

Oregon Wasted Food Study: Institutional and Commercial Sector Case Studies



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Executive Summary

The Oregon Department of Environmental Quality funded the Oregon Wasted Food Study in 2017 and 2018, to investigate the quantities, types and causes of wasted edible food in the state in both the residential and commercial sectors. This report presents the results of wasted food assessments and reduction efforts in fifteen case studies of a cross-section of Oregon food service businesses.

From these fifteen case studies we identified general principles and specific strategies to reduce wasted food in the commercial sector. The key take-aways listed here can be applied across business contexts. A comprehensive list of 45 recommended practices with more guidance for specific contexts can be seen in Table A2 in the appendix.

Track. Often times the first step to minimizing waste is understanding what waste is occurring (and where). Waste measurement (alongside other types of tracking, like sales, production, etc.) can be valuable tools for minimization and can help a business target reduction efforts and track progress.

Understand. Waste has many causes, some of which may not be obvious. Use strategies discussed above, like staff interviews or surveys, to understand why waste is occurring. Try also to understand other important factors at a business, like patterns in customer demand, demand by item or customer preferences.

Plan. Use whatever information available to plan crucial process elements at a business. For example, use sales data to tailor production to demand, use waste measurement data to plan for buffet serving dish sizes or plate sizes, or use customer portion preference information to plan portion sizes that better meet customer needs.

Train. Set strong expectations for current and incoming staff around waste reduction and use frequent trainings to cement these understandings, establish new waste prevention practices and create a platform for best-practice sharing among staff.

Set expectations. A business will benefit by setting clear expectations to both staff and customers about waste and waste prevention efforts. Use signage to help customers understand why products may not be available towards the ends of meal times. Use routine performance evaluations as a time to talk with staff about expectations of waste prevention.

Be dynamic. Even with the best planning unfavorable things do happen. Attendance at a catering event barely reaches 50% or twice as many customers as usual show up to a Sunday brunch. Businesses can build in systems and practices to help them accommodate abnormal events and ensure they do not cause unnecessary waste or overproduction. Below are a few suggestions:

- Cook-to-order when possible so little food is over-prepared.
- Use smaller batch sizes to minimize overproduction in the case of less-than-expected demand.
- Stock emergency menu item substitutes that store well but allow for quick use when regular menu items run out.
- Use dynamic production planning, reviewing PARs multiple times per week (or even day) to adjust to abnormal events or new patterns of demand.

Target. Waste prevention can take the form of broad changes, but it can also look like targeted interventions. It may work best to target energy and staff resources to address the most significant causes of waste.

Furthermore, prevention strategies themselves may benefit from a narrow focus. Track a particular stream or type of waste to monitor progress. Re-evaluate production planning and PARs at the product level. Work with specific staff to change processes they primarily control.

Repurpose. Businesses can benefit when they support creative ingredient repurposing. Support can mean both cultural (e.g. setting expectations for staff to repurpose ingredients) and structural (e.g. planning menu items with complimentary ingredients). Additional strategies to support repurposing include:

- Prepare ingredients separately when possible and combine when served (for example, bake chicken breasts separately from sauces).
- Plan menus so that by-products from one menu item can be used in another (e.g. trim from sirloin steak is ground for beef for sliders).
- Create a shelf in the refrigerator for ingredients needed to be repurposed. Encourage staff to look there first when selecting ingredients.

Change culture. Edible food waste is as much a cultural problem than it is a logistical one. Businesses can support waste prevention by supporting a culture of waste reduction, re-purposing, and problem-solving. Consider hiring employees who demonstrate dedication to waste prevention or have thrifty tendencies. Recognize employees who demonstrate commitment to waste prevention.

Celebrate. Waste prevention work can be difficult. Furthermore, it heavily relies on front-line staff to problem solve and adapt, utilizing their time, labor and knowledge. Businesses should recognize and compensate their employees for this work through recognition, celebration, increased pay or other methods.

Introduction

Overview

This is a report on the methods and results of one of 15 food service business case studies, as part of the institutional and commercial (IC) sector portion of the Oregon Wasted Food Study. This study is funded by the Oregon Department of Environmental Quality and conducted by Community Environmental Services (CES) at Portland State University.

The research objectives for the IC portion of this study are to:

- Understand components of wasted food in IC sector
- Highlight causes of commercial wasted food and key opportunities for waste prevention
- Test wasted food reduction best practices and quantify their effectiveness
- Promote wasted food reduction best practices for application at commercial food service institutions

What is wasted food and why prioritize prevention?

This study focuses on the causes of wasted edible food and strategies to reduce the *generation* of this waste as opposed to waste diversion. This section discusses why a focus on waste prevention rather than diversion is important, and helps define what food waste and wasted food is in the context of these studies. .

Food waste is an all-encompassing term that refers to edible and inedible food that is unfit for human consumption and sent for disposal. Food waste can be sent to feed animals, for composting or to anaerobic digestion as well as less preferable disposal options, such as landfill or incineration. In these studies, we use the term food waste to refer to all of the organic food material generated by a business that is not consumed or taken off site by customers or staff. **Wasted food, however, refers to only a subset of food waste - the edible parts of unconsumed food** (see Figure 1). Wasted food does not have to be edible at the point of disposal, but it has to have been intended for human consumption. For example, moldy bread, while inedible now, was once intended for consumption and is therefore considered wasted food. In contrast, banana peels and eggshells are generally not considered edible as human food; they contribute to food waste but are not wasted food.

Of the food waste we throw away ...



Figure 1: Food waste includes wasted food (food that could have been eaten at some point) and is often the majority of the food thrown away

Reducing the generation of wasted food is the primary priority of these cases studies. Figure 2 visualizes the hierarchy for wasted food, and illustrates that source reduction (reduction of the generation of wasted food) is the most preferable outcome before rescue (i.e. donation), use for animals, recovery of energy or nutrients through composting or anaerobic digestion, or landfilling. Source reduction is the highest priority as the majority of economic and environmental burdens of wasted food happen *before* consumption, in the food’s production, processing, transportation, storage and preparation. For example, the greenhouse gas impacts of producing foods purchased by Oregon consumers are almost 60 times higher than the impacts from landfilling wasted food (10.73 million metric tons CO₂e in 2015 for production vs. 0.18 million metric tons CO₂e from disposal)¹. Focusing on post-consumption interventions does not prevent these upstream costs. For businesses, too, the most potent cost and labor savings are associated with avoiding the purchasing and preparation of food, rather than pursuing rescue or recovery efforts.

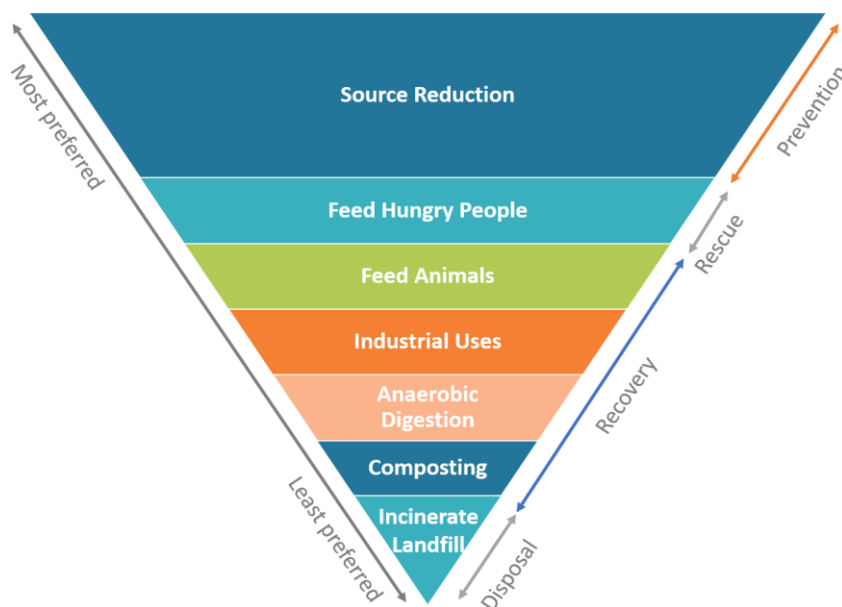


Figure 2: Wasted Food Hierarchy, from waste prevention to landfill disposal, with elements higher in the pyramid being economically and environmentally preferable to the lower elements. ²

Report structure

This report summarizes key themes and source reduction strategies discussed across the fifteen case studies. First, we summarize the characteristics of industrial, commercial and institutional wasted food found across the case studies. Next, in case study design, core methodological approaches used across most of the case studies are discussed. In conclusions, key takeaways from the case studies as they relate to causes of wasted edible food and critical opportunities for source reduction are summarized. Key findings are also aggregated and displayed in Table 1. These findings are meant to provide overviews of each case study, but are best understood by reading the case study itself. Terms are defined both in the glossary in the appendix of this report and in each case study individually. In recommended practices, a range of practices that address critical

¹ Oregon GHG Emissions Inventory Report, Appendix B, Table B-2: Retrieved from <https://www.oregon.gov/deq/FilterDocs/OregonGHGreportAB.pdf> (October 26, 2018)

² Oregon Department of Environmental Quality

causes of wasted food are described and assessed. Finally, there is a glossary of terms used throughout this report and the in case studies themselves. Click on the case study number to access each case study.

Table 1: Guide to the fifteen commercial case studies

Case	Business type	Practice	Key findings
1	Large brewery and restaurant	Portion size calibration	<ol style="list-style-type: none"> 1. Routine calibration tests were mildly effective at improving portioning accuracy. 2. The business operated on a “bigger-is-better” mindset, even though portions were not found to be a significant concern of customers
2	Retail commissary kitchen	Tracking repurposing potential	<ol style="list-style-type: none"> 1. Tracking of meat trim demonstrated a potential \$8,200 in food cost savings per year if trim were repurposed.
3	College cafeteria	Production and overproduction tracking	<ol style="list-style-type: none"> 1. Overproduction was common, occurring in nearly 30% of menu items produced. 2. Chronic understaffing limited the business’ potential to deploy source reduction practices.
4	College cafeteria	Waste awareness campaign and routine trainings	<ol style="list-style-type: none"> 1. The waste awareness campaign appeared effective at reducing overproduction waste. 2. Methods of assessing and tracking waste need to be appropriate to the analysis at hand. Waste sorting is useful for point-in-time assessments while waste tracking is better for assessing change over time.
5	Hospital cafeteria	PAR reduction and small batch firing	<ol style="list-style-type: none"> 1. Reductions in planned production amounts, influenced by waste tracking, alongside small batch firing reduced back-of-house entree waste by 45.5%. 2. Institutional ordering practices meant this small cafeteria consistently had spoiled ingredients due to limited package size choices.
6	Small restaurant and wholesale kitchen	Culture of waste minimization and source reduction	<ol style="list-style-type: none"> 1. The lived experience of the business’ employees, and the high expectations of the manager, informed a culture of source reduction. 2. Strategies for repurposing ingredients and menu items minimized edible wasted food.

Case	Business type	Practice	Key findings
7	Corporate cafeteria	Waste tracking	<ol style="list-style-type: none"> 1. Waste tracking demonstrated substantial amounts of edible wasted food, but considerably under-recorded waste when verified by a researcher-led waste composition assessment. 2. Client expectations of abundance supported a widespread fear of running out that led to significant overproduction.
8	Medium-sized caterer	Preparation on-site practices	<ol style="list-style-type: none"> 1. Preparation on-site improved the ability to repurpose excess production, representing a potential \$14,540 in food cost savings per year. 2. Analysis of event records found that events are chronically under-attended and portions are chronically over-sized leading to consistent edible wasted food.
9	Hotel kitchen	Cross-utilization of catering leftovers	<ol style="list-style-type: none"> 1. The business saved between \$27,000 and \$54,000 in estimated food costs per year by repurposing catering leftovers for use in their employee cafeteria, at their breakfast and lunch buffets and for their corporate cafeteria.
10	Hotel kitchen	Knife skills trainings	<ol style="list-style-type: none"> 1. Knife skills training anecdotally supported better trimming practices and reduced edible wasted food. However, some style of cuts (e.g., wedge) continue to create edible wasted food.
11	Retail grocery	Consistency of quality standards interpretations	<ol style="list-style-type: none"> 1. Inadequate training practices appear to support inconsistent understanding of quality standards across produce associate, resulting in appropriate culling of produce that could still be sold. 2. Under-trained staff and competing priorities caused improper culling, markdown and data tracking.
12	College retail grab-and-go	Dynamic PAR setting and waste tracking	<ol style="list-style-type: none"> 1. Dynamic production planning practices supported low levels of grab-and-go overproduction at the commissary kitchen (2.7%) and the business' largest retail location (6.69%). 2. The business' point-of-sale system lacked the ability to analyze product-level sales over time, requiring waste tracking to be used as a proxy.
13	Large upscale restaurant	Meat repurposing through intentional menu planning	<ol style="list-style-type: none"> 1. The business saves approximately \$67,330 per year in food costs by repurposing meat and seafood trim into new menu items. 2. The business clearly communicates their high quality standards to employees and suppliers - reducing loss upstream and downstream.

Case	Business type	Practice	Key findings
14	Small hotel restaurant	Changing purchasing practices	1. Switching from whole fish purchasing to pre-processed fish filets saved an estimated \$1,351 per year, and reduced overall waste because of their supplier's ability to repurpose byproduct.
15	Small retail cafe	Waste tracking and corporate policy review	1. Corporate policies mandating overproduction of bakery goods led to consistent waste (averaging 18% of all baked goods per day) and low product sell-out rates. 2. Bakery overproduction costs the business almost \$10,000 in food costs per year, and represents a significant labor demand.

Wasted food in case studies

Wasted edible food was found across case studies, and often accounted for substantial percentages of total food waste (ranging from 34% to 82% of back-of-house waste with a median of 55%, and 58% to 91% of front-of-house waste with a median of 88%). Back of house wasted edible food was primarily prepared foods, dry foods, and vegetables and fruit. Front of house wasted edible food was primarily prepared foods, with vegetables and fruit also common. Figures 3 - 8 provide more details on the magnitude and composition of inedible and edible food waste across the case studies where broad waste assessments were conducted. Note that there are not fifteen data points in these graphs because not every case study included a physical wasted food assessment, or only assessed a narrow portion of a businesses wasted food stream. For a few businesses, both an initial and a post-practice assessment were conducted and are included here. The data included in these graphs represents pounds produced per business day. As is apparent, the size and scope (and therefor waste) of these businesses was highly variable, however, edible wasted food was prevalent regardless of business size or type.

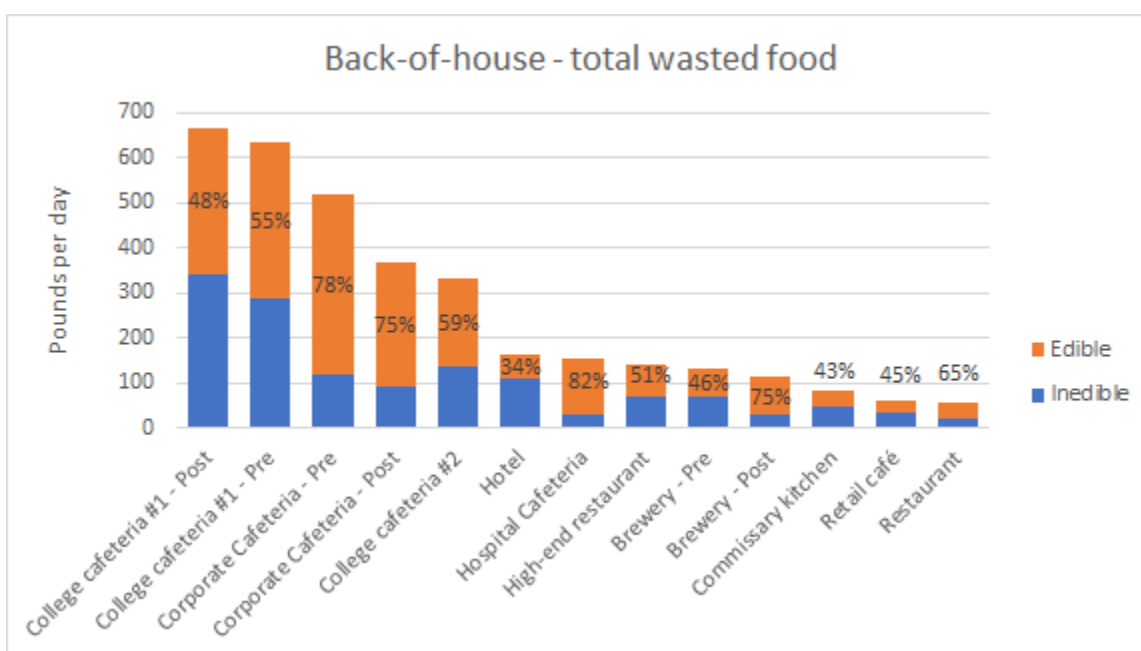


Figure 3: Back-of-house edible and inedible food waste by Case Study, with percentage of edible wasted food

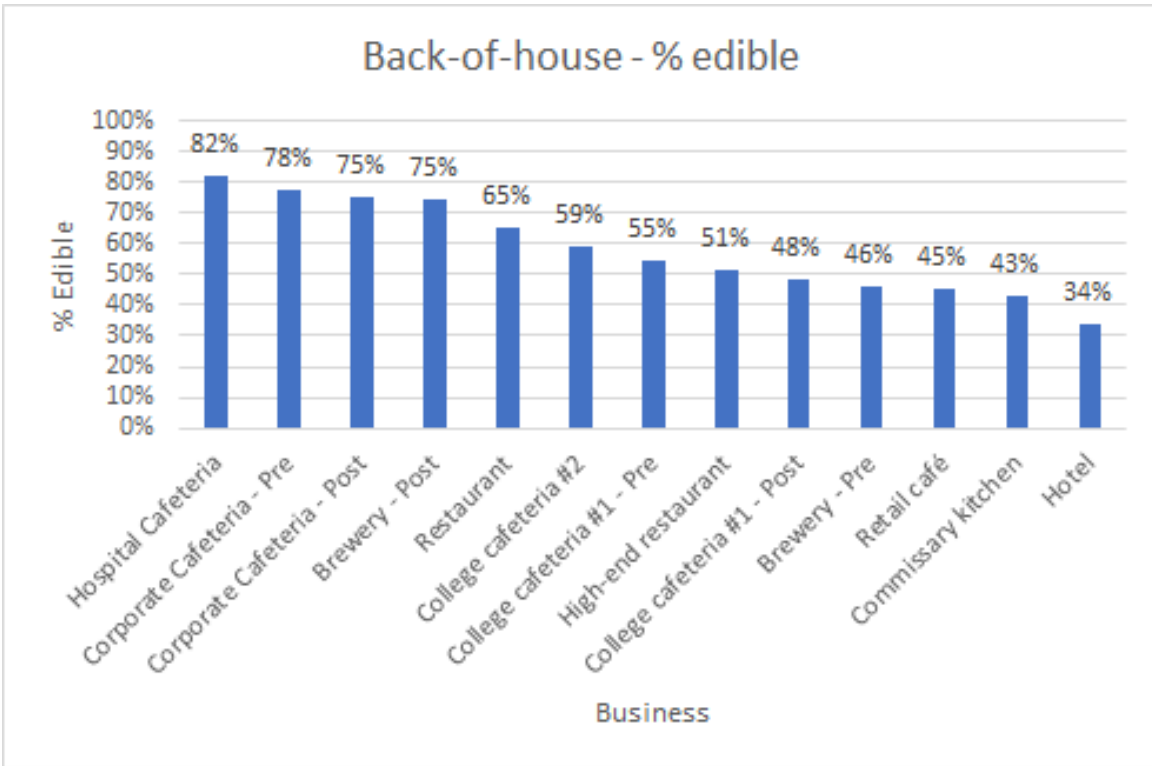


Figure 4: Back-of-house wasted food, sorted by percentage of edible wasted food

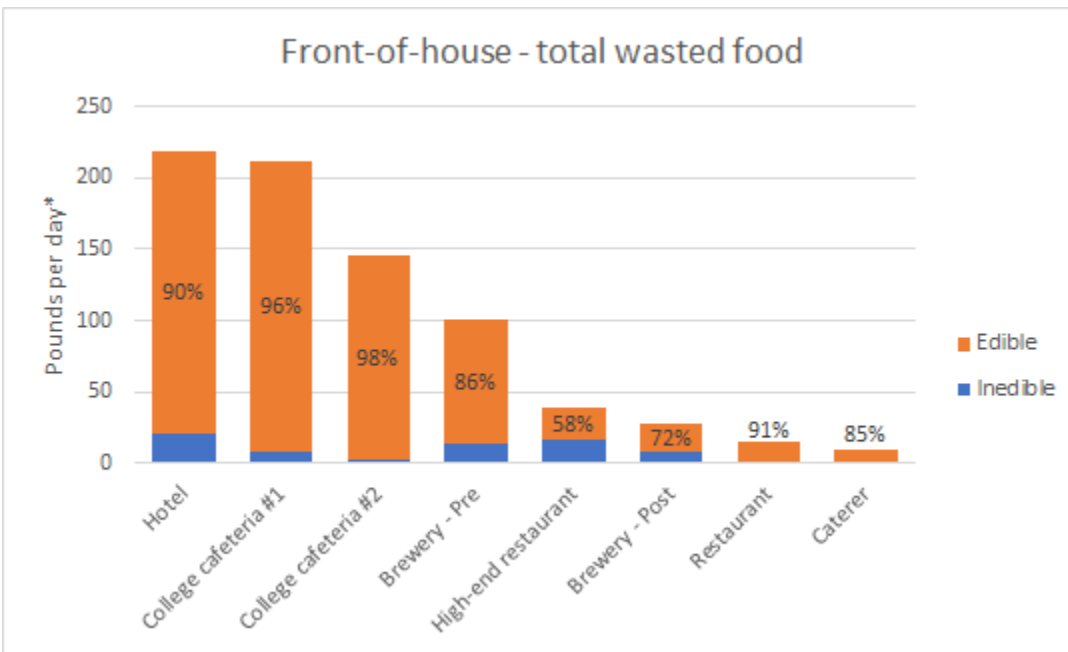


Figure 5: Front-of-house edible and inedible food waste by Case Study, with percentage of edible wasted food

* The caterer data point both represents front-of-house waste for a single day and a single event. This particular caterer sometimes had two or more events, or zero, so this may not be an accurate per-day estimate.

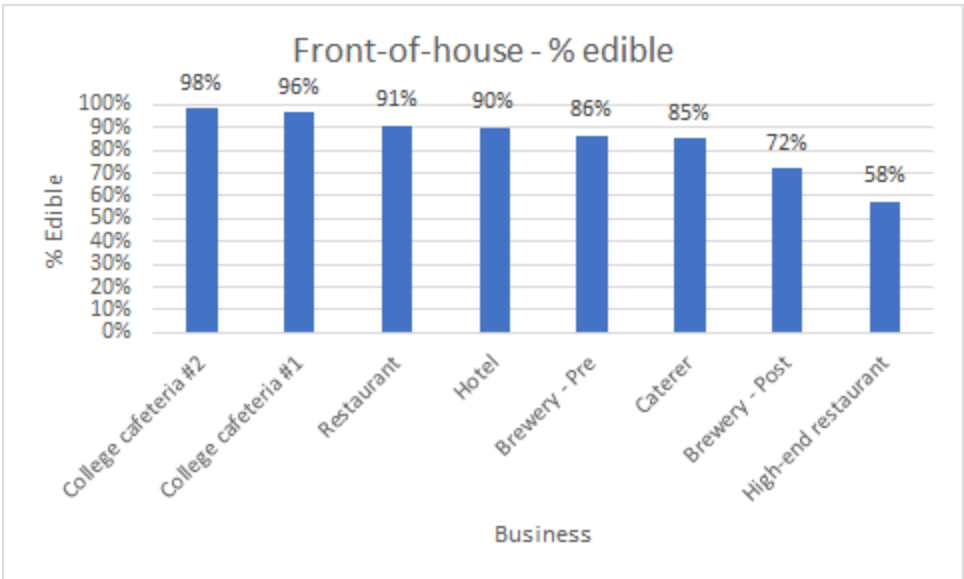


Figure 6: Front-of-house wasted food, sorted by percentage edible wasted food

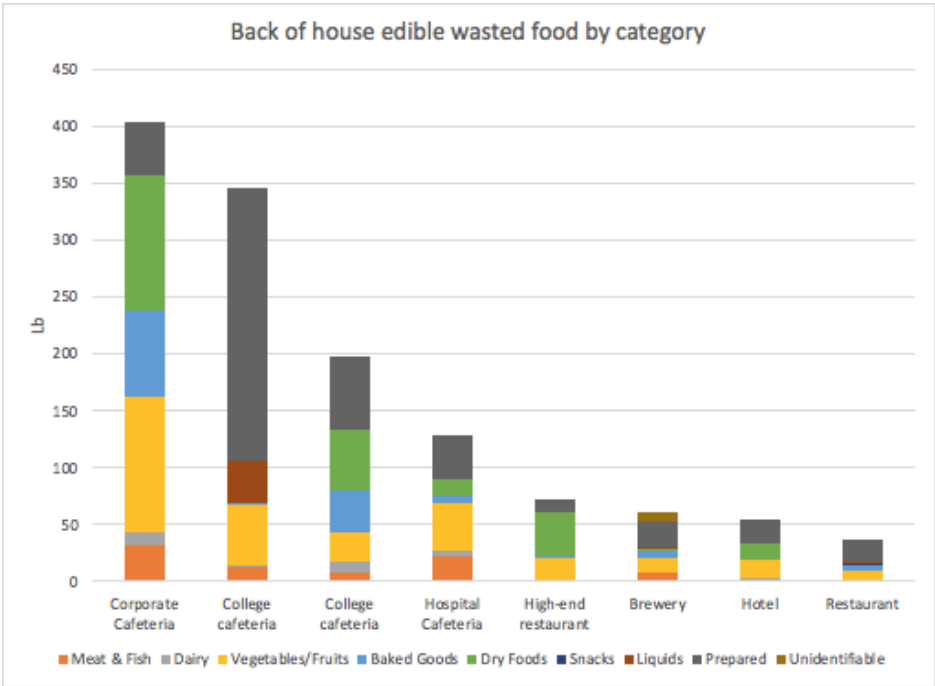


Figure 7: Back-of-house edible wasted food by Case Study, by category

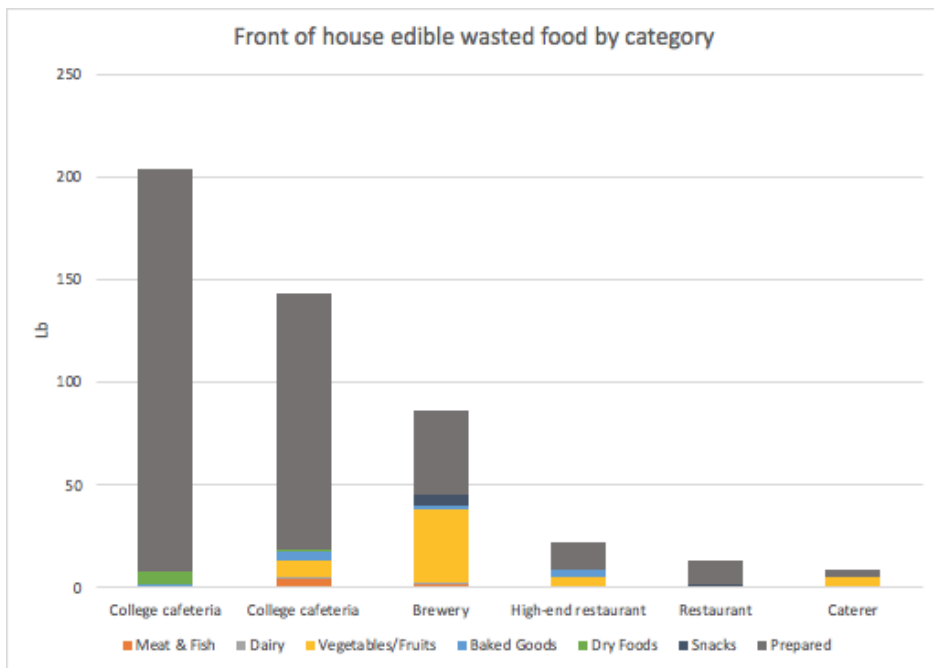


Figure 8: Front-of-house edible wasted food by Case Study, by category

Study design

Each case study included a waste composition assessment, interviews with staff in both operations and management, collection of sales and tracking data where possible, and introduction and evaluation of a new practice intended to improve food utilization and reduce waste. The following section briefly describes the most commonly used data collection and analysis tools. Unique data collection or analysis protocols are outlined in their respective case studies.

Waste assessment

Preliminary waste assessments were performed in most of the fifteen case studies. These assessments were used to understand the nature and magnitude of wasted food and assist in targeting types and causes of wasted food. These sample size varied by assessment, sorting between 30% and 100% of a business' food waste generation over a 24-hour period of a normal business day. Food scraps were sorted into categories outlined by the NRDC, seen in Table 1 in the appendix.

Staff interviews

Staff voluntarily participated in one-on-one interviews, on site but in a private location. Interviews were recorded and typically took between 15 and 25 minutes. The number of staff interviewed at each participating business ranged from 3 to 9. The interviews were semi-structured; standard interview questions were asked of each employee with additional questions asked that either responded to employee answers or pertained to their specific role.

Environmental impact analysis

Carbon emissions and energy use data were calculated for wasted food and source reduction practices in many of the case studies. This analysis used the U.S. Environmental Protection Agency’s WARM tool, version 14.³

Cost savings estimates

Cost savings estimates were calculated in many of the case studies using either food cost data provided directly by the relevant business or food cost estimates used by ReFED for wholesale food costs, as outlined in their *Technical Appendix to the Roadmap to Reduce US Food Waste by 20%*.⁴ The food cost assumptions are presented in Table 2.

Table 2: Costs per pound of retail and wholesale food groups, drawn from ReFED’s Technical Appendix to the Roadmap to Reduce US Food Waste by 20%.

	Grain products	Meat	Fruit and vegetables	Seafood	Milk and dairy
Retail	\$1.21	\$5.73	\$1.51	\$8.04	\$1.21
Wholesale	\$0.97	\$3.24	\$0.74	\$4.88	\$1.17

Findings

While each of the fifteen case studies focused on a different business setting, causes of wasted food and strategies for source reduction, there were cross-cutting themes that can help illuminate common causes of wasted food, barriers to prevention and strategies for reduction. In this section, we elaborate on six critical themes, providing evidence for them with references to applicable case studies.

Valuing food

A primary cause of wasted edible food, found across many case studies, is the undervaluing of food. When a business and its employee’s view food as disposable and waste as a part of doing business, wasted food is more likely to occur and source reduction efforts are limited or inadequately resourced. The retail cafe studied in Case Study 15 perfectly demonstrated the outcome of valuing abundance and undervaluing food, while operating from a fear of running out, regardless of the cost to the business or environment. The business set expectations for overproduction that were consistently met, leading to chronic wasting of edible food, coming at a high monetary, labor and environmental cost to the business.

³ For more information about the WARM calculator tool, please see Appendix A in Oregon DEQ’s *Strategy to Prevent the Wasting of Food*. <https://www.oregon.gov/deq/FilterDocs/foodstrategic.pdf>

⁴ ReFed. (2016, March). *A Roadmap to Reduce US Food Waste by 20%: Technical Appendix*. Retrieved from https://www.refed.com/downloads/ReFED_Technical_Appendix.pdf

The caterer in Case Study 8 provides another example - they calculated wasted food costs as part of their cost of service, minimizing their motivation to reduce preventable edible waste and externalizing its cost to the client. Events that were under-attended, where edible wasted food was prevalent, were generally understood to be the client's problem, absolving the caterer from responsibility for re-purposing the food.

Even when the monetary value of wasted edible food is fully understood, the studies showed actors were still hesitant to address causes of waste. In Case Study 2, while the tracking of meat scraps pointed to a substantial potential cost savings, the manager still struggled to push past a mindset of wasted food, and its associated costs, as being a necessary cost of doing business, and “baked into” the business model. This mindset, then, was a barrier to deploying waste prevention practices.

This issue extends beyond the monetary value of food. In Case Study 5, staff expressed a perception that hospital food service operations were not run like culinary institutions. They believed the organization’s lack of vision and appreciation for the art and practice of cooking supported wasteful behaviors because of a lack of respect for food itself.

When food is not valued, businesses are less concerned about waste. Where food is valued, however, case studies results suggest that businesses act to reduce waste. Case Study 13 provides a good example of what happens when food is valued. The restaurant was very cognizant of food costs and the profit potential in fully utilizing ingredients, supporting low levels of waste. Accordingly, they utilized tens of thousands of dollars of meat scraps each year.

Quality Standards

Quality standards were a double edged sword. When well-established, clear, and understood by all staff, high quality standards served to reinforce a belief that food is valuable (Case Study 6). An insistence on using high quality ingredients, also resulted in repurposing food that didn’t meet standards (Case Study 13). In both settings, these standards appeared to help minimize waste. However, when quality standards focused on aesthetics and were open to staff interpretation, they contributed to waste generation as staff used subjective judgement, generally biased towards discarding food rather than keeping it on the shelf or marking it down (Case Study 11).

Valuing staff and other labor issues

A business’ employees, especially those with direct responsibilities related to food preparation, planning and purchasing, are crucial allies in source reduction efforts. These case studies suggest, however, they are best supported when they are properly valued, trained and given enough time to complete their work. Several case studies demonstrate how undervaluing employees or not supporting them in their work contributed to wasted edible food.

In Case Study 3, chronic understaffing led to under-trained and over-worked employees, limiting potential for the deployment of source reduction strategies. This problem suggests changes to labor policies may benefit long-term sustainability and health of business. In Case Study 11, changes to training practices, including, moving away from shadowing practices to online training, complicated standard implementation of quality standards. Undertraining was particularly a problem because the business had high turnover rates for produce associates.

Working with existing staff capacity, some businesses found ways to improve efficiency and reduce waste by outsourcing higher-skill or labor-intensive activities. In Case Study 14, poor knife skills led to edible fish trim waste, while purchasing fillets from a processor supported less waste because the processor enjoyed efficiencies of scale and had sources for the sale of byproduct.

The effects of valuing employees appropriately and supporting their work was seen clearly in Case Studies 6 and 13. These cases demonstrate that when staff are highly valued and supported, through fair wages, flexible schedules, vacation time and ample venues for providing feedback, businesses see a variety of benefits including low employee turnover and stable employee culture around source reduction, or waste prevention.

Even in the context of chronic understaffing and labor shortages, source reduction efforts should not go ignored. Daily waste tracking practices are often perceived as being too time-consuming to consider implementing in kitchens. However, daily waste tracking takes only takes about 3 - 4 minutes extra per day, based on data from companies using LeanPath's food waste tracking system⁵. Many practices explored in these case studies call for limited additional labor and are more likely to reduce labor needs by way of improved efficiency than add burdens. Case Study 9 demonstrated that cross-utilization of leftovers meant staff had to prepare an average of six fewer hotel pans of food per day. Case Study 5 demonstrated that smaller-batch sizes and reduced PARs meant a 45% reduction in entree waste, reducing the need to prepare this wasted edible food.

Fear of running out

A critical cause of edible wasted food in many of the fifteen case studies was the fear of running out, held by business owners, managers and employees. This fear is often caused by actual experiences of running out, but in many cases, running out was actually a rare event, that nonetheless drove business choices. In Case Study 5, rare events of selling out led to consistent overproduction at dinner meals.

Similar to the fear of running out was the fear of not meeting customer or client expectations. Analysis of catering practices in Case Study 8 found that overproduction was prevalent across events, with the caterer planning oversized portions and bringing extra food (too many portions) to quell the fear of running out. Case Study 9, for example, highlighted pervasive leftovers, which staff indicated was primarily the fault of the client either because of under eating or under attendance. The caterer thought clients overestimated attendance because of their fear of running out. The business in Case Study 15 also responded to a fear of running out by mandating overproduction of baked goods, preferring to maintain product offerings throughout the day than sell out.

In Case Study 1, the business operated from inaccurate assumptions about client expectations of large portions. Over-portioning led to significant plate waste, even as an analysis of customer reviews showed that portion size was not a significant customer concern. Similarly, client expectations of over-abundance described in Case Study 7, coupled with pressure to comply with these expectations in order to maintain the corporate contract, led to a pervasive fear of running out that caused significant amounts of wasted edible food.

⁵ Estimate from LeanPath based on the following data points (average) from food businesses using waste tracking software: Average waste tracking transactions take 12-15 seconds. A recent average figure for weekly transactions is 85. This translates to 21.25 minutes per week in recording food waste transactions, or about 3 minutes per day over a 7-day work week and 4 minutes per day on a 7 day work week. (Email communication, 10/7/18)

The business in Case Study 12 demonstrated practices that could be implemented to counteract a fear of running out. Employees used dynamic PAR setting and production practices, including bi-weekly PAR setting, daily production and cross-business utilization to effectively minimize grab-and-go overproduction. In essence, they closely tailored their production tailored to actual demand and normalized practices to increase the responsiveness of production - allowing products to be made quickly to fill unexpected customer needs.

“Culture eats strategy for breakfast”⁶

Business culture was crucial in either contributing to wasted edible food or minimizes it. In Case Study 7 (at a corporate cafeteria), the culture of the client, one that prioritized having many food options available at all times, was imprinted on the food service business who responded by ensuring overabundance. Here, a culture of entitlement manifested itself as a policy for abundance. The client's entrenched cultural expectations placed hard limits to the effectiveness of source reduction practices or willingness to try new strategies. Similarly, the culture around food as a service rather than an art, discussed by staff in Case Study 5, supported a culture where waste was viewed as inevitable.

Culture was also used to prevent waste and support innovation and staff engagement. As seen in Case Study 6, the lived experience of many of the business's employees, alongside the owner's philosophy of full utilization of ingredients, meant little food was wasted, and staff at all levels deployed creative ways to fully utilize ingredients and unsold menu items. Case Study 13 echoed the findings reported in Case Study 6, demonstrating that staff culture, cultivated both by leadership and reflecting employee cultural background, supported low-waste practices and full ingredient utilization.

Standardization does not always mean efficiency

Across the case studies, especially those focusing on larger businesses or those who were part of a chain of retail locations or under management from a larger company, standardization was a common goal. While at times standardization was a helpful tool in reducing waste (for example, standardizing portion sizes in Case Study 1 or switching to pre-processed fish fillets in Case Study 14), sometimes standardization caused wasted edible food.

Standardization across affiliates of a larger network meant individual locations could not adapt to meet their individual needs. In Case Study 5, institutional ordering practices that worked for large hospitals meant small hospitals routinely over-ordered leading to wasted edible food. The business in Case Study 15 limited the deployment of source reduction practices using the justification that standardization across retail locations was a paramount priority. Such standardization dissuaded dynamic and responsive action to prevent wasted edible food.

In other cases, standardization meant to encourage consistency complicated the completion of intended practices. In Case Study 11, the business's push to standardize data collection practices may have complicated staff ability to collect data at all, making it difficult to complete responsibilities in the time available.

⁶ Attributed to Peter Drucker by Mark Fields, 2006

Methods of assessment matter

The case studies informed another important conversation - the importance of proper measurement practices. For example, the studies highlighted the pros and cons of point-in-time waste sorts. Waste sorts played an important diagnostic role in highlighting key areas of wasted edible food and supported staff interviews in discovering critical causes of waste. Sorts also are a more objective measurement of levels and types of waste than daily tracking by staff. On more than one occasion, sorts revealed higher levels of waste or unexpected kinds of wasted food that staff or management insisted did not exist. On the other hand, audits of large volumes of food waste requires a high level of staff time. Also, it can be difficult to isolate waste to specific time frames, especially when mixed together and generated over a series of days (as observed in Case Studies 3 and 4). Point-in-time waste sorts also were unable to fully evaluate the effectiveness of recommended practices over time. In Case Study 10, waste audits were able to provide visual evidence that knife skills had improved after employee training as it could be seen that less edible food was left on trimmed product. Longitudinal measurement and observation would, however, be necessary to confirm the practice's effectiveness and whether it reduced wasted food, to see if the practice was carried out consistently, across all food types and staff.

Case Study 12 demonstrated how some trends are best understood over longer periods of time. The business' college context meant sales varied due to changing demand that resulted from the academic calendar and holidays. Staff-led waste tracking systems, like that used in Case Study 4, proved helpful to understand trends in waste over time. However, their accuracy is questionable. In Case Study 7, researchers found that staff-led waste tracking drastically underreported actual waste weights, indicating the need to include systems to test accuracy, like counter-referencing waste hauler data, weighing before disposal, or other methods.

Tracking was also found to be most useful when it was crafted to meet the needs of the practice being tested. Implementing a new system of tracking was helpful in quantifying the monetary impact of a source reduction practices, like in Case Study 9, where tracking the cross-utilization of catering leftovers over time demonstrated significant cost savings that would have been obscured by waste assessments alone.

Recommended practices

In the previous section, we discussed how six cross-cutting themes inform how wasted food is generated and how, opportunities for reduction are inhibited. Themes also identified opportunities to address barriers to waste prevention. In this section we more explicitly provide strategies for waste prevention, and organize these strategies using the same six themes. These strategies are drawn from the case studies, and include those tested, observed or hypothesized, as well as from a review of additional literature. **Case study numbers are indicated in parentheses, and a complete, abbreviated table of strategies can be found in the appendix.**

Valuing food

In the previous section, we discussed how undervaluing food leads to the wasting of edible food. Here, three broad strategies are discussed that work to increase perceptions of value, revise policies accordingly and improve the utilization of food.

Quantify value. In some cases, food is not valued because decision-makers are unaware of the monetary value of the food their business wastes. Measuring wasted food prior to disposal can be particularly helpful here, and may be generally focused (7) or target a specific cause of waste, like overproduction (5) or trim (2). General waste measurement has been shown to reduce waste by 10%, studied in the context of a hotel kitchen.⁷

Review policies. Undervaluing food may have cultural roots, but often undervaluing of food then gets expressed in business policies and norms. To counteract this, conduct intentional policy reviews to identify and change existing policies that encourage waste or inhibit source reduction practices (15).

Improve utilization. When food is valued, it is more likely to be utilized to its fullest. These case studies highlight a variety of strategies to support full-utilization. First, use dedicated refrigerator space for repurposing (4) so staff know to look there first when cooking. Second, build menus that support repurposing by creating complimentary menu items that rely on similar core ingredients or byproducts of other menu items to support full-utilization and repurposing (2, 6, 13). Third, when possible, support the cross-utilization of product across retail cafes or food service venues (2, 9,12). Fourth, construct menu items as close to the serving location or time as possible, like construction on site practices for caterers (8) or keeping proteins and sauces separate until serving (3). Finally, if possible, consider using a commissary system which could offer new opportunities for efficiency, source reduction and appropriate portioning of ingredients (5, 12).

Valuing staff and other labor issues

Staff at all levels are crucial allies for source reduction, but are able to do their best when fully supported and valued. Below are some critical strategies to support employees and an environment of innovation.

Value employees. Highly valuing employees (through fair wages and schedule flexibility) supports high retention rates and employee satisfaction (6, 13). Expanding opportunities for stability for employees also works to improve retention (3).

Improve training. Support increased training for new and existing employees and rely on training practices that best serve the demands of the situation (10,11). As part of these efforts, implement routine times for training and conversations around waste (4). Institutionalize moments for teaching using things like calibration tests, knife skills, or manager walkthroughs as a feedback system for training (1, 10).

Build capacity. Work with staff to provide knowledge and tools to expand their capacity to do their job quickly, efficiently and without waste. For example, use or upgrade an electronic inventory management system that supports more product tracking and accurate ordering, and train numerous staff to utilize the system (6). Building capacity might also mean allocating more staff time for particular tasks, like waste or production tracking and data analysis, or by investing in additional tools to alleviate bottlenecks (e.g. scanners in Case Study 11). When building staff capacity is not an option, outsource specialized needs, like shifting purchasing practices to buying pre-processed meats and fish (14).

⁷ World Wildlife Fund. (2017, November 13). Hotel Kitchen: Fighting Food Waste in Hotels. Retrieved from <https://www.worldwildlife.org/publications/hotel-kitchen-fighting-food-waste-in-hotels>

Fear of running out

Businesses are frequently motivated to overproduce or over-order because they are afraid of running out of food or failing to meet client expectations. Here, we outline five strategies that work to fight that fear by creating more realistic expectations, working with clients to renegotiate expectations, standardizing production and portion sizes, better planning for customer demand and improving a business' ability to respond to unexpected customer demand.

Fight the fear. Sometimes, fears of running out or having too small of portions are based on inaccurate perceptions of customer expectations. Consider analyzing customer reviews to quantify magnitude of portion-related customer concerns (1). To better understand the frequency of running out of food, track overproduction to see how frequent or infrequent running out actually occurs (5). Finally, in the case of food service contracts, be sure to review expectations with the client for abundance and availability to ensure you are operating along actual and not misperceived expectations (7).

Change client expectations.

If client expectations of abundance are driving wasted edible food, work with them to set more realistic expectations. Supporting these conversations with waste tracking data to show the magnitude of the problem may be helpful (7). Businesses may also consider finding new ways to meet expectations that improve the perception of value without creating waste, by for example, using a different plate size to demonstrate abundance rather than using large portions of side dishes or fillers (1). Finally, businesses could create new practices that support source reduction. For example, a caterer could implement an approach that allows it to serve unanticipated guests different meals that are constructed on site and kept in reserve (8).

Reduce abundance and standardize demand. Over-abundance of food is often a symptom of fearing running out, but there are other ways to avoid running out. Lower expectations for abundance and allow for running out at the end of meal time (3,7) by using smaller serving ware at these times to avoid serving from half empty dishes. For buffet-style food service used in cafeterias, consider using staff to serve food rather than self-serve as a way to standardize portion sizes and product demand (3). Finally, use smaller serving utensils for self-serving stations to encourage customers to take smaller and more consistent portions (3).

Plan for customer demand. A critical step to avoid both running out and over-producing is accurately forecasting daily customer demand. Conduct periodic review of sales data to inform daily and weekly trends in customer demand (3, 12). Consider deploying or improving systems of recordkeeping to allow for reference of past events (i.e. annual catering events or holidays) (8, 12). More targeted approaches may also help. Consider tracking plate, catering, or buffet waste and analyzing this waste in terms of amount per customer in order to more accurately determine portion size (8). When customer demand is understood, translate this into production planning. Use dynamic PAR setting practices, including planning multiple times per week and using sales or waste data to inform production numbers (12). Finally, instead of setting or reducing PARs across the board, deploy targeted PAR reduction by analyzing product-level sales or waste data (15).

Improve dynamic response to customer demand. Even the best forecasts may prove incorrect. In these cases, businesses benefit by being flexible and dynamic, adapting in real time to fluctuations in customer demand. Using smaller batch sizes allows for more responsive production to meet unexpected demand or avoid cooking in cases of under-attendance (7). Furthermore, cook-to-order practices work well as a means of assuring the availability of food without necessitating waste (7).

Culture beats strategy

The case studies suggested business culture can either enable or prevent the wasting of edible food. Here, two strategies are discussed that support cultures of source reduction and waste prevention.

Shift business culture to promote source reduction. Changing business culture means working with employees at all stages of their employment. Businesses should hire employees with strong ethics around source reduction (6). They should set high expectations for adherence to waste prevention practices (13). Finally, they should support employees sharing strategies with each other and reward them for innovation (4).

Social norms can change customer behavior. Businesses can use norm setting techniques to influence customers to reduce plate waste or support their own source prevention practices. Descriptive norms, those that simply state what the ‘normal’ behavior is, have been shown to be effective in influencing customer meal choices.⁸ For example, the leftover sharing program that has been in place at a college cafeteria for decades, demonstrates that a norm letting people know when and under what conditions it is acceptable to eat others’ leftovers is powerful enough to counteract other, very strong cultural norms around disgust (4).⁹ Furthermore, Case Study 5 demonstrated that letting buffet items run out can help shift expectations of abundance.

Standardization does not always mean efficiency

Standardization can be a positive approach, when it leads to efficiency and less waste. However, some practices and policies deployed in the name of standardization actually cause less efficiency and inhibit adaptability. Here strategies are discussed that avoid some of these issues.

Support individualized practices when appropriate. At the smallest level, relating to the standardization of production practices, businesses should consider when standard PARs are appropriate, and keep in mind they may not reflect daily variations in demand and customer preferences (3). When planning menus, businesses should consider expanding portion size options (i.e. lunch specials, half-orders, side options etc.) to cater to a variety of customer appetites (1, 6). Businesses should tailor data collection protocols take into account the realities of employee capacity, both in terms of time and training (11). For multi-store businesses, consider how chain-level policies may stifle store-level innovation, strategy deployment (15), and ordering (5) or hiring (3). Similarly, these businesses should allow for unique product offerings by retail location, which allows for better matching of retail supply to customer demand (12).

Methods of assessment matter

Measurement and tracking are important for developing source reduction strategies, but they should be conducted using the appropriate methods. Here, a few strategies are discussed that should inform businesses as they deploy tracking practices.

⁸ Thomas, J. M., Ursell, A., Robinson, E. L., Aveyard, P., Jebb, S. A., Herman, C. P., & Higgs, S. (2017). Using a descriptive social norm to increase vegetable selection in workplace restaurant settings. *Health Psychology, 36*(11), 1026.

⁹ This study did not assess the public health impacts of a leftover sharing program.

Use robust, appropriate and routine assessment practices. First of all, systems of tracking should be created specifically for the practice being tested or the source of waste (10), unless a business wants to understand details about all of their wasted food. Second, while waste assessments can help pinpoint specific types and sources of wasted food, they have limitations for assessing changes over time. In these cases, tracking over time supports more robust data (4). However, tracking may be inaccurate when not properly deployed. Implementing systems of accountability and verifying strategies are important to ensuring the accuracy of data (7). In addition, businesses should consider tracking at the point of waste generation to ensure more accurate data, though verification may still be necessary to ensure accuracy. Businesses should also avoid using food costs as a proxy for food waste. Instead, they should use metrics (e.g. edible food wasted per unit of food produced or sold) that more accurately represent wasted food and potential for source reduction (15). Finally, measurement data should be collected and aggregated in a way that supports both ease of collection and data analysis. For example, paper records may be easier to collect, but should be digitized, if possible, to support quick analysis and archiving or digital collection needs to be redesigned to fit the needs of staff. Finally, if assessment of all types of sources of wasted food is not feasible, assessment should focus on high-impact (such as meats), or high-volume sources of waste.

Conclusion

Using a combination of assessment methods – interviews, detailed waste sorts, tracking waste levels over time, analyzing sales and production data - we found that food waste, particularly the wasting of edible food, is problematic across many types of food service and sales settings. In these case studies, we identified six cross-cutting themes that contribute to the wasting of food or prevent reducing waste: undervaluing food, variable quality standards, undervaluing staff and other labor issues, a fear of running out, organizational culture, standardization standing in for efficiency, and inadequate methods of assessing loss. We also identified several strategies to address these problems, detailed in the recommended practices section. These strategies can reduce food loss, reduce environmental impacts and save costs in food purchasing and labor. Effective prevention of wasted food in institutional and commercial settings will require valuing food, valuing and empowering staff, addressing concerns regarding running out, changing culture, and deploying effective methods of assessment. It will take stakeholders at every level to advocate for and deploy these strategies - from the customer to the server, the manager to the business owner, the city staffer to the county commissioner - but the environmental, financial and social costs are too high to ignore.

Glossary

Back-of-house (BOH) - the parts of the business that do not directly involve serving food to customers, but rather, involve the preparation and processing of food. This includes the kitchen and dishwashing areas. It also is used to refer to food waste that is created by employees before the point of serving, including trim waste, overproduction or misfiring.

Cull - the process of removing unsellable product from the display.

Cross-utilization - the use of ingredients or prepared meals across different venues for food service within a single business (for example, the use of catering leftovers for employee meals).

Edible wasted food - wasted food that was edible, either before or at the point of disposal. For example, a spoiled apple is still considered edible food waste because it could have been consumed had it not gone bad, whereas watermelon rinds are not intended for consumption, so they are considered inedible.

Fired - cooked, often referring to a pre-prepared item that is cooked when needed.

Food waste - both the edible food and inedible parts of food disposed to landfill or recycling solutions like composting and anaerobic digestion. Wasted food is an edible subset of food waste.

Front-of-house (FOH) - the parts of a business that directly involve serving food to customers, including dining, cafeteria or retail areas. It also is used to refer to food waste that is created in these spaces, including plate and buffet waste.

Inedible food waste - food pieces that cannot, and were never intended to be, consumed. This includes inedible trim waste, fully utilized vegetable scraps from soup stock, eggshells, etc.

Markdown - selling damaged or soon-to-spoil products at a discount.

On the fly - producing or cooking products as needed. Also referred to as *cook-to-order*.

Overproduction - referring to the action of, or the food generated from, producing too much food causing food to remain uneaten at the end of service.

Periodic Automatic Replenishment (PARs) - PARs are set production amounts that are generally set by management and followed by preparation staff. Some businesses have standard PARs across days or menu items, while others adjust their PARs according to anticipated customer demand.

POS (point-of-sale) system - the electronic system businesses use to process and track customer sales, often integrated (although with varying degrees of effectiveness) with ordering and waste tracking systems.

Prep - short for preparation, which can be used to refer to the action of preparation or the point of waste generation (i.e. prep waste can refer to things like vegetable trim produced during preparation).

Prepared foods - a category of food that includes products with a variety of ingredients, specifically, those that are less than 90% of a single product, and those that are repurposed as leftovers.

Repurposing - the use of leftover ingredients or prepared food for new applications, e.g., the repurposing of onion skins for soup stock or beef trim for empanadas.

Shadowing - a training practice that involves a trainee observing or working alongside an experienced staff member.

Shrink - the loss of inventory due to spoilage, damage, theft or error.

Source reduction or waste prevention - a reduction in the amount of surplus food waste generated, i.e. reducing the amount of food grown or purchased to feed people that goes unconsumed. Business actions to minimize overproduction, improve operational efficiency, and repurpose ingredients typically result in source reduction or food waste prevention.

Tare weight - the weight of the container being used to measure something, such as waste.

Trim - the byproduct of trimming or preparing ingredients for use (i.e. egg shells, banana peels, onion skins, etc.).

Wasted food - food that could have been eaten at some point in time but was discarded due to spoilage, food safety concerns, individual preference, or cooking knowledge.

Appendix

Table A1: Categories Used For Commercial Waste Sorts

Categories	Definition	Examples
1 Inedible	Items not intended for human consumption (small amounts of edible material associated with the inedible material are permitted to be included)	Egg shells, banana peels, pits/seeds, bones
2 Meat & Fish	Uncooked or cooked meat (with mostly edible components) unmixed with other types of food	Boneless chicken breast, salmon fillet
3 Dairy & eggs	Solid dairy products unmixed with other food types or in original form and egg products unmixed with other food types or in original form	Cheese, yogurt, fried egg, whole eggs, liquid egg whites
4 Fruits & Vegetables	Solid uncooked or cooked vegetables and fruits (with mostly edible components) unmixed with other types of food	Potatoes, spinach, berries, salad with only vegetables
5 Baked Goods	Baked goods and bread-like products unmixed with other food types or in original form, including pastries	Bread, tortillas, pastries
6 Dry Foods	Cooked or uncooked grains, pastas, legumes, nuts, or cereals unmixed with other food types or in original form	Rice, cereal, pasta
7 Snacks, Condiments, Sauces	Includes confections, processed snacks, condiments, and other miscellaneous items	Condiments, candy, granola bars, sauces, jellies
8 Liquids, Oils, Grease	Items that are liquid, including beverages	Sodas, milk, oil, juice
9 Cooked or Prepared Food	Items that have many food types mixed together as part of cooking or preparation	Lasagna, sandwiches, burritos
10 Unidentifiable	Used only if necessary	

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Table A2: Wasted food prevention strategies, by cause of waste and action

Theme	Action	Strategies	Relevant Case studies
Valuing food	Quantify value	Waste measurement and tracking	1, 2, 5, 7
	Review policies	Review policies that cause edible wasted food or inhibit source reduction	15
		Dedicate refrigerator space for repurposing	4
		Create complementary menu items	2, 6, 13
	Improve utilization	Cross-utilize ingredients and leftovers across business areas	2, 9, 12
		Construct menu items as close to serving as possible	8
		Use central systems for production when able (i.e. commissary kitchens)	5
Valuing staff	Value employees	Improve staff retention and satisfaction by paying fair wages and providing schedule flexibility	6, 13
		Expand opportunities for employment stability and advancement	3
	Improve training	Supported increased training for new and existing employees and tailor training programs to serve demands of the employee's responsibilities	11
		Deploy feedback systems to improve routine opportunities for training	1
	Build capacity	Implement routine trainings or times for conversations around waste	
		Improve capacity by deploying inventory managements systems and train numerous employees to use such systems	6
		When staff capacity is unavailable, outsource highly specialized needs	14

Table A2: Wasted food prevention strategies, by cause of waste and action, cont.

Theme	Action	Strategies	Relevant Case studies
Fear of running out	Fight the fear	Analyze customer reviews to understand concerns about portion sizes	1
		Track overproduction to support realistic understanding of the problem of running out	5
		Review expectations of abundance and availability with the client/owner	7
		Deploy targeted PAR reduction by analyzing product-level sales data	15
	Change client expectations	Consider ways to improve perceived value instead of relying on abundance	1
		Create new services that explicitly support source reduction strategies	8
	Reduce abundance and standardize demand	Lower expectations of abundance and allow for running out at the end of meal time	4, 7
		Use buffet servers as a way to standardize portion sizes and product demand	3
		Use smaller serving utensils for self-serving stations	3
	Plan for customer demand	Conduct periodic review of sales data to inform daily and weekly trends in demand	3, 12
		Use overproduction tracking to inform portioning	8
		Improve systems of recordkeeping to allow for reference of past events or holidays	8, 12
		Use dynamic PAR setting practices informed by sales data	12
	Improve dynamic response to customer demand	Use smaller batch sizes to support more responsive production to meet demand	7
		Cook-to-order to assure availability of food without overproduction	7

Table A2: Wasted food prevention strategies, by cause of waste and action, cont.

Theme	Action	Strategies	Relevant Case studies
Culture over strategy	Shift business culture	Hire employees with strong ethics around source reduction	6, 13
		Set high expectations for adherence to source reduction practices	13
		Support employees sharing source reduction strategies and reward their innovation	4, 6
		Unique strategies, like leftover-sharing programs, demonstrate the power of social norms to reduce the wasting of edible food	4
Standardization ≠ efficiency	Support individualized practices when appropriate	Standard PARs across menu items may not reflect daily variations in demand and customer preference	3
		Expand customer choice in portion sizes	6
		Revise data collection methods to match realities of employee capacity	11
		Support store or department-level innovation and strategy deployment	15
		Allow for unique product level offerings by retail location to best match demand	12
		Expand ordering options to better meet needs of specific departments or locations	5
Methods matter	Use robust, appropriate, and routine assessment practices	Systems of tracking should be created specifically for the practice being tested	10
		Track over time to support more robust and accurate data	2, 4
		Waste tracking may be inaccurate when not properly deployed, meaning systems of accountability or ground truthing should be used to check accuracy	7
		Track as close to the point of waste generation as possible	4
		Avoid using food costs as a proxy for food waste	15
		Use electronic record keeping practices when possible to support ease of analysis	8