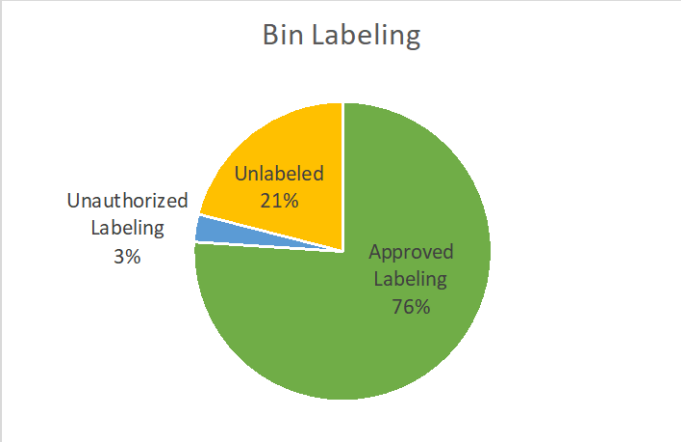


Figure 3. Bin Labeling. In an ideal world, 100% would have approved labeling.



From conducting five different waste audits, I found that knowledgeable sorting could increase diversion rates from 48% to 91%. The audits illustrated that 83% of waste sent to landfill could be diverted to composting or recycling if sorted correctly. From these waste audits, I extrapolated that UCB's true-waste is sourced 37% from food sold off campus, 22% from food sold on campus, 21% from laboratories, 12% from office/classroom supplies, 4% from personal items, and 4% from other goods. Table 2 lists the different source categories, along with the most common items found for each category during the audits.

Table 2. Categorical True-Waste Production.

Waste Source Category	Percent of total non-divertable stream	Most common items
On-campus food	22%	Yogurt cups, nutrition/granola bar wrappers, chip/snack bags
Off-campus food	37%	Plastic bags, clamshell to-go containers, plastic utensils, beverage cups
Office/classroom supplies	12%	Pens, expo markers, staplers
Personal items	4%	Clothing, toys/gadgets
Laboratories	21%	Pipettes, latex gloves, peetree dishes
Other	4%	Plastic film, bandages, styrofoam

As per explained in the UCB 2013 Zero Waste Plan, UCB is currently somewhat behind with their near-term/in-progress Strategies. The measurable near-term/in-progress strategies that were included in the 2013 plan are listed below, with a summary of their 2013 status and a current update. There were many strategies/goals that were too vague to measure or follow up on.

- Make signage more consistent.
    - **2013 status:** Signage consisted of "various designs, sizes, and messaging" (2013 Plan). The 2013 system was described as incomprehensive and inconsistent.
    - **2017 update:** From a sample in taken in 2017, 76% of bins were labeled with approved signage, 3% were had some sort of unauthorized labeling, and 21% were unlabeled.
- Expand ReUSE stations throughout campus and spread reuse awareness.
    - **2013 status:** There were 12 ReUSE stations across campus. The plan did not specify their condition.

  - **2017 update:** There are four ReUSE stations currently being maintained by a campus club, six are neglected (empty and ignored but still standing), and two have been officially removed. In 2016 campus also introduced its first ever ReUSE store, where students can donate and buy used belongings.
- Work with event-planning so that campus events can be 'zero-waste'.
  - **2013 status:** Event coordinators were encouraged to minimize waste, but no set processes or guidelines had been created to address 'zero-waste' events
  - **2017 update:** Events can now go through a certification process under the Office of Sustainability and Cal Zero Waste that classifies certain events as 'Zero-Waste Events'. Said process is not mandatory and information regarding the certification is only distributed to event planners upon request.
- Promote environmentally-preferred products on Campus e-procurement system BearBuy.
  - **2013 status:** No distinction existed for environmentally-preferred products on BearBuy.
  - **2017 update:** BearBuy now labels its environmentally-preferred products with a green leaf that appears on the products' image.
- Include waste management policies in leases/contracts with on-campus vendors.
  - **2013 status:** Leases with on-campus vendors had varying language regarding landfill and recycling expectations and costs, which lead to inconsistent diversion efforts, infrastructure, and signage from location to location.
  - **2017 update:** No change.

As per explained in the UCB 2013 Zero Waste Plan, UCB is seriously behind with their longer-term strategies. Their main longer-term strategies are listed below, with a summary of their current update I found and compared to their 2013 status. There were many strategies/goals that were too vague to measure or follow up on.

- Find recycling options for plastics #3-7.
  - **2013 status:** Campus only accepted plastics 1 and 2 for recycling.
  - **2017 update:** No change.
- Develop take-back programs with vendors.
  - **2013 status:** No take-back programs had been implemented yet on campus.

  - **2017 update:** Laboratories have begun utilizing some take-back programs with Styrofoam coolers and other shipping materials, but these efforts are not clearly recorded through Cal Zero Waste.
- Expand food and paper towel composting to campus buildings and exterior spaces.
  - **2013 status:** Six buildings had begun to be serviced for composting.
  - **2017 update:** 42 buildings are now serviced for composting.
- Use washable and reusable alternatives to single-use materials in labs.
  - **2013 status:** Laboratories were struggling to incorporate reusable alternatives due to safety hazards.
  - **2017 update:** No detectable change.
- Replace paper towel dispensers with air dryers in high volume areas.
  - **2013 status:** 2 buildings had air dryers installed in high volume restrooms.
  - **2017 update:** 18 buildings have air dryers installed in high volume restrooms.
- Include waste reduction, recycling, and composting training in new student orientation and educate Residence Assistants (RAs) so they can work with the new students on proper diversion.
  - **2013 status:** No aspect of waste management was included in new student or RA orientations.
  - **2017 update:** Negotiations are underway with orientation coordinators to include a sustainability segment for new students in Fall 2018.
- Work with vendors on campus to offer more discounts or incentives to customers who bring their own bag, mug, or other items to reduce one-time use materials.
  - **2013 status:** No such incentive programs existed yet.
  - **2017 update:** The "Chews-to-Reuse" program allows students to use washable to-go containers when buying take-out food from the dining halls. The "Refills Not Landfills" program offers students a free drink at participating on-campus locations after using their own mug five times (monitored through a punch card).

Section II: Analysis of Current Setting

Even though UC Berkeley's diversion rates have improved over the past eight years, the campus is not on track to reach its zero waste goal by 2020. Since 2009, when UC Berkeley first

implemented the Zero Waste Goal program, the campus has averaged an increase of 1% in their diversion rate every year. Based on this trend, I expect campus to reach a diversion rate of around 52% by 2020. For UCB to instead reach its 95% diversion rate goal by 2020, the campus would have to significantly improve and intensify its ZW efforts. Based solely on its diversion rate, it appears that campus is far from reaching its goal. However, the composition of the waste stream typically sent to the landfill shows that campus might not be as far away as it seems.

Perfect sorting alone could nearly push campus to its 'zero waste' goal. The waste audits I conducted demonstrated that 35% of the materials campus sends to the landfill could be recycled or composted. Increased diversion through perfect sorting would push campus to an overall diversion rate of 91%. Comparing this data to campus' most recent waste audit information (2013), UC Berkeley has not made any significant improvements in capturing its diversion potential. In 2013, an estimated 97% of the materials sent to the landfill could be recycled or composted. My data demonstrates that UCB has only managed to capture 6% more of its divertable waste since 2013. This difference is very small, and could be due to random variation.

In waste audits, I also collected data on true-waste, or the waste that would still be sent to the landfill even after perfect sorting. The audits showed that most true-waste collected on campus was sourced from food-related purchases from on and off campus. The most common items were nutrition/granola bar wrappers, plastic beverage cups, chip bags, and plastic clamshell to-go containers. Addressing food-related true-waste could be a proactive means of pushing campus toward its goal, since it is the source of 60% of campus' true-waste. However, according to my waste audits, true-waste only accounts for 9% of campus' total waste. A very significant amount of campus' waste could already be diverted with proper sorting. This poses the question of whether campus should focus on reducing true-waste, or whether it should focus on increasing diversion to most effectively work towards its goal.

Section IV: Why Are We Here?

The failure to attain diversion potential is likely attributable to campus' inconsistent and imperfect waste bin signage and distribution. Cal Zero Waste had introduced bins for both plastic/metal and paper recycling in all buildings by 2009, when it also began introducing

composting. Since then, Cal Zero Waste has begun collecting compost from 42 of campus' 200 buildings (labeling them as 'zero waste buildings'). However, I found that 30-40% of all common-space waste areas lack the correct bins, making composting and recycling unavailable to about a third of the public in buildings that are serviced for such diversion and undermining diversion potential. Additionally, 25% of the bins available to the public were either mislabeled, labeled with unapproved signage, or not labeled at all. It is already difficult enough to convince people to expend extra effort in properly sorting their waste when the proper bins are available, and having inconsistent and incorrect bin distribution and signage makes proper sorting even less probable.

This imperfect distribution of waste bins and bin signage is likely due in part to unclear and inconsistent custodial training and management. Custodial members work in multiple buildings, many of which might have different bin allocations. This variation means that custodial staff must change their job duties depending on whichever building they are working in. While all new custodial staff have begun partaking in 'zero waste' training upon hiring since 2015 (where staff learn about the 'zero waste' goal and are given special training on servicing 'zero waste' buildings), custodial members that were hired before 2015 have not gone through such training (King 2017).

The lack of proper sorting could also be due to a lack of waste-related educational outreach. With no waste disposal education available to incoming students, unless new students have independently researched what materials can and cannot be accepted on campus, no new students will be familiar with UC Berkeley's waste collection practices. Additionally, since the City of Berkeley and campus have different waste management systems, students who live off of campus must understand the distinction and adapt two different waste sorting habits to achieve maximum diversion. Yet, campus still does not mandate a briefing or educational program to inform new students about waste management procedures on campus or in the City of Berkeley.

Although both the UC System and UC Berkeley have made strides in publicizing their Zero Waste goals, another barrier to reaching 'zero waste' could be the lack of funding available for the initiative. This fiscal year was the first time the UC system distributed any funds to campuses for implementing 'zero waste' projects or policies. Through a new campaign called "#mylasttrash", campus affiliates now have the opportunity to apply for up to $1,500 for 'zero waste' efforts. Before this funding opportunity was available, and for any costs that supersede

the $1,500 limit, campuses must independently source funding for zero waste initiatives. Until more significant funding can be secured, this will inevitably continue to restrict campus' abilities to implement projects and policies (King 2017).

Section V: What Must Be Done?

From compiling all of the information I collected throughout my study, I drafted the first version of UC Berkeley's 2017 Zero Waste Plan. This plan largely mirrored the 2013 plan in structure. The first section of the plan was dedicated to summarizing campus' current waste setting. The second section outlined current upstream and downstream strategies and their corresponding near-term and long-term goals. The third section summarized the correct and approved bin distribution and signage, and it also offered building managers 'best practices' for proper waste management. The conclusion summarized the key necessary next-steps for campus to reach its 2020 goal.

With only three years left until the UC's deadline for reaching 'zero waste', the suggestions made throughout the 2017 plan were designed to have the strongest effect on campus. Since true-waste is only responsible for around 17% of UC Berkeley's waste stream, my main suggestion for campus was to focus efforts on diverting the divertables in the landfill stream. While I did suggest some goals that would focus on reducing campus' true-waste, the large quantities of divertable materials are currently sent to the landfill illustrate a lot of room for improvement through proper sorting. Also, addressing waste-related issues downstream (*e.g.* improving sorting) takes less effort and resources than it does addressing them upstream (*e.g.* changing purchasing behaviors). Thus, the suggested actions and goals I created in the 2017 plan follow this same theme.

Based on the progress report I developed on the 2013 goals, all of the goals I made for 2017 were more metric-specific (measureable) and focused more on downstream solutions. In assessing the 2013 goals, I often found it difficult to measure their progress due to the broad nature of their wording. Thus, the goals in the 2017 plan were drafted to be much more specific. Each goal was written so that it could be quantified as easily as possible, and the current 2017 status of each goal was also included. In addition, I found that the breadth and lack of specificity of the goals did not encourage proactive work towards the 'zero waste' goal. UCB's new goals

for 2017 are now easier to accomplish due to their measurability, and would push campus to ZW by 2020 should they all be followed diligently.

Section VI: Broader Implications

Even though it would be possible for campus to reach its ZW goal in the next three years if the new 2017 ZW Plan were carefully followed, it is highly improbable. Campus is on an upward trend towards improved diversion rates, but the necessary spike that would be required for campus to nearly double its diversion rate in the next four years seems impossible to achieve. The goals I laid out in the 2017 plan were selected because they were the easiest, and thus most likely, for campus to accomplish. Still, goals related to improved sorting rely heavily on the participation of campus users, which is largely impossible to control. Additionally, most of the goals related to improved bin accessibility/distribution and better education and outreach have been goals of the campus since the 2013 plan. Unfortunately, aside from expanding the composting program, not much quantifiable improvement has been made, implying that these goals will require more diligent and thorough work than what has been done since the 2013 plan.

The suggestions I laid out in the 2017 plan will help push campus towards its overall goal, but I also strongly suggest that work done towards the goal is not done hastily. While the whole purpose of the 2017 ZW Plan was to identify the easiest-to-achieve next steps that would increase campus' diversion rate, I feel it imperative to also acknowledge the other effects of such efforts. To truly make the most impactful difference on campus' waste profile, all efforts made must be done at the infrastructural level as to ensure successful, permanent, proliferated effects.

Quick fixes that address an aspect of waste management in a temporary manner might look good for one year's diversion rate. However, these temporary solutions could fall apart for the next. For example, one campus entity introduced a new composting scheme through a one-time grant expenditure, but did not secure continual funding or create a permanent infrastructure for the program to carry on beyond the first year of implementation. Permanent changes are almost always slower in displaying impacts and take more effort to instill, but would result in better outcomes.

The 2017 plan was written with a focus on downstream efforts since they are often easier and cheaper to implement, and they have the potential to divert a large amount of recyclables and

compostables from the landfill. Although upstream solutions tend to take more time and effort to implement and might have less of an effect on the campus' diversion rate, upstream solutions are more likely to lead to permanent changes. Instead of focusing on how to best manage waste and increase diversion, upstream solutions (such as eliminating the sale of non-recyclable food containers on campus, or offering better waste-related education to new students) focus on overall waste reduction. Upstream efforts may have less of an effect on campus' 'zero waste' goal, but they promote the overall reduction of waste production and lead to changes that are not reliant upon campus user participation. Thus, once implemented, these efforts tend to have more permanent and proliferated effects.

The implementation of the University of California's system-wide goal of 'Zero Waste by 2020' demonstrates the UC's dedication to sustainability. However, the narrow scope of the UC's definition of 'zero waste' is pushing its campuses towards quick fixes that only consider effects to diversion rates. Waste management practices have wide ranges of impacts, and solely considering a campus' diversion rate undermines the effect that waste truly has. The University of California could better its goal by including language that encourages and prioritizes overall waste reduction above improving diversion rates, since overconsumption of recyclable or compostable goods is still overconsumption. In addition, I believe it is time for the UC to push back its 2020 goal for a more realistic timeline. By keeping this deadline, campuses will rush to maximize diversion rates instead of focusing on instilling permanent and proliferated changes. An ideal 'zero waste' goal should promote infrastructural changes so that entities can best become, and then remain, truly 'zero waste'.

ACKNOWLEDGEMENTS

I owe the hugest of thanks to Kurt Spreyer, who put up with me in (and out of) countless office hours. Without your constant encouragement and thoughtful advice, I would never have finished this damn thing. And, of course, thank you to the rest of the ESPM 175 team for always building me. I feel so lucky to have been a part of such an awesome class.

Thank you to my mentor, Kate O'Neil, who never failed to offer trash-y words of wisdom, and to John Battles who helped me shape this thesis when it was a mere clump of thoughts.

Thank you to Amani for always answering my calls and listening to my rants, no matter how many miles and hours were in between us. Thank you to my Ward family, Alisa, Kenneth and Dane, who made building a home-away-from-home so easy for the past 4 years. Though you may not know it, you all soothed me while I was going (slightly) crazy over this project.

Thank you to my dad, who inspires me to be a better person every day. Thank you to my sister, for always making me laugh and for teaching me how to be passionate. Thank you to Fay, for always listening when Dad and Emma couldn't pretend to care anymore.

And thank you to my mom. This is all for you, Mama.

SOURCES

Curran T. and I.D. Williams. 2012. A zero waste vision for industrial networks in Europe. Journal of Hazardous Materials. 207:3-7.

Dynes, R.C. 2007. UC Policy on Sustainable Practices. The University of California, Office of the President.

Greyson, J. 2007. An economic instrument for zero waste, economic growth and sustainability. Journal of Cleaner Production 15:1382–1390.

Hoornweg, D., P. Bhada-Tata, and C. Kennedy. 2013. Waste production must peak this century. Nature 502.

King, L. 2017. Zero Waste by 2020. ESPM 175. University of California, Berkeley. Lecture. Berkeley, California, United States.

Lam K. 2012. Campus Waste: Getting to 75% Diversion and Striving for Zero Waste. UC Berkeley Chancellor's Advisory Committee on Sustainability. http://ucop.edu/sustainability/_files/ucb-waste-diversion-plan.pdf (Version 02/2012).

McDonough W. and M. Braungart. 2002. Design for the Triple Top Line: New Tools for Sustainable Commerce. Corporate Environmental Strategy. 9:251-258.

Shen, L.-Y., J. Jorge Ochoa, M. N. Shah, and X. Zhang. 2011. The application of urban sustainability indicators – A comparison between various practices. Habitat International 35:17–29.

U.S. Environmental Protection Agency (EPA). 2010. Landfill Gas Energy Cost Model (LFGcost), Version 2.2. LMOP, Climate Change Division, U.S. EPA. July 2010.

US News. 2015. How Does UC Berkeley Rank Among America's Best Colleges? (n.d.). https://www.usnews.com/best-colleges/uc-berkeley-1312.

US Zero Waste Business Council. 2016. (n.d.). https://uszwbc.org/.

SF Environment. 2016. Zero Waste - Frequently Asked Questions (FAQs). https://sfenvironment.org/zero-waste-faqs.

Verfaillie H.A. and R. Bidwell. 2000. Measuring eco-efficiency: a guide to reporting company performance. World Business Council for Sustainable Development.

Zero Waste International Alliance (ZWIA). 2015. (n.d.). . http://zwia.org/.