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Executive Summary



This first-of-its-kind report by the Natural Resources Defense Council describes the results of a food waste baseline assessment study in three U.S. cities—Denver, Nashville, and New York City—for residential and non-residential sectors, including the industrial, commercial and institutional (ICI) sectors. The intent of the study was to characterize the amount of food that is wasted in these cities, identify some of the reasons why the food is going to waste, and then use that data to help inform and inspire initiatives to prevent wasting food, to rescue surplus food to benefit people in need, and to recycle food scraps. Outputs from the study not only include the results of the research, but also templates and descriptions of the methodologies in hopes that this study will contribute to a working model for other cities to perform similar assessments. We also hope the study will help highlight opportunities for municipal policy and program work related to food waste, as well as further future research in consumer behaviors and attitudes.

Uneaten food equates to Americans throwing out as much as \$218 billion each year, most of which ends up rotting in landfills, where it emits harmful greenhouse gases. Cities are often motivated and well-positioned to address food waste because they are primarily responsible for providing solid waste services, seek to source and redistribute wholesome surplus or unsold food to residents in need of supplemental food, and have climate and sustainability goals which addressing food waste can help them achieve. Although many U.S. cities have conducted studies that identify proportions of different types of materials in the waste stream, only a handful of cities worldwide have completed detailed food waste assessments, especially at the household level. Even less research has been done on what types of food are going to waste, the potential edibility of that wasted food, and the reasons why the food is wasted. There is also a lack of consistency across the studies, all of which could support better designed interventions to reduce the generation of wasted food and the disposal of food waste.

This study differs from other waste studies in that, for the residential sector, it attempts to track not only how much food is disposed, but what types of food and beverage are discarded to multiple destinations (including in the trash, down the drain, composted, and fed to pets) and why the food was discarded, with an eye toward determining how much of that food was potentially edible (and therefore could potentially have been eaten and not wasted). The ICI assessment provides a method of estimating the amounts of food likely to be wasted in specific sectors of a city, including restaurants, groceries, hotels, hospitals, and schools.

For the residential research, households in the three study cities were recruited to track how much and what types of food they discarded for one week, along with the reasons for discarding, and to fill out surveys on household demographics, attitudes and behavior related to food. We

received a total of 613 kitchen diaries and 1,357 completed surveys (including surveys given both before and after the study period). We also conducted 277 household bin digs (detailed waste audits separating food into ten different categories) to assess how much and what types of food were in the trash (and in some cases collected for composting).

An average of 68 percent of all food discarded as tracked in kitchen diaries was potentially edible.

Our study classified all food items included in both the kitchen diary and bin digs as either edible food or inedible parts. Edible food refers to any substance intended for human consumption; it does not reflect the state of food at any particular point in time (such as purchase or disposal), but is used to describe an item that would have been considered edible at some point. Inedible parts refers to components of food which are not typically consumed in the United States (e.g. banana peels). Additionally, in order to capture the complexity of defining edibility, we divided the category of edible food into typically edible and questionably edible food. Typically edible food is intended for human consumption and not generally considered inedible (e.g. pizza, liquid coffee, and bananas without the peel). Questionably edible food can be safely eaten, but may not be considered edible by a portion of the population due to culture or preference (e.g. potato peels, beet greens, and carrot peels/tops). Note that wasted food defined as edible for purposes of this study is not the same as wasted food that is preventable, as the study did not provide sufficient information to determine where in its lifecycle a particular item became unsuitable for eating. Edible is also not the same as rescuable: for one thing, excess edible food from the residential sector or that has already been served

FIGURE ES-1: FOOD WASTED BY EDIBILITY BY WEIGHT

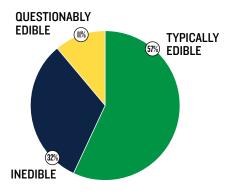
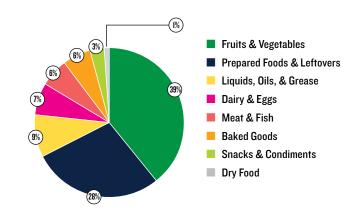


FIGURE ES-2: EDIBLE FOOD WASTED BY CATEGORY



Over half (58 percent) of survey respondents felt less guilty about wasting food if it is composted.

is rarely rescued for redistribution due to food safety restrictions; for another, rescued food may contain inedible parts (e.g. donated whole fruit may include inedible parts such as peels).

For all three cities we studied, we found that most of the discarded food tracked in kitchen diaries was at least potentially edible (meaning that the food was defined as edible in our study, though may not have been suitable for eating at the time it was discarded). Including questionably edible food, an average of 68 percent of all food discarded as tracked in kitchen diaries was considered edible. The average amount of total food wasted per capita (includes typically edible, questionably edible, and inedible) across all three cities was 3.5 pounds per person per week. The average amount of edible food wasted per capita (includes typically edible and questionably edible) across all three cities was 2.5 pounds per person per week. At the household level, total food wasted was 8.7 pounds per household week, and edible food wasted was 6.0 pounds per household per week.

The kitchen diaries also tracked food discarded by category, including fruits and vegetables, meat and fish, dairy and eggs, prepared food and leftovers, liquids and oils, baked goods, dry food, snacks and condiments, and inedible parts. Kitchen diary data indicated that the largest two categories of food wasted by participants were inedible parts and edible fruits and vegetables, for all cities. Prepared foods and leftovers were also wasted in high quantities. The fourth highest category of food wasted on average was liquids, oils, and grease, which includes beverages. Meat and fish, dairy and eggs, and baked goods were all wasted in similar proportions. Participants in all cities tended to discard similar types of food. When tracking total food wasted (including edible food and inedible parts), three items-coffee, banana, and chicken-appeared in the top five most wasted foods in all three cities. Items appearing in the top ten most wasted edible (including typically edible and questionably edible) food items for all three cities included coffee, milk, apples, bread, potatoes, and pasta. Three food items—apples (skins and cores), potatoes (peels), and broccoli (stalks)—are in the top five most wasted questionably edible foods in all three cities. Looking more closely at the lists of commonly wasted foods might highlight possibilities for consumer education to reduce food waste, such as providing cooking instructions and recipes for questionably edible items such as apple skins and cores, potato peels, and broccoli stalks.



Kitchen diary participants were asked to track food discarded to multiple destinations: trash, compost, down the drain, or feeding animals (pets, such as dogs or chickens). Across the three cities, trash disposal represented over half of the kitchen diary discard destinations; down the drain was another 11 percent, and feeding to animals (pets) was two percent. Thirty-one percent of food was discarded to compost (including home composting, curbside pickup, and drop-off).

Residential participants also recorded the reasons for discarding each food item. Most often, food tracked in kitchen diaries was reported as discarded due to being inedible parts, moldy or spoiled, or simply not wanted as leftovers. The report also includes additional data from our kitchen diary and bin dig research, such as participation in composting, actions taken with respect to date labels, and treatment of leftovers.

Our residential surveys included several questions about behaviors related to shopping for, storing, preparing, and consuming food. Food is wasted at all these stages of consumer interaction, and behaviors at each stage may also influence whether a food item is ultimately eaten or discarded. For example, over half of respondents said they regularly engage in strategies to waste less food such as eating leftovers and freezing food, and agreed that it is important to them to finish all food put on their plates for a meal. However, a majority also preferred fruits and vegetables with no blemishes, and nearly half felt less guilty about wasting food that has been in the refrigerator for a long time. Over half (58 percent) felt less guilty about wasting food if it is composted.

Our analysis compared per capita-level total and edible food waste generated (as determined by kitchen diaries) to household demographics and attitudes and behaviors collected in the first survey (e.g. age, education level, frequency of eating away from home). Most of the statistically significant relationships we found applied to one city only; a few of these findings applied to all three cities.

76 percent of our survey respondents indicated they believe they throw out less food than the average American.

Household size was found to be related to amount of food wasted in all three cities, though with slight variations. The general trend is that smaller households waste more food per capita; as household size increases, per capita total food waste generation decreases.

There were also areas where no significant relationship was found, across all three cities:

- Income level and primary language spoken at home were not shown to be related to the amount of food that was wasted.
- For the most part, the amount spent on food eaten either at home or away from home also was not related to wasted food generation.
- We found no link between wasted food generation and households that know about the issue of wasted food versus households that do not know about the issue of wasted food.
- Also, for the most part, race/ethnicity and national origin were not related to amount of food wasted.

Part of the challenge underlying this research is that not much similar research has been previously conducted; as more of this type of research is conducted in the future, it will be easier to identify trends and potentially aggregate data for better extrapolation.

Seventy-six percent of our survey respondents indicated they believe they throw out less food than the average American. This result seems consistent with our respondents' beliefs (70 percent across the three cities) that they could reduce food wasted in their home only a little or not at all through changes in behavior (e.g. through planning meals ahead of time or changing food shopping habits). Encouragingly, though, nearly 80 percent of respondents indicated their household believes that reducing the amount of food they throw away would be good and 70 percent intend to reduce the amount of food their household throws away. This perhaps indicates that although survey respondents felt they could only make minor changes in the amount of food discarded, they intended to make those changes despite nearly one quarter



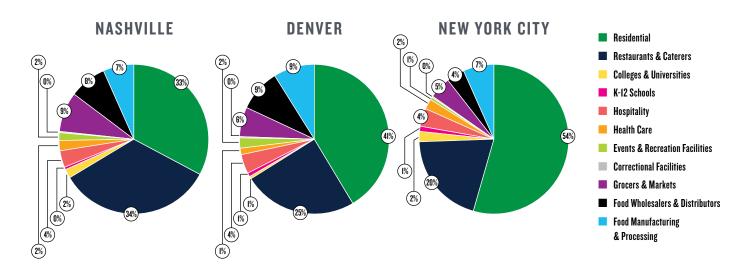
of respondents feeling that the actions of their individual household would not make a meaningful difference in the amount of food being wasted.

Also assuring was the fact that awareness of the impacts of wasting food in their homes was consistent across the three cities and that most respondents agreed that reducing their household's food waste would save money and reduce various environmental effects. Together these results strongly suggest that consumer education should highlight that the overall effect of wasting less food is not just about reducing the quantity wasted by individual households, but in creating cumulative impact, including creating a cultural shift in our attitudes and behaviors toward food. In turn, this shift can lead to changes farther up the supply chain as well.

In addition to the residential assessment, this study also conducted an estimate of how much food is being wasted at the baseline level in the industrial, commercial and institutional (ICI) sectors in the study cities. For the ICI assessment, we estimated the amount of food wasted by each sector using formulas derived from previous studies and regional business information pertaining to 34,040 food-related facilities across the three study cities. We also conducted a total of 145 bin digs for selected organizations.

Each city's largest estimated contributing ICI sector to food waste generation is restaurants and caterers, with other substantial contributors including food wholesalers and distributors, food manufacturing and processing, grocers and markets, and hospitality.

FIGURE ES-3: ESTIMATED FOOD WASTE GENERATED BY SECTOR (ICI AND RESIDENTIAL)



Although the estimates showed enough variance between the three cities to warrant separate studies for each city, some overarching trends emerged. Each city's largest estimated contributing ICI sector to food waste generation was restaurants and caterers, with other substantial contributors including food wholesalers and distributors, food manufacturing and processing, grocers and markets, and hospitality.

When the residential sector was included in our sectorbased food waste generation estimates, it was the highestproducing sector in both Denver and New York City. In Nashville, the residential and restaurant sectors were virtually tied as the top two estimated generators. Although the residential sector and the restaurant sector were the largest estimated contributors to food waste in all three cities, these are also the sectors with the most members, meaning a relatively large number of entities are each producing a relatively small amount of waste. Cities tackling food waste should consider whether to address the sectors with the highest totals of food wasted overall versus those with lower waste contribution but with fewer members.

The methodology, the tools and the analysis developed by NRDC offer important insights for a city considering implementing effective interventions to reduce wasted food. For example, if a city is initiating or expanding food scrap recycling collection or infrastructure, the city should first consider to what extent the need for food scrap recycling might be reduced by allocating resources to prevent wasted food in the first place and to rescue surplus food. There are several recommendations that can be made for cities in general for the residential sector and for the industrial, commercial and institutional sectors based on the analyses presented in this paper. For residential

food waste, consumer education programs should include information on the extent to which consumers contribute to food waste along with strategies for wasting less food. And the data collected on the most commonly wasted foods could be used to guide specific consumer educational campaigns at the household level, such as providing tips on how to waste less coffee or use perceived inedible parts of fruits and vegetables. In the industrial, commercial and institutional sectors, the data can point cities to the sector where the biggest opportunity to reduce food waste exists at the macro level, or at the micro level help design targeted efforts if fewer resources are available or if the city has an interest in working with a particular sector.

Overall, this analysis provides critical data on food waste generation in the three cities studied, but also points to considerable opportunity for future research. More research is needed to help analyze and measure wasted food in consistent ways that enable action across the entire hierarchy of preventing wasted food, rescuing surplus food, and recycling food scraps. Most current municipal diversion policies and waste characterizations of food waste tend to help drive food waste recycling, but are less helpful in prioritizing and assessing success in wasted food prevention and the redistribution of surplus food. To achieve the broadest environmental benefits related to wasting less food, municipalities should conduct research on and set goals related to reducing the total generation of wasted food (not just disposal), as well as climate goals that address more impacts from wasted food than just landfill methane. As more research in this vein is conducted, it will be easier to identify trends and potentially aggregate data for better extrapolation, better intervention design—and eventually, less wasted food.

Chapter 1: Background



Forty percent of food in the United States today goes uneaten. When we waste that food, we also waste all the water, energy, agricultural chemicals, labor, and other resources that go into growing, storing and transporting it. Uneaten food equates to Americans throwing out as much as \$218 billion each year, most of which ends up rotting in landfills, where it emits harmful greenhouse gases. This is particularly poignant at a time when 42 million Americans are food insecure. If we reduced our food waste by just 30 percent, it would equate to enough food to provide the total diet for 49 million Americans.1

Cities are often motivated and are well-positioned to address food waste, for three key reasons:

1. Cities in the United States are often primarily responsible for providing solid waste services, including the infrastructure and financing of waste systems. As food waste represents the largest component of disposed municipal solid waste,2 recycling food scraps or rescuing surplus food for donation can help reduce costs associated with disposal and household and commercial efforts to prevent wasting food in the first place can offer more cost savings along with environmental benefits.

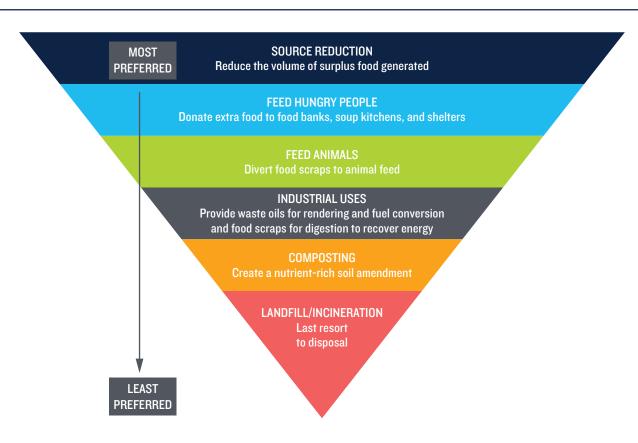
- 2. Many cities are seeking strategies to source and redistribute wholesome surplus or unsold food to residents in need of supplemental food to help alleviate food insecurity and build community resiliency; learning more about where food waste originates and identifying opportunities to enhance food rescue as appropriate can contribute to better access to food.
- 3. Many cities also have climate, sustainability, and solid waste goals. Reducing the amount of uneaten, wasted food through prevention, food rescue, and recycling food scraps through composting and/or anaerobic digestion can reduce the amount of organic waste sent to landfills where it generates methane, a powerful global warming pollutant. In addition, prevention strategies can also reduce upstream emissions associated with producing food that is not consumed.

The U.S. Environmental Protection Agency (EPA)'s Food Recovery Hierarchy³ suggests that strategies to combat the problem of wasted food should focus first on preventing wasted food, then on redirecting surplus food to people, next on redirecting food to animals, and finally on an array of strategies to recycle food scraps (e.g. through

composting and anaerobic digestion). To best understand how to tackle the problem of food waste at the local level, and the amount of resources to dedicate to each stage of the hierarchy, cities need to know more about the state of the problem. Research on food waste is still in early stages, with only a handful of cities worldwide having engaged in detailed food waste assessments to date. Many cities in the United States have conducted waste characterization studies, which typically identify relative proportions of different types of materials in the waste stream. Although food may be identified and measured as one of the materials in the waste stream, a typical waste characterization study does not offer a more in-depth analysis of the characteristics of the food going to waste. There has been little direct measurement of food waste, especially at the household level; little detail obtained about types of food going to waste, the potential edibility of that waste, and reasons the food is wasted; little focus on drain disposal or other discard destinations other than landfill; and a lack of consistency across existing measurement studies. Better understanding these characteristics of wasted food is a critical component of understanding behavior associated with wasting food, which in turn is critical to designing effective interventions and tracking progress in reducing both the generation of wasted food and the disposal of food waste.



FIGURE 1: EPA'S FOOD RECOVERY HIERARCHY



Chapter 2: NRDC Food Waste Baseline Assessment Overview

This report describes the results of a food waste baseline assessment study conducted by the Natural Resources Defense Council in both the residential and industrial, commercial, institutional (ICI) sectors in three U.S. cities: Nashville, Tennessee; Denver, Colorado; and New York City, New York. The intent of this study was to characterize the amount of food that is wasted in these three cities, identify some of the reasons behind the food going to waste, and use the collected data to help inform and inspire initiatives to prevent wasting food, to rescue surplus food to benefit

people in need, and to recycle food scraps. We have included the templates and descriptions of methodologies used in hopes that this study will contribute to a working model for other cities to perform similar assessments. We also hope that this study will help highlight opportunities for municipal policy and program work related to food waste, as well furthering our understanding of how consumer behaviors and attitudes may contribute to the problem of wasted food and illuminating some potential areas for future research.

GLOSSARY

This report uses several terms that relate to food and waste. Many of these terms are used and defined differently by different groups and in different contexts. A selection of terms used in this report is defined below only for the purposes of this report.

ANAEROBIC DIGESTION: a type of organics recycling in which organic materials, such as food scraps, are subjected to controlled breakdown in an enclosed chamber in the absence of oxygen; produces both energy and products which can be processed for use (e.g. through composting) into soil amendments

BIN DIGS: for these assessments, detailed waste audits in which material from trash and compost (when available) was collected from residences and facilities and sorted into different categories (including ten categories for food waste)

COMPOST: a type of organics recycling in which organic materials, such as food scraps or yard waste, are decomposed in a controlled environment into a product which can be used as soil amendment or fertilizer; used to refer to the product of the composting process; also used to refer to organics discards including food scraps destined for composting

DISCARDED FOOD: all food that is discarded to any destination, including trash, compost, feeding animals, etc.

DISPOSED FOOD: all food discarded either directly or indirectly to landfilling, incineration, or drain disposal

EDIBLE FOOD: any substance intended for human consumption compatible with the definition of food in the Food Loss and Waste Accounting and Reporting Standard (FLW Standard)4; see Section 3.2.4: Definitions Related to Edibility

FOOD SCRAPS: the portion of food remaining after consumption; may include edible food as well as inedible parts, though ideally includes only inedible parts

FOOD WASTE: all edible and inedible parts discarded or wasted

INEDIBLE PARTS: components associated with food which are not typically consumed in the United States and/or for which significant skill or effort would be required to render edible; compatible with the definition of inedible parts in the FLW Standard; see Section 3.2.4: Definitions Related to Edibility

ORGANICS RECYCLING: processes such as composting or anaerobic digestion in which organic waste, such as food scraps or yard waste, are decomposed in controlled environments to produce soil amendments, fertilizer, energy, or other beneficial products

QUESTIONABLY EDIBLE FOOD: food items which can be safely eaten, but may not be considered edible by a portion of the population due to culture or preference; see Section 3.2.4: Definitions Related to Edibility

REDUCTION/PREVENTION: employing strategies to prevent food from being wasted in the first place or reducing the amount of food that goes to waste

RESCUABLE FOOD: food which is fit for human consumption and meets criteria for suitability for rescue/donation, generally limited to preconsumer surplus food; may include inedible parts as parts of food products donated

RESCUE/DONATION: the practice of redistributing to people on a charitable basis surplus food that would otherwise go to waste

TYPICALLY EDIBLE FOOD: food items which are intended for human consumption and are not generally considered inedible; see Section 3.2.4: **Definitions Related to Edibility**

WASTED FOOD: edible food which has been wasted; may include associated inedible parts

This food waste study, among the first of its kind in the United States, differs from other waste studies in that, for the residential sector, it attempts to track not only how much food is disposed, but also what types of food are discarded to multiple destinations and why the food was discarded, with an eye toward determining how much of that food was potentially edible-and therefore could potentially have been eaten and not wasted. The residential study also tracks beverage discards, as well as multiple destinations for wasted food and beverage (i.e. whether items were disposed down the drain, fed to animals, composted at home or outside the home, or put in the trash). The ICI assessment provides a method of estimating the amounts of food likely to be wasted in specific sectors of a city, including the residential sector.

On-ground residential research consisted of recruiting households in all three cities to track how much and what types of food they discarded for one week, along with the reasons for discarding, using kitchen diary templates and scales we provided, and to fill out two surveys conducted before and after the kitchen diary period to provide information on household demographics and attitudes and behavior related to food. We also conducted bin digs, or detailed waste audits, separating food into 10 different categories to assess how much and what types of food were in the trash and in some cases collected for composting. We also conducted bin digs for selected organizations in the ICI sector and used previous studies and regional business information to estimate the amount of food wasted in the ICI sector.



A total of 1,151 households in the three study cities agreed to participate in the study, from which we received a total of 613 fully completed kitchen diaries and 1,357 completed surveys, including the surveys given both before and after the kitchen diary period. We conducted 277 bin digs in the residential sector and another 145 bin digs in the ICI sector, including trash and compost bins.

TABLE 1: RESIDENTIAL AND INDUSTRIAL, COMMERCIAL, INSTITUTIONAL PARTICIPATION IN BASELINE FOOD WASTE ASSESSMENT								
	RESIDENTIAL							CI
	NUMBER OF Households Recruited	NUMBER OF Completed Kitchen Diaries	NUMBER OF COMPLETED SURVEYS	NUMBER OF COMPLETED BIN DIGS (TRASH ONLY)	NUMBER OF COMPLETED BIN DIGS (COMPOST ONLY)	NUMBER OF COMPLETED BIN DIGS (TRASH & COMPOST)	NUMBER OF TRASH Samples	NUMBER OF COMPOST SAMPLES
NASHVILLE	115	68	76 #I 7I #2	IO2 (single- family only; includes before and after digs)	n/a	n/a	22	1
DENVER	350	198	222 #I 203 #2	5I (46 single- family and 5 multi-family)	l (single- family)	I4 (single- family)	28	П
NYC	686	347	428 #1 357 #2	94 (76 single- family and 18 multi-family)	5 (2 single- family and 3 multi-family)	IO (single- family)	50 (from 43 businesses)	33 (from 26 businesses)
TOTAL	1,151	613	1,357	247	6	24	100	45

Chapter 3: Residential Assessment



3.1 RESIDENTIAL OVERVIEW

Participating households, both single-family and multifamily, agreed to complete one-week-long kitchen diaries that tracked food wasted by type, weight, loss reason, and discard destination. Note that discard here refers to any destination, including trash, down the drain, composting, or fed to pets; disposal is a subset of discard, which refers to trash and/or down the drain. Additionally, each participating household was asked to complete two surveys: one before and one after participating in the kitchen diary. The surveys collected basic demographic information as well as information on household food-related behaviors. Data collected through kitchen diaries, surveys, and bin digs was used to estimate the amount and types of food wasted in households in study cities, as well as to identify and describe individual and household behaviors related to wasting food.

From the participating households, a subset was randomly selected to have trash collected, sorted, and categorized once during the study. The bin digs were not used as a primary source of data to determine how much food was wasted. However, they were used to validate kitchen diary data by comparing reported quantities of wasted food with what was found in the trash bin. For households participating in compost collection pilots, both trash and curbside compost were collected for bin digs where feasible.

Using quota random sampling, households were randomly selected for Denver and New York City (NYC); a mix of random selection and volunteer enrollment was used for households in Nashville. Households in Nashville were recruited through English language outreach only; households in Denver were recruited through Spanish language outreach as well as English, and households in NYC were recruited through English, Spanish and Chinese language outreach. Study materials and support services were offered in English and Spanish in Denver, and in English, Spanish, and Chinese in NYC.

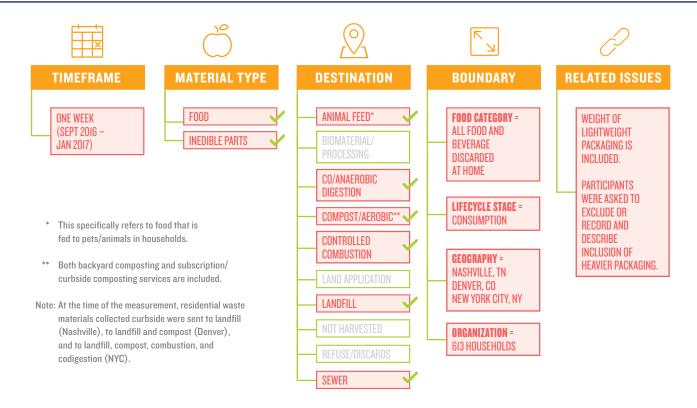
Incentives were provided to participants who completed the kitchen diaries and surveys, including a \$50 grocery/ convenience store or electronic gift card, a kitchen scale, and two plastic containers for weighing food.

3.2 RESIDENTIAL METHODOLOGY

The Food Loss and Waste Accounting and Reporting Standard (FLW Standard⁵) provides a framework for accounting for and reporting on food loss and waste. Figure 2 below describes the scope of the residential assessment using the FLW Standard.

Appendix A: Conformance with FLW Standard (Residential), Appendix C: Baseline Assessment Field Methodology, and Appendix D: Kitchen Diary Background for Analysis provide additional details on residential methodology (including more details in conformance with the FLW Standard).

FIGURE 2: BASELINE FOOD WASTE ASSESSMENT: RESIDENTIAL (FOOD LOSS AND WASTE ACCOUNTING AND REPORTING STANDARD)



3.2.1 Kitchen Diaries

Participants were asked to track all food and beverages discarded in their household for one week. The following information was collected:

- Date
- Time
- Associated with Which Meal: Breakfast, Lunch, Dinner, Dessert, Snack, Other
- Description of Food/Beverage Being Discarded: Written in by respondent (e.g. lasagna, bananas, ham sandwich with cheese, broccoli stems)
- State of Food/Beverage at Time of Discard: Cooked/Leftovers, Prepped (chopped or prepared but not cooked), Whole, Inedible Parts, Other
- Weight: Measured to the nearest tenth of an ounce (ounces with one decimal point) on provided kitchen scale

- Packaging: If wasted food was in a glass, metal, or hard plastic container when weighed, participant was asked to estimate the size (dimensions or volume). Participants were instructed not to include the weight of plastic containers provided for weighing.
- Discard Destination: Trash, Drain Disposal, Home Compost, Curbside Compost Collection (Denver and NYC only), Compost Drop-off (NYC only), Feeding Pets, Other
- Loss Reason: Past Date on Label, Moldy or Spoiled, Didn't Taste Good, Improperly Cooked, Inedible Parts, Left Out Too Long, Too Little to Save, Don't Want as Leftovers, Other

Participants were provided with a pre-printed kitchen diary to reduce time needed to complete each entry. They were also given a digital kitchen scale and two small plastic containers to assist with weighing the food. Additionally, a short guidebook describing how to complete the kitchen diary was provided to every participant, including information on how to prepare/tare the scale before use and answers to frequently asked questions. Participants had access to support via text, phone, and/or email throughout the measurement process.



Households were only asked to weigh and record details of food wasted in the household. Households were asked to provide a short, daily narrative on food discarded outside of the household for every member of the household.

See Appendix P: Study Templates for kitchen diary and guidebook templates and Appendix E: Kitchen Diary Data for detailed kitchen diary results.

3.2.2 Residential Surveys

Two surveys were administered: one before and one after the kitchen diary. Both surveys were provided electronically unless the household did not have access to the Internet. The first survey captured demographic information, as well as food-related behaviors, attitudes and motivations. The second survey was much shorter and focused on changes in attitudes and motivations after completing the kitchen diary, as well as feedback on their participation.

See Appendix P: Study Templates for survey templates and Appendix F: Survey 1 Data for detailed survey results.

3.2.3 Residential Bin Digs

A subset of households from the participants was randomly selected to have their trash collected, sorted, and categorized. For each of the households, the trash was collected once at the end of or during the kitchen diary study period, except Nashville, in which some households had trash collected at both the beginning and end of the kitchen diary period. For households participating in compost collection pilots, both their trash and curbside compost were collected for bin digs where feasible.

After waste was collected and removed to an offsite location, the waste materials were sorted into material categories by the local field team; food materials were sorted into ten categories. (See Table 2: Categories by Food Type for Bin Digs.) The food waste categories were designed to determine both food type and edibility. (See Section 3.2.4: Definitions Related to Edibility.)



Additionally, waste that was not food was sorted into the following categories:

- 1. Food-Soiled Paper;
- 2. Yard Trimmings;
- 3. Glass;
- 4. Recyclable Paper and Cardboard (not food-soiled);
- 5. Metals;
- 6. Rigid Plastics;
- 7. Plastic Films and Composites; and
- 8. All Other Materials.

Although categorization of these materials was not the focus of the waste audit, collecting this additional information on wastage rates of commonly recyclable and other materials provides additional context and data on the types of materials found in the waste overall. (See Appendix C: Baseline Assessment Field Methodology for more details on waste sorting.)

3.2.4 Definitions Related to Edibility

All food items included in both the kitchen diary and bin digs were given classifications related to edibility. Participants were asked to report both food and beverage items that were discarded. The primary classification first splits all items into edible food and inedible parts. (See Appendix A: Conformance with FLW Standard [Residential] and Appendix D: Kitchen Diary Background for Analysis for more information.) Edible food refers to any substance intended for human consumption, which is compatible with the definition of food in the FLW Standard. Edible does not reflect the state of food at any point in time, such as purchase or disposal, but is used to describe an item that would have been considered edible at some point. Inedible parts refers to components of food which are not typically consumed in the United States (e.g. banana peels) and/or for which significant skill or effort would be required to render this part of food edible (e.g. citrus rinds).

The secondary classification seeks to capture the complexity of defining edibility, especially in terms of culture and preference. Accordingly, items considered edible food were split into two groups:

- Typically Edible: These items are intended for human consumption and are not generally considered inedible. Examples include pizza, liquid coffee, and bananas without the peel.
- Questionably Edible: These items can be safely eaten, but may not be considered edible by a portion of the population due to culture or preference. These items might also require additional processing/cooking to make them desirable to eat. Examples include potato peels, beet greens, kale stems, carrot peels/tops, and apple cores/peels.

Note that wasted food that is edible is not the same as wasted food that is preventable (i.e. food wasting that could have been reasonably avoided, in this case at the consumer level). The study did not provide sufficient information to determine where in its lifecycle an item spoiled or otherwise became undesired by the consumer. For example, if the consumer purchased an item which was later found to have been already spoiled when purchased, that might not be considered preventable food waste at the consumer level as the consumer might not reasonably have been expected to eat it once spoiled. However, if the item spoiled after having been at the consumer's home for some time, that waste could arguably have been prevented by the consumer. Both the items in this example would be defined as edible, however, as they would have been intended for human consumption and edible at some point. Edible is also not the same as rescuable. For one thing, excess edible food from the residential sector or that has already been served

FIGURE 3: TWO LEVELS OF CLASSIFICATION OF DISCARDED FOOD **BASED ON "EDIBILITY"**



is rarely rescued for redistribution due to food safety restrictions; for another, rescued food may contain inedible parts (e.g. donated whole fruit may include inedible parts such as peels).

The ten food waste categories used for bin digs can be grouped into four main types per definitions related to edibility (see Table 2: Categories by Food Type for Bin Digs):

- Inedible parts of all types of food (Category 1)
- Edible foods of one food type (Categories 2-8)
- Edible foods comprised of multiple food types (Category 9)
- Unidentifiable foods (Category 10)

TABLE 2	TABLE 2: CATEGORIES BY FOOD TYPE FOR BIN DIGS						
	CATEGORIES	DEFINITION	EXAMPLES				
ſ	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	Edible - Meat & Fish	Uncooked or cooked meat (with mostly edible components) unmixed with other types of food	Boneless chicken breast, salmon fillet				
3	Edible – Dairy & Eggs	Solid dairy or egg products unmixed with other food types or in original form	Cheese, yogurt, fried egg				
4	Edible – Vegetables & Fruits	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	Edible - Baked Goods	Baked goods and bread-like products unmixed with other food types or in original form, including pastries	Bread, tortillas, pastries				
6	Edible - Dry Foods	Cooked or uncooked grains, pastas, legumes, nuts, or cereals unmixed with other food types or in original form	Rice, cereal, pasta				
7	Edible – Snacks, Condiments, & Other	Includes confections, processed snacks, condiments, and other miscellaneous items	Condiments, candy, granola bars, sauces, jellies				
8	Edible - Liquids/Oils/Grease	Items that are liquid, including beverages	Sodas, milk, oil, juice				
9	Edible - Cooked/Prepared Items/ Leftovers	Items that have many food types mixed together as part of cooking or preparation	Lasagna, sandwiches, leftovers				
10	Unidentifiable	Used only if necessary					

Some foods had small amounts of other food types mixed in (e.g. salad with dressing and croutons or noodles with butter). If 90 percent or more of the food (by weight; estimated visually) was represented by a specific food category, it was characterized as such (e.g. a food item including less than 10 percent of inedible parts, such as peels or bones, was categorized as edible). If more than 10 percent of an edible food item was of another edible food type, then it was categorized as "Edible: Cooked/ Prepared Items/Leftovers." Examples of the latter include sandwiches and lasagna.

3.2.5 Limitations of Residential Data

The pilot study in Nashville utilized both random and nonrandom sampling methods of door-to-door recruitment and online recruitment, respectively. Because of this, the participating households are not representative of the larger Nashville population. Specifically, it is likely that the research population is more aware and engaged with foodrelated and waste-related topics. As a result, this sample may represent a population that wastes less, on average, than the broader population.

The food waste assessment in Denver utilized quasirandom sampling methods of door-to-door recruitment in randomly selected neighborhoods. The food waste assessment in New York utilized quasi-random sampling methods for participating households in single-family households or multi-family housing with fewer than 10 units of door-to-door recruitment in randomly selected census tracts in Brooklyn, Queens, and the Bronx. To gain access to multi-family housing in large buildings, building managers and homeowners associations were contacted. Recruitment was done through tabling in the buildings and/or attending building meetings. It is likely that some bias was introduced into the sample population because households who are more environmentally aware and more aware of the issue of food waste may be more likely to agree to participate in the study.

Additionally, the results in terms of food wasted per capita are not normally distributed. A non-normal distribution means that the data are not symmetrically distributed around the mean (see histograms of distribution in Appendix D: Kitchen Diary Background for Analysis). For the statistical calculations used in our analysis, a normal distribution is a required assumption. However, because of the large sample size of our data in all three cities, the nonnormal distribution is likely to have a minimal effect on the statistical analysis.6

See Appendix A: Conformance with FLW Standard (Residential) and Appendix D: Kitchen Diary Background for Analysis for additional assessment of uncertainty related to the residential study.

3.2.6 Accounting for Underreporting in Kitchen Diaries

Similar studies, such as that undertaken in the United Kingdom by WRAP. have shown that there is substantial underreporting of how much food is wasted compared to how much is reported as being wasted. To understand the level of underreporting, a subset of households that participated in the kitchen diary data recording also had their trash, and curbside compost when available, collected at some point during the kitchen diary study period and sorted into the categories used in the bin dig analysis (see Section 3.2.3: Residential Bin Digs). The amount of total wasted food found in the trash or compost was compared to the amount of total wasted food reported as being thrown in the trash or compost in the kitchen diary. Trash and compost were compared separately. (See Appendix A: Conformance with FLW Standard [Residential] for more information on accounting for underreporting.)

For the purposes of this study, the average total wasted food underreporting rate from the trash digs of all three cities combined, 47 percent, was used as a correction factor applied to kitchen diary results. This correction factor is applied to total food waste generation and is not dependent on discard destination. The underreporting rate for trash is used as a proxy for all other discard destinations. Even though the reporting rate for compost was also calculated, the sample size was too small to be significant, and the results were inconclusive.

3.3 RESIDENTIAL PARTICIPANT DEMOGRAPHICS

The first survey collected demographics on study participants, including household size, average income, and expenditures on food eaten both at home and away from home. Most participants lived in households with an average of between two and three residents, all of whom were related to one another; approximately onethird of participating households included children. The average age of adult household members was 43. Although households were divided nearly equally by male and female members, nearly two-thirds of the primary respondents defined themselves as female. Slightly more than half of participating households defined as white and the primary language of approximately three-quarters of participating households was English. One-quarter of households included at least one member whose highest level of education was a bachelor's degree, while another one-third of households included at least one member whose highest level of education was a graduate degree. More details on participant demographics can be found in Tables 3 through 5 and in Appendix F: Survey 1 Data.

TABLE 3: HOUSEHOLD COMPOSITION OF RESIDENTIAL PARTICIPANTS*						
	NASHVILLE	DENVER	NYC	TOTAL		
Family or Related Individuals	63%	66%	73%	70%		
Alone	21%	21%	16%	18%		
Non-Related Individuals (e.g. roommates)	16%	12%	11%	11%		

^{*}Percentages may not add up to 100% due to rounding and blank responses. Totals for all tables represent weighted averages unless otherwise stated.

TABLE 4: HOUSEHOLD SIZE AND AGE OF RESIDENTIAL PARTICIPANTS						
	AVERAGE HOUSEHOLD SIZE	PERCENTAGE OF HOUSEHOLDS WITH CHILDREN (UNDER 18)	AVERAGE AGE OF ADULT HOUSEHOLD MEMBERS (OVER 18)			
Nashville	2.5 people	33%	37			
Denver	2.6 people	31%	44			
New York	2.9 people	36%	44			

TABLE 5: HOUSEHOLD ECONOMICS OF RESIDENTIAL PARTICIPANTS RELATED TO FOOD						
	AVERAGE ANNUAL Household income	AVERAGE \$/WEEK SPENT ON Food eaten at home	AVERAGE \$/WEEK SPENT ON FOOD EATEN AWAY FROM HOME			
Nashville	\$55,000-\$65,000	\$51-100	\$51-100			
Denver	\$65,000-\$75,000	\$101-150	\$51-100			
New York	\$65,000-\$75,000	\$101-150	\$51-100			

3.4 QUANTITY AND TYPES OF FOOD WASTED

As described in Section 3.2.6: Accounting for Underreporting in Kitchen Diaries, the average underreporting rate of all three cities, 47 percent, was used as a correction factor applied to kitchen diary results. (See Appendix A: Conformance with FLW Standard [Residential] for more information on calculating underreporting rates.) In the analysis below, both the original and a "corrected" number to account for underreporting are reported.

3.4.1 Quantity of Food Wasted by Households

As both the kitchen diary and bin dig portions of our assessment looked at household-level waste, we calculated the amount of food waste occurring at the household level. In the three cities we studied, the average amount of total food wasted per household (includes typically edible, questionably edible, and inedible; corrected for underreporting) ranged from 7.5 pounds per household per week to 9.6 pounds per household per week, for an overall average of 8.7 pounds per household per week. The average amount of edible food wasted per household (includes

typically edible and questionably edible, corrected for underreporting) ranged from 4.6 pounds per household per week to 7.5 pounds per household per week, for an overall average of 6.0 pounds per household per week. (See Section 3.2.4: Definitions Related to Edibility.) In comparison, assuming 238 pounds of food waste per person per year are wasted (from ReFED's Roadmap to Reduce U.S. Food Waste by 20 Percent⁸), and that the average number of persons per household in the United States is 2.53,9 it is estimated that the average household would waste a total of 11.6 pounds of food per week.

Nashville:

- Total (average): 5.1 pounds/household/week (corrected to 7.5 pounds/household/week)
- Edible (average): 3.1 pounds/household/week (corrected to 4.6 pounds/household/week)

Denver:

- Total (average): 6.5 pounds/household/week (corrected to 9.6 pounds/household/week)
- Edible (average): 5.1 pounds/household/week (corrected to 7.5 pounds/household/week)

The average amount of food wasted by households (including inedible parts) was 3.5 pounds per person per week, approximately 68 percent of which was potentially edible.

New York City:

- Total (average): 5.7 pounds/household/week (corrected to 8.4 pounds/household/week)
- Edible (average): 3.7 pounds/household/week (corrected to 5.4 pounds/household/week)

Weighted Average (all three cities; corrected for underreporting):

- Total (average): 8.7 pounds/household/week
- Edible (average): 6.0 pounds/household/week

3.4.2 Quantity of Food Wasted Per Capita

Although our study primarily looked at food wasted at the household level, given that households vary in size, it is also useful and offers more accuracy in extrapolation to calculate the amount of food wasted per capita. In the three cities we studied, the average amount of total food wasted per capita (includes typically edible, questionably edible, and inedible; corrected for underreporting) ranged from 3.2 pounds per person per week to 4.2 pounds per person per week, for an overall average of 3.5 pounds per person per week. The average amount of edible food wasted per capita (includes typically edible and questionably edible, corrected for underreporting) ranged from 2.1 pounds per person per week to 3.2 pounds per person per week, for an overall average of 2.5 pounds per person per week. (See Section 3.2.4: Definitions Related to Edibility.) In comparison, assuming 238 pounds of food waste per person per year are wasted (from ReFED¹⁰), it is estimated that the average person would waste a total of 4.6 pounds of food per week.

Nashville:

- Total (average): 2.3 pounds/person/week (corrected to 3.4 pounds/person/week)
- Edible (average): 1.4 pounds/person/week (corrected to 2.1 pounds/person/week)

Denver:

- Total (average): 2.8 pounds/person/week (corrected to 4.2 pounds/person/week)
- Edible (average): 2.2 pounds/person/week (corrected to 3.2 pounds/person/week)

New York City:

- Total (average): 2.2 pounds/person/week (corrected to 3.2 pounds/person/week)
- Edible (average): 1.4 pounds/person/week (corrected to 2.1 pounds/person/week)

Weighted Average (all three cities; corrected for underreporting):

- Total (average): 3.5 pounds/person/week
- Edible (average): 2.5 pounds/person/week

TABLE 6: AVERAGE QUANTITY OF FOOD WASTED FROM KITCHEN DIARIES*						
	NASHVILLE	DENVER	NYC	ALL Cities		
Average Total Pounds Per Household	7.5	9.6	8.4	8.7		
Average Edible Pounds Per Household	4.6	7.5	5.4	6.0		
Average Total Pounds Per Capita	3.4	4.2	3.2	3.5		
Average Edible Pounds Per Capita	2.1	3.2	2.1	2.5		

^{*}Corrected for underreporting

3.4.3 Wasted Food by Edibility

Most of the discarded food tracked in kitchen diaries was at least potentially edible, for all cities. Including questionably edible food, an average of 68 percent of all food discarded was considered edible. This does not necessarily signify that the food was edible at the time of discarding, only that it was at some point food defined as edible (see Section 3.2.4: Definitions Related to Edibility and Appendix A: Conformance with FLW Standard [Residential]).

TABLE 7: FOOD WASTED BY EDIBILITY BY WEIGHT*						
	NASHVILLE	DENVER	NYC	TOTAL		
Typically Edible	56%	66%	51%	57%		
Questionably Edible	6%	10%	13%	11%		
Inedible	37%	25%	35%	32%		

^{*}Percentages may not add up to 100% due to rounding and blank responses.

3.4.4 Food Wasted by Food Category

Kitchen diary data indicate that the largest two categories of food wasted by participants, using our sorting categories, were inedible parts and edible fruits and vegetables, for all cities (see Table 8: Food Wasted by Category by Weight from Kitchen Diaries). Prepared foods and leftovers were also wasted in high quantities. The fourth highest category of food wasted on average was liquids, oils, and grease, which includes beverages. Meat and fish, dairy and eggs, and baked goods were all wasted in similar proportions. (See Appendix E: Kitchen Diary Data for more details on food wasted by food category.)

TABLE 8: FOOD WASTED BY CATEGORY BY WEIGHT FROM KITCHEN DIARIES*						
	NASHVILLE	DENVER	NYC	TOTAL		
Inedible	37%	25%	35%	31%		
Fruits & Vegetables (edible)	24%	29%	26%	27%		
Prepared Foods & Leftovers (edible)	13%	19%	21%	19%		
Liquids, Oils, & Grease (edible)	10%	9%	4%	6%		
Dairy & Eggs (edible)	5%	6%	4%	5%		
Meat & Fish (edible)	2%	6%	3%	4%		
Baked Goods (edible)	3%	5%	4%	4%		
Snacks & Condiments (edible)	3%	2%	1%	2%		
Dry Food (edible)	1%	<1%	1%	1%		

^{*}Percentages may not add up to 100% due to rounding and unidentifiable items.

Bin dig data show proportions of categories disposed in trash collected for bin digs are similar to the corresponding categories wasted as tracked in kitchen diaries (Tables 9 and 10). Note that the kitchen diary data on food wasted by category track food discarded to all destinations, not just trash; bin dig data in Tables 9 and 10 refer only to food disposed in trash. Table 9 shows the percentages of each category of food disposed in trash collected for bin digs (including proportion of each category to total food in each city's bin digs, as well as to total trash collected for bin digs). Table 10 compares these bin dig category proportions to kitchen diary category proportions. Similar to kitchen diary data, inedible parts also represent the largest food category disposed in trash (per bin digs), followed by

prepared foods and leftovers, and fruits and vegetables. Edible food was 65 percent of overall food disposed in trash per bin digs, similar to the 68 percent of edible food as a percentage of overall food discarded per kitchen diary data. Food waste represented 29 percent of all materials disposed in trash collected for bin digs, including materials other than food. One-fifth (19 percent) of all materials disposed in trash collected for bin digs was edible food. For additional information on food and other materials, including other compostable materials and commonly recyclable materials, found in trash and compost bin digs, see Section 3.5.1.2: Food Wasted by Loss Reason and Appendix G: Residential Bin Dig Data.

TABLE 9: FOOD DISPOSED IN TRASH BY CATEGORY BY WEIGHT FROM BIN DIGS*						
	NASHVILLE % OF WASTED FOOD	DENVER % OF WASTED FOOD	NYC % OF Wasted Food	TOTAL % OF Wasted Food	TOTAL % OF Total trash	
Inedible	23%	38%	44%	35%	10%	
Prepared Foods & Leftovers (edible)	28%	16%	24%	23%	7%	
Fruits & Vegetables (edible)	23%	24%	15%	20%	6%	
Baked Goods (edible)	6%	6%	6%	6%	2%	
Liquids, Oils, & Grease (edible)	8%	6%	2%	5%	1%	
Snacks & Condiments (edible)	4%	5%	3%	4%	1%	
Meat & Fish (edible)	3%	3%	4%	3%	1%	
Dry Food (edible)	4%	1%	2%	2%	1%	
Dairy & Eggs (edible)	1%	1%	1%	1%	0%	
SUBTOTAL EDIBLE (% OF FOOD)	77%	62%	56%	65%	19%	
SUBTOTAL FOOD WASTE (% OF TRASH)	26%	26%	35%	N/A	29%	

^{*}Note that although "Unidentifiable" was a designated sorting category, no waste from bin digs was categorized as unidentified.

TABLE 10: COMPARISON OF BIN DIG FOOD DISPOSED IN TRASH TO KITCHEN DIARY FOOD DISCARDED TO ALL DESTINATIONS BY WEIGHT, ALL CITIES COMBINED*						
	% OF WASTED FOOD (BIN DIGS – TRASH ONLY)	% OF WASTED FOOD (KITCHEN DIARIES – ALL DESTINATIONS)	DIFFERENCE IN % OF WASTED FOOD (DIARIES MINUS BIN DIGS)			
Inedible	35%	32%	-4%			
Fruits & Vegetables (edible)	20%	27%	7%			
Prepared Foods & Leftovers (edible)	23%	19%	-4%			
Liquids, Oils, & Grease (edible)	5%	6%	1%			
Dairy & Eggs (edible)	1%	5%	3%			
Meat & Fish (edible)	3%	4%	1%			
Baked Goods (edible)	6%	4%	-2%			
Snacks & Condiments (edible)	4%	2%	-2%			
Dry Food (edible)	2%	1%	-1%			
SUBTOTAL EDIBLE	65%	68%	4%			

^{*}Percentages may not add up due to rounding.

3.4.5 Top Foods Wasted by Food Type

Participants in all cities tended to discard similar types of food in the highest quantities. In Table 11, the seven items highlighted in blue appear in the top 10 most wasted total food types (typically edible, questionably edible, and inedible) tracked in kitchen diaries in Nashville, Denver, and New York City. Three of the items—coffee, banana, and chicken—appear in the top five most wasted total food types in all three cities. Note that because this table includes all parts of food, some food types appear on this list primarily due to high proportions by weight of inedible components (e.g. banana). Others appear primarily because of components that are questionably edible (e.g. potato peels or apple cores). (See Appendix D: Kitchen Diary Background for Analysis for lists of items included in each category.)



TABLE II: 1	TABLE II: TOTAL FOOD WASTED BY TYPE (INCLUDES TYPICALLY EDIBLE, QUESTIONABLY EDIBLE, AND INEDIBLE)								
RANK	NASHVILLE	DENVER	NYC						
1	Coffee (including liquid coffee and grounds)	Coffee (including liquid coffee and grounds)	Coffee (including liquid coffee and grounds)						
2	Banana	Chicken	Banana						
3	Chicken	Milk	Chicken						
4	Egg	Banana	Orange						
5	Milk	Bread	Apple						
6	Apple	Potato	Potato						
7	Bread	Apple	Bread						
8	Squash	Egg	Soup						
9	Sauce (various condiments and sauces)	Soup	Milk						
10	Potato	Pork	Rice						



In Table 12, the six items highlighted in pink appear in the top 10 most wasted edible food types in all three cities. Two of the items—milk and bread—appear in the top five most wasted edible food types in all three cities. Note that we included beverages as well as food in our study, as well as



including a variety of discard destinations beyond just the garbage bin, such as down the drain or fed to pets, which enabled us to gain information that would otherwise have been obscured, such as the frequency with which coffee and milk are poured down the drain, for example.

TABLE 12: EDIBLE FOOD WASTED BY TYPE (INCLUDES TYPICALLY EDIBLE AND QUESTIONABLY EDIBLE)									
RANK	NASHVILLE	DENVER	NYC						
1	Coffee (liquid)	Coffee (liquid)	Apple						
2	Milk	Milk	Bread						
3	Apple	Bread	Potato						
4	Bread	Chicken	Milk						
5	Sauce (various condiments and sauces)	Potato	Soup						
6	Chicken	Apple	Rice						
7	Potato	Soup	Sauce (various condiments and sauces)						
8	Pasta	Pork	Pasta						
9	Tomato	Salad	Coffee (liquid)						
10	Broccoli	Pasta	Cauliflower						

In Table 13, the six items highlighted in green appear in the top 10 most wasted questionably edible food types in all three cities. Three of the items—apples (skins and cores), potatoes (peels), and broccoli (stalks)—are in the top five most wasted questionably edible foods in all three cities.

Especially as there is a fair amount of overlap between cities, identifying the most wasted questionably edible foods might highlight possibilities for consumer education (e.g. providing cooking instructions and recipes for those food types).

TABLE 13: (TABLE 13: QUESTIONABLY EDIBLE FOOD WASTED BY TYPE										
RANK	NASHVILLE	DENVER	NYC								
1	Apple (skin and cores)	Apple (skin and cores)	Apple (skin and cores)								
2	Potato (peels)	Potato (peels)	Potato (peels)								
3	Carrot (peels and tops/greens)	Broccoli (stalks)	Cauliflower (stalks)								
4	Broccoli (stalks)	Carrot (peels and tops/greens)	Broccoli (stalks)								
5	Lettuce (outer leaves and cores)	Asparagus (stems)	Pear (skin and cores)								
6	Chicken (skin, fat, and giblets)	Chicken (skin, fat, and giblets)	Carrot (peels and tops/greens)								
7	Tomato (cores)	Cucumber (skins)	Lettuce (outer leaves and cores)								
8	Cucumber (skins)	Lettuce (outer leaves and cores)	Kale (stems)								
9	Radish (leaves)	Pear (skin and cores)	Herbs (stems)								
10	Leek (tops)	Celery (tops)	Cucumber (skins)								

In compiling the lists above, edible items that were mixtures of multiple food types and appeared frequently in the diaries (such as soup and pasta) are tracked as separate items. Other mixtures of multiple food types (such as prepared foods and leftovers) that appeared less often were aggregated into categories such as "red meat dishes," which are red meat-based prepared dishes such as beef tacos or bacon omelet; "mixed fruits and vegetables," which are produce-based unprepared/uncooked items such as vegetable scraps of unknown vegetable origin, and "non-meat dishes," which are meatless prepared dishes such as vegetable stirfry or peach cobbler. If we had included those aggregated categories in these lists, the three examples above (red meat dishes, non-meat dishes, and mixed fruits and vegetables) would all have appeared with varying frequency in the lists. In particular, prepared dishes/leftovers are frequently discarded. (See Appendix D: Kitchen Diary Background for Analysis for lists of items included in each category.)

3.5 WHERE, WHY, AND WHEN FOOD WAS WASTED

3.5.1 Food Wasted by Discard Destination

Kitchen diary participants were asked to track food discarded to multiple destinations: trash, compost, down the drain, or feeding animals (pets, such as dogs or chickens). Note that discard here refers to any of the multiple destinations for wasted food, while disposal is a subset of discard, which refers to trash and/or down the drain. Trash disposal represented more than half of the kitchen diary discard destinations. Down the drain was another 11 percent and feeding to animals (pets) was two percent. (See Table 14.) Thirty-one percent of food was

discarded to compost, including home composting, curbside pickup, and drop-off. (See Appendix E: Kitchen Diary Data for more details on food wasted by discard destination.)

The average proportion of total discarded food that was discarded to compost and feeding animals was 31 percent in Nashville, 26 percent in Denver, and 38 percent in New York City (NYC). Note that the composting rate in Nashville is higher than would be expected given that there is no curbside composting option offered by the city. Thirty percent of Nashville respondents indicated they participate in home composting, which is likely more than the average Nashville population. We speculate that this is a result of Nashville participants primarily consisting of volunteers with recruitment accomplished largely through public outreach as compared with targeted recruitment in Denver and NYC. Consequently, this population may already be more active participants in food waste strategies, such as composting, than the average Nashville population.

TABLE 14: FOOD WASTED BY DISCARD DESTINATION BY WEIGHT FROM KITCHEN DIARIES*									
	NASHVILLE	DENVER	NYC	TOTAL					
Trash	52%	54%	52%	53%					
Compost (includes home, curbside, drop-off)	28%	24%	37%	31%					
Down the Drain	15%	16%	7%	11%					
Feeding Animals	3%	2%	1%	2%					

^{*}Percentages may not add up to 100% due to rounding and blank/"other" responses.

3.5.1.1 Participation in Composting

In Denver and NYC, some household participants were members of each city's respective curbside compost pilot program. At the time the residential study was conducted in Denver, approximately 89,415 households in the city were eligible for compost service and approximately 9,338 households had subscribed to the city's compost program. At the time the residential study was conducted in NYC, approximately 980,000 New York City residents had access to curbside compost collection. In Nashville, there is no city-provided curbside compost pickup, but some household participants subscribe to a compost service, and others engage in home composting. Nashville participants did not specify which method of composting they used in kitchen diaries. Table 15 provides information from the survey on participation in composting. Note that respondents may engage in more than one form of composting (e.g. composting at home as well as participating in city compost programs).

TABLE 15: SURVEY RESPONSES INDICATING WHETHER AND HOW HOUSEHOLD CURRENTLY COMPOSTS									
	NASHVILLE	DENVER	NYC	TOTAL					
No	64%	67%	55%	58%					
Yes, we compost at our home	30%	17%	11%	14%					
Yes, we contribute to community or other type of composting	3%	3%	12%	8%					
Yes, we subscribe to a composting service	1%	14%	23%	18%					

3.5.1.2 Compost Bin Digs

In addition to tracking kitchen diary discards to compost, we conducted a subset of compost bin digs on the contents of compost bins set out by participants in Denver and NYC's city composting programs. In Denver, 70 percent of the contents of compost bins collected were vard waste, although yard waste represented only 4 percent of the contents of NYC compost bins collected; consequently, as seen in Appendix G: Residential Bin Dig Data, food as a percentage of total contents of compost bin is much lower for Denver (23 percent) than for NYC (86 percent). This difference is likely enhanced by seasonality, as the Denver study was conducted in the autumn during peak leaf season. In addition, home lot and yard sizes are larger in Denver and therefore are likely to generate more yard waste than homes in NYC. The proportion of edible food found in compost bin digs is much lower than the proportion of edible food found in trash bin digs. In Denver, 62 percent of food disposed in trash was edible food, although only 35 percent of food discarded to compost was edible food. In NYC, 56 percent of food disposed in trash was edible food, although only 25 percent of food discarded to compost was edible food.

For additional information on food and other materials (including compostable and non-compostable materials) found in compost bin digs, see Appendix G: Residential Bin Dig Data.

TABLE 16: FOOD DISCARDED TO TRASH AND COMPOST BY CATEGORY (FROM TRASH AND COMPOST BIN DIGS)*										
	DENVER % OF WASTED FOOD (IN TRASH)	DENVER % OF WASTED FOOD (IN COMPOST)	NYC % OF Wasted Food (In Trash)	NYC % OF WASTED FOOD (IN COMPOST)	TOTAL % OF Wasted Food (In Trash)	TOTAL % OF WASTED FOOD (IN COMPOST)				
Inedible	38%	65%	44%	75%	35%	71%				
Meat & Fish (edible)	3%	4%	4%	3%	3%	3%				
Dairy & Eggs (edible)	1%	0%	1%	1%	1%	1%				
Fruits & Vegetables (edible)	24%	25%	15%	9%	20%	15%				
Baked Goods (edible)	6%	4%	6%	3%	6%	3%				
Dry Food (edible)	1%	0%	2%	1%	2%	0%				
Snacks & Condiments (edible)	5%	0%	3%	2%	4%	1%				
Liquids, Oils, & Grease (edible)	6%	0%	2%	0%	5%	0%				
Prepared Foods & Leftovers (edible)	16%	4%	24%	6%	23%	5%				
SUBTOTAL EDIBLE (% OF FOOD)	62%	35%	56%	25%	65%	29%				

^{*}Percentages may not add up to 100% due to rounding

In both cities, the compost bins at our participating households had lower set-out rates than trash bins, so we were not able to collect a number of samples. We did, however, find some statistically significant differences related to the amount of wasted food in trash from households participating in the city composting programs versus households not participating. (See Appendix G: Residential Bin Dig Data for data related to bin digs.)

In Denver, households participating in city composting discarded less than half the amount of total and edible wasted food (to trash and compost combined) than the households not participating in city composting discarded (to trash). The percentage of food in trash was also much lower for households that compost. It is possible, however, that the quantity of wasted food for the composting households might be underrepresented, as not all composting households set out their compost bins for collection; in other words, there may have been additional food discarded in compost bins by those households that we were unable to collect (e.g. if it was in a compost bin that had not been set out).

In NYC, as in Denver, there were low set-out rates of compost (i.e. bins were not made available for pickup at the designated time), so it is possible that there was additional food discarded to compost by the households that did not end up in the compost samples that were collected for bin digs. Although we did not find statistically significant difference in the proportion of food wasted by composting households compared to households not participating in city composting, we did find statistically significant difference with respect to the amount of food in the trash, though not the amount of food in the compost. Per capita and per household, the composting households discarded about half the amount of food (total and edible) to trash compared with the households not participating in city composting.

Although the small number of our compost samples limits our ability to determine relationships between composting and wasting food, it appears that the households participating in city composting in both Denver and NYC did dispose of less food in the trash than households not participating in city composting. What we were unable to determine, however, was whether the composting households discarded less food overall (to compost and trash combined) than the households not participating in city composting. This highlights a potential area for future research, especially since our survey data indicate that more than half of respondents (58 percent feel less guilty about wasting food if it is composted (see Table 42: Respondents Who "Agree" or "Somewhat Agree" with the Following Statements Related to Attitudes about Food). Note that the comparison in this section is based on data from trash and compost collected for bin digs. Section 3.8.2: Comparing Attitudes and Behavior with Wasted Food Generation compares data derived from kitchen diaries on

per capita food waste generation with households that selfidentified in the surveys as participating in composting, so those different data sources have slightly different results.

3.5.2 Food Wasted by Loss Reason

Most often, food tracked in kitchen diaries was reported as discarded due to being inedible parts (44 percent), moldy or spoiled (20 percent), or simply not wanted as leftovers (11 percent); however, although nearly half of discarded food was reported by respondents as discarded due to being inedible parts, our categorization of food wasted by edibility (see Section 3.4.3: Wasted Food by Edibility) suggests that at least some of that was food that was edible as defined for this study (it is likely that much of the discrepancy was food we classified as questionably edible, while other edible items were incorrectly classified by respondents as inedible, such as pizza crusts).

TABLE 17: FOOD WASTED BY LOSS REASON BY WEIGHT FROM KITCHEN DIARIES*									
	NASHVILLE	DENVER	NYC	TOTAL					
Inedible Parts	41%	36%	50%	44%					
Moldy or Spoiled	20%	24%	17%	20%					
Don't Want as Leftovers	11%	12%	10%	11%					
Left Out Too Long	7%	8%	7%	7%					
Doesn't Taste Good	6%	5%	4%	5%					
Past Date on Label	3%	4%	4%	4%					
Too Little to Save	5%	5%	4%	4%					
Improperly Cooked	1%	0%	1%	0%					
Other or Multiple Reasons	5%	2%	2%	2%					

^{*}Percentages may not add up to 100% due to rounding and blank responses.

3.5.2.1 Date Labels

Only four percent of food was reported in the diaries as being discarded because it was past the date on the label (see Table 17), despite responses to the survey indicating that for a quarter to half of respondents (29 percent Nashville, 44 percent Denver, 50 percent NYC), date labels are the main source of information used when deciding whether to throw away food (Table 18). However, 87 percent of respondents also noted that they frequently use sight, taste, or smell to determine if food is safe to eat (see Table 18), perhaps suggesting that many people use more than one strategy when deciding whether or not to consume food. In Nashville, a majority (59 percent) disagreed that date labels are the main source of information they use when deciding whether to throw away food, compared to



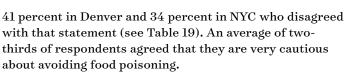


TABLE 18: RESPONDENTS WHO "AGREE" OR "SOMEWHAT AGREE" WITH THE **FOLLOWING STATEMENTS RELATED TO FOOD SAFETY**

	NASHVILLE	DENVER	NYC	TOTAL
We are very cautious about avoiding food poisoning	46%	72%	69%	67%
Date labels are the main source of information we use when deciding whether to throw away food	29%	44%	50%	46%
We frequently use sight, taste, or smell to determine if food is safe to eat	92%	89%	86%	87%

TABLE 19: RESPONDENTS WHO "DISAGREE" OR "SOMEWHAT DISAGREE"
WITH THE FOLLOWING STATEMENTS RELATED TO FOOD SAFETY

WITH THE FULLOWING STATEMENTS RELATED TO FOUN SAFETY									
	NASHVILLE	DENVER	NYC	TOTAL					
We are very cautious about avoiding food poisoning	32%	14%	11%	14%					
Date labels are the main source of information we use when deciding whether to throw away food	59%	41%	34%	39%					
We frequently use sight, taste, or smell to determine if food is safe to eat	4%	4%	6%	5%					



Based on kitchen diary data, it is likely that few respondents performed refrigerator clean-outs during the study period. Survey data also indicated that only 44 percent of respondents agree that they perform refrigerator clean outs at least every other week (see Table 33). One hypothesis for the low frequency of date labels as a reason for discarding food is that date labels are more frequently used to determine whether or not to throw out food during refrigerator clean-outs, as compared to regular daily activity. Our study also did not track freezer cleanouts; it is possible that a substantial quantity of the food respondents noted they froze before the date on the label may have been ultimately discarded even if frozen first. (See Section 3.6.2: Storing Food and Section 3.7: Attitudes and Beliefs Around Wasting Food for more information on refrigerators.)

When asked what they generally do with different types of foods after the date provided on the packaging has passed, a minority (2 percent to 17 percent) of respondents claimed to never rely on date labels, depending on the type of food (see Table 20). In particular, 17 percent disregard date labels on eggs, while only two percent of respondents disregard date labels on meat and fish, suggesting that at least for some food types (e.g. meat and fish, yogurt and sour cream, milk), date labels are at least somewhat considered in deciding whether to keep food. Respondents also claimed to eat or freeze, or discard between 11 percent and 31 percent of food (based on type) before the date on the label. Although 87 percent of people claimed they frequently use sight, taste, or smell to determine if food is safe to eat (see Table 18), only 33 percent to 64 percent of respondents claimed they use these strategies for the foods listed in Table 20.

TABLE 20	TABLE 20: WHAT RESPONDENTS DO WITH FOOD TYPES WHEN THE DATE ON THE PACKAGE HAS PASSED																			
	DON'T PAY ATTENTION TO DATE LABELS							SMELL OR LOOK AT IT TO Determine IF IT IS STILL GOOD			EVERYTHING IS EATEN OR FROZEN BEFORE DATE ON PACKAGE				I DON'T CONSUME THIS Type of food					
	Nash	Den	NY	Total	Nash	Den	NY	Total	Nash	Den	NY	Total	Nash	Den	NY	Total	Nash	Den	NY	Total
Meat & Fish	1%	4%	2%	2%	20%	20%	28%	24%	36%	34%	32%	33%	34%	36%	27%	31%	8%	5%	8%	7%
Eggs	25%	21%	14%	17%	5%	18%	24%	20%	41%	31%	30%	32%	22%	25%	25%	25%	4%	5%	4%	4%
Milk	0%	1%	2%	2%	13%	18%	25%	22%	63%	55%	49%	52%	16%	15%	14%	15%	7%	11%	6%	7%
Bread	9%	7%	8%	8%	7%	12%	16%	14%	63%	58%	51%	55%	13%	17%	20%	18%	5%	5%	2%	3%
Cheese	9%	8%	6%	7%	9%	14%	20%	17%	66%	59%	51%	55%	9%	15%	14%	14%	5%	4%	5%	5%
Yogurt & Sour Cream	4%	3%	3%	3%	14%	26%	29%	27%	67%	51%	46%	50%	5%	13%	12%	11%	8%	6%	7%	7%
Fruits & Veg	9%	6%	7%	7%	8%	14%	16%	14%	78%	67%	60%	64%	3%	12%	13%	12%	0%	0%	0%	0%

Although nearly half of survey respondents rely primarily on date labels in deciding whether to discard food, some participants noted in comments to the survey that date labels were generally confusing. For example:

"I don't understand the expiration dates on products. Some say 'sell by' (but then by when do I need to use them?); canned or jarred products just have a date, but once opened, when do they need to be thrown away? How long do things like spices last? Seems to me there is a lot of confusion regarding these dates and this causes me to err on the side of caution and throw away products that are perfectly good just because of confusing expiration dates."

3.5.2.2 Leftovers

Eleven percent of food was discarded per kitchen diary data because it was not wanted as leftovers (see Table 17). When asked to identify specific actions taken with respect to leftovers, a majority claimed to eat leftovers as another meal, either without alteration or adding other food (see Table 21). Although 12 percent of respondents claim to compost leftovers, more respondents (19 percent) say they throw leftovers in the garbage; since destination was not specified, though, this may include leftovers disposed both in trash and down the drain. Ten percent of respondents say they feed leftovers to animals, while five percent of respondents claimed to not have leftovers.

70 percent of respondents note that they sometimes save leftovers even if they think they will not be eaten.

TABLE 21: ACTIONS TAKEN WITH LEFTOVERS BY SURVEY RESPONDENTS									
	NASHVILLE	DENVER	NYC	TOTAL					
Leftovers are eaten as another meal without alteration	78%	76%	72%	74%					
Leftovers are used as part of another meal (other food is added)	61%	56%	60%	59%					
Leftovers are composted	13%	9%	13%	12%					
Leftovers are thrown in the garbage	24%	20%	18%	19%					
Leftovers get fed to animals	12%	16%	7%	10%					
We don't have leftovers	4%	5%	5%	5%					

While 68 percent of respondents say that they prioritize eating leftovers (see Table 38), 70 percent of respondents note that they sometimes save leftovers even if they think they will not be eaten (see Table 22). As 75 percent of respondents feel less guilty when they save leftovers than when they throw food away, and 45 percent feel less guilty about wasting food that has been in the refrigerator for a long time (see Table 42), it is possible that a substantial portion of food saved as leftovers is not, in fact, ultimately eaten by people (though it may be eaten by animals). Leftovers from restaurants are not consumed much more frequently than leftovers from meals made at home (see Table 22). Thirteen percent of respondents dislike leftovers generally.

TABLE 22: RESPONDENTS WHO "AGREE" OR "SOMEWHAT AGREE" WITH THE FOLLOWING STATEMENTS RELATED TO LEFTOVERS				
	NASHVILLE	DENVER	NYC	TOTAL
We are more likely to eat leftovers from a restaurant compared to leftovers from meals made at home	9%	12%	15%	13%
We sometimes save leftovers even if we think that we might not eat them	71%	70%	70%	70%
Saving leftovers makes me feel less guilty than throwing the food away	78%	75%	75%	75%
Generally, we do not like leftovers	11%	10%	15%	13%



A substantial amount of household food waste was generated at dinner and breakfast (see Table 23), which a majority prepared at home at least five days a week (see Table 24). Less household food waste was generated from lunch or snacks than from breakfast or dinner, possibly in part because lunch and snacks were prepared at home slightly less frequently than breakfast or dinner. Although the data do not provide enough information to determine why less waste resulted from lunch/snacks than other meals, other possibilities include less food consumed overall for those meals, either because the meals are smaller than other meals or because they are eaten less frequently (both of which would likely correspond to less food wasted); and/or types of food eaten for those meals tending to produce less preparation waste (e.g. pre-packaged snacks). Another explanation for lower waste rates for lunch/snacks might be that these meals are prepared at home but eaten elsewhere, which seems to be the case at least some of the time for lunch (see Tables 24 and 25), though not necessarily for snacks. As only at-home discards were recorded in diaries (excepting optional narrative comments on out-of-home discards), our study does not provide information that would allow us to compare at-home to out-of-home food wasting. This may suggest an area for subsequent research. One survey respondent noted, "I throw away a lot more food when I eat out than when I cook and eat at home."



TABLE 23: FOOD WASTED BY MEAL BY WEIGHT FROM KITCHEN DIARIES							
	NASHVILLE DENVER NYC TOTAL						
Breakfast	29%	22%	20%	22%			
Lunch	8%	10%	14%	12%			
Dinner	28%	33%	31%	32%			
Snacks	9%	7%	11%	9%			
Other & Multiple Meals	26%	27%	24%	25%			

TABLE 24: MEALS PREPARED OR COOKED AT HOME AT LEAST FIVE DAYS A WEEK				
	NASHVILLE	DENVER	NYC	TOTAL
Breakfast	70%	69%	66%	68%
Lunch	51%	51%	40%	45%
Dinner	67%	67%	64%	65%
Snacks	57%	59%	52%	55%

Note that food prepared at home is not necessarily the same as food eaten at home (compare Table 24 and Table 25). Although lunch is prepared at home slightly less than half the time, it is only eaten at home one-third of the time.

TABLE 25: MEALS EATEN AT HOME AT LEAST FIVE DAYS A WEEK							
	NASHVILLE DENVER NYC TOTAL						
Breakfast	71%	61%	64%	64%			
Lunch	27%	37%	33%	33%			
Dinner	69%	67%	68%	68%			
Snacks	55%	57%	53%	54%			

3.6 ACTIONS TAKEN RELATED TO WASTING FOOD AND PREVENTING WASTE

Our surveys included several questions about behaviors related to shopping for, storing, preparing, and consuming food. Food is wasted at all stages of consumer shopping, storing, preparing, and consuming, and behaviors at each stage may also influence whether a food item is ultimately eaten or discarded, so highlighting some of the behaviors respondents reported at each stage may provide insights that can help identify potential areas for intervention or education. Respondents generally do not think that changing their behavior in these areas (e.g. through planning meals ahead of time, changing food shopping habits) will result in much change in the amount of food they waste; 70 percent indicated that behavior change would likely result in little to no reduction in the amount of food they discard at home in an average week (see Table 26), although 70 percent also indicated that their household intends to reduce the amount of food thrown away (see Table 45).

TABLE 26: ASSESSMENT OF AMOUNT OF FOOD CURRENTLY DISCARDED AT HOUSEHOLD THAT COULD BE AVOIDED*

("Considering the food thrown away in your household in the average week, how much of that food disposal do you think could be avoided (e.g. through planning meals ahead of time, changing food shopping habits)?")

	NASHVILLE	DENVER	NYC	TOTAL
None	9%	10%	11%	10%
A Little	68%	63%	57%	60%
A Fair Amount	16%	21%	24%	22%
A Lot	5%	6%	5%	6%

 $^{^*}$ Percentages may not add up to 100% due to rounding and blank responses.

3.6.1 Shopping for Food

Survey respondents most often shop for food at grocery stores. In fact, 79 percent of all respondents visit a grocery store at least once per week (see Table 27). In NYC, convenience stores are the next most common shopping destination. For both Nashville and Denver, backyard gardens were cited as the second most common source of food. Eleven percent of all respondents visited a farmer's market at least once per week. In NYC, respondents were more likely to use an online delivery service for food than those in Nashville or Denver. Nashville respondents were less likely to visit a superstore than those in Denver or NYC. Note that shopping frequency does not necessarily equate to shopping volume; some destinations may be visited less than once a week for larger quantities of food (e.g. superstore), or more than once a week for smaller quantities of food (e.g. backyard garden).

TABLE 27: SURVEY RESPONDENTS SHOPPING AT LOCATION AT LEAST ONCE PER WEEK				
	NASHVILLE	DENVER	NYC	TOTAL
Grocery Store	86%	83%	75%	79%
Corner Store/ Convenience Store	11%	14%	35%	26%
Superstore	7%	17%	15%	15%
Backyard Garden	18%	24%	4%	12%
Farmers' Market	12%	7%	13%	11%
Online Delivery Service	1%	5%	10%	8%
Community Supported Agriculture	1%	3%	2%	2%
Local Garden (not at respondent's household)	1%	2%	1%	2%
Food Pantry	0%	3%	2%	2%

More than 90 percent of Nashville and Denver respondents primarily use a car owned by the household to shop for food, rather than other transportation (see Table 28). Unsurprisingly, New Yorkers were much less likely (42 percent) to use a car owned by the household for food shopping than respondents in Nashville and Denver, though they were more likely to use a borrowed car. New Yorkers were also more likely than other respondents to use public transportation or walk to shop for food, as well as to use delivery services.

TABLE 28: MODES OF TRANSPORTATION USED FOR FOOD SHOPPING BY SURVEY RESPONDENTS				
	NASHVILLE	DENVER	NYC	TOTAL
Owned Car	96%	94%	42%	63%
Walking	28%	36%	78%	60%
Delivery	13%	5%	24%	17%
Public Transportation	3%	2%	23%	14%
Borrowed Car	5%	9%	14%	11%
Bicycling	9%	13%	9%	10%

Strategies such as preparing for shopping by making lists of what is needed, checking what supplies are on hand, and only purchasing items on shopping lists can help consumers to waste less food. More than half of survey respondents reported they "always" or "often" make shopping lists, check existing supplies, and estimate the amount needed

of each item before grocery shopping, although NYC respondents were a little less likely than respondents in the other cities to do all the above (see Table 29). Fewer respondents claim to plan meals before shopping or buy only items on their shopping list while in the store; in fact, nearly a third of respondents say they "rarely" or "never" buy only items on their shopping list, and nearly a third say they "always" or "often" buy something unplanned because it looks good at the time. While nearly a third of respondents claim they "rarely" or "never" buy food

in larger quantities than needed due to the way it is packaged, because it is on sale, or because it is cheaper to buy in larger quantities, between 20 percent to 25 percent of respondents note they "always" or "often" buy food in larger quantities than needed for those reasons (see Tables 29 and 30). As one survey respondent noted, "We need to quit buying in 'bulk' since people's good intentions (cooking home-cooked meals throughout the week) can get sidetracked by hunger, something else popping up, etc., and that 'bulk' food can be forgotten."

TABLE 29: RESPONDENTS WHO "ALWAYS" OR "OFTEN" DO THE FOLLOWING BEFORE OR DURING FOOD SHOPPING					
	NASHVILLE	DENVER	NYC	TOTAL	
Make a shopping list	68%	68%	55%	60%	
Check to see what is in refrigerator/freezer and cupboards before shopping	74%	72%	65%	68%	
Plan meals before shopping	46%	49%	45%	47%	
Estimate how much of each item is needed before shopping	66%	61%	56%	58%	
Buy only items on shopping list	42%	40%	31%	35%	
Buy food in larger quantities than desired due to the way food is packaged	14%	26%	20%	21%	
Purchase more of a product than needed because it is on sale	17%	23%	19%	20%	
Purchase more of a product than needed because it is cheaper to buy in larger packages or quantities	22%	30%	24%	25%	
Purchase something unplanned because it looks good at the time	33%	29%	31%	31%	

TABLE 30: RESPONDENTS WHO "RARELY" OR "NEVER" DO THE FOLLOWING BEFORE OR DURING FOOD SHOPPING					
	NASHVILLE	DENVER	NYC	TOTAL	
Make a shopping list	12%	14%	20%	17%	
Check to see what is in refrigerator/freezer and cupboards before shopping	9%	10%	9%	10%	
Plan meals before shopping	20%	17%	17%	17%	
Estimate how much of each item is needed before shopping	14%	17%	13%	14%	
Buy only items on shopping list	28%	34%	32%	32%	
Buy food in larger quantities than desired due to the way food is packaged	28%	31%	31%	31%	
Purchase more of a product than needed because it is on sale	25%	32%	30%	30%	
Purchase more of a product than needed because it is cheaper to buy in larger packages or quantities	29%	31%	30%	30%	
Purchase something unplanned because it looks good at the time	11%	15%	16%	15%	

As one survey respondent noted, "We need to quit buying in 'bulk' since people's good intentions (cooking home-cooked meals throughout the week) can get sidetracked by hunger, something else popping up, etc., and that 'bulk' food can be forgotten."

3.6.2 Storing Food

Nearly half of respondents (48 percent) noted that their primary refrigerator is "mostly full," while the third of respondents who have a secondary refrigerator or freezer primarily indicated the secondary refrigerator or freezer was "mostly" or "half" full (see Tables 31 and 32).

TABLE 31: STATUS OF PRIMARY REFRIGERATOR*							
	NASHVILLE DENVER NYC TOTAL						
Mostly Full	38%	46%	51%	48%			
Half Full	51%	44%	38%	41%			
Fairly Empty	9%	9%	7%	8%			
Don't Have One	0%	0%	0%	0%			

^{*}Percentages may not add up to 100% due to rounding and blank responses.

TABLE 32: STATUS OF SECONDARY REFRIGERATOR OR FREEZER*							
	NASHVILLE DENVER NYC TOTAL						
Mostly Full	18%	13%	13%	13%			
Half Full	11%	17%	14%	15%			
Fairly Empty	7%	10%	6%	7%			
Don't Have One	62%	59%	63%	62%			

^{*}Percentages may not add up to 100% due to rounding and blank responses.

Survey respondents were also asked to indicate their agreement with the statement, "We clean out our refrigerator regularly (at least every other week)." Only 44 percent of respondents agreed or strongly agreed and 39 percent disagreed or strongly disagreed (see Tables 33 and 34). Less than half of all respondents said they frequently put foods that need to be used soon in a certain part of the refrigerator. This suggests that there may be a need to increase education on the use of strategies such as designating areas of the refrigerator for certain foods and regularly cleaning out refrigerators to help prevent wasting food.

	MAGUNALLE	DENIVED	NIVO	TOTAL
FOLLOWING STATEME	NTS RELATED TO) REFRIGERAT	OR USE	
TABLE 33: RESPONDE	NTS WHO "AGREI	E" OR "SOMEW	/HAT AGREE"	WITH THE

	NASHVILLE	DENVER	NYC	TOTAL
We frequently put foods that need to be used soon in a certain part of the refrigerator	39%	43%	47%	45%
We clean out our refrigerator regularly (at least every other week)	39%	51%	41%	44%

TABLE 34: RESPONDENTS WHO "DISAGREE" OR "SOMEWHAT DISAGREE"
WITH THE FOLLOWING STATEMENTS RELATED TO REFRIGERATOR USE

	NASHVILLE	DENVER	NYC	TOTAL
We frequently put foods that need to be used soon in a certain part of the refrigerator	47%	41%	36%	39%
We clean out our refrigerator regularly (at least every other week)	51%	33%	39%	39%

Although survey data showed that 89 percent of respondents keep their primary refrigerators "mostly full" or "half full" (see Tables 31 and 32), slightly more than half of respondents claimed they do not care about how full their refrigerator is (see Table 35). Slightly less than half, however, noted they feel "uncomfortable or nervous" if their refrigerator is either "too empty" or "too full." This suggests that for these respondents, the size of their refrigerator may play a role in determining how much food they purchase.

TABLE 35: RESPONSES TO "WHICH OF THE FOLLOWING BEST DESCRIBES **YOUR THOUGHTS ABOUT YOUR REFRIGERATOR?"***

	NASHVILLE	DENVER	NYC	TOTAL
It makes me uncomfortable or nervous if my refrigerator is too empty	28%	21%	23%	23%
It makes me uncomfortable or nervous if my refrigerator is too full	24%	22%	19%	20%
I don't care or don't think about how full my refrigerator is	47%	57%	54%	54%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

3.6.3 Preparing Food

Three-quarters of respondents agreed that there is at least one person in their household who is a skilled cook (see Table 36). A large majority of respondents agreed that the person in the household who most frequently prepares meals improvises meals based on what food is available, but over half also indicated that the person in the household who most frequently prepares meals usually follows a recipe when cooking. Twenty-eight percent of respondents agreed that the primary cook in the household frequently makes too much food (see Table 36), while 48 percent of respondents disagreed (see Table 37).

TABLE 36: RESPONDENTS WHO "AGREE" OR "SOMEWHAT AGREE" WITH THE FOLLOWING STATEMENTS RELATED TO FOOD PREPARATION IN HOUSEHOLD

	NASHVILLE	DENVER	NYC	TOTAL
At least one person in the household is a skilled cook	74%	74%	75%	74 %
The person in the household who most frequently prepares meals usually follows recipes when cooking	54%	54%	49%	51%
The person in the household who most frequently prepares meals improvises meals based on what food is available	87%	82%	80%	81%
The person in the household who most frequently prepares meals frequently makes too much food	21%	30%	28%	28%

TABLE 37: RESPONDENTS WHO "DISAGREE" OR "SOMEWHAT DISAGREE" WITH THE FOLLOWING STATEMENTS RELATED TO FOOD PREPARATION IN HOUSEHOLD

	NASHVILLE	DENVER	NYC	TOTAL
At least one person in the household is a skilled cook	14%	11%	11%	12%
The person in the household who most frequently prepares meals usually follows recipes when cooking	30%	29%	30%	30%
The person in the household who most frequently prepares meals improvises meals based on what food is available	11%	10%	6%	8%
The person in the household who most frequently prepares meals frequently makes too much food	59%	44%	48%	48%

More than half of respondents say they regularly engage in strategies to waste less food, including prioritizing eating leftovers and freezing food if they don't think they'll be able to eat it in time (see Table 38). Note, however, that freezing food in some cases may merely delay rather than prevent discarding it. However, respondents were less likely to try to use all parts of food items (e.g. eating "questionably edible" foods such as broccoli stalks or using bones to make soup stock). Fifty-eight percent of respondents always or most of the time remove and discard only the bruised parts of fruits and vegetables instead of the entire food, although 59 percent also prefer fruits and vegetables without blemishes (see Table 42).

TABLE 38: RESPONDENTS WHO "ALWAYS" OR "MOST OF THE TIME" DO THE FOLLOWING TO CONSERVE FOOD IN AN AVERAGE WEEK				
	NASHVILLE	DENVER	NYC	TOTAL
Remove and discard only the bruised parts of fruits and vegetables instead of throwing away the entire food	64%	59%	56%	58 %
Try to use all parts of food items (e.g. broccoli stalks, bones for soups)	43%	35%	43%	40%
Prioritize eating leftovers	79%	71%	65%	68%
Freeze food if you think you will not be able to eat it in time	59%	64%	63%	63%

TABLE 39: RESPONDENTS WHO "RARELY" OR "NEVER" DO THE FOLLOWING TO CONSERVE FOOD IN AN AVERAGE WEEK				
	NASHVILLE	DENVER	NYC	TOTAL
Remove and discard only the bruised parts of fruits and vegetables instead of throwing away the entire food	14%	13%	14%	14%
Try to use all parts of food items (e.g. broccoli stalks, bones for soups)	26%	32%	21%	25%
Prioritize eating leftovers	5%	8%	6%	6%
Freeze food if you think you will not be able to eat it in time	18%	13%	14%	14%

3.6.4 Consuming Food

Survey respondents are split evenly as to whether or not they claim to frequently prepare meals in advance to save time and 28 percent agree that they frequently eat prepared or frozen meals to save time (see Tables 40 and 41). Seventy-one percent of survey respondents agreed or somewhat agreed that when they eat out, it is on the spur of the moment or with less than 48 hours planning.

TABLE 40: RESPONDENTS WHO "AGREE" OR "SOMEWHAT AGREE" WITH THE FOLLOWING STATEMENTS RELATED TO CONSUMING FOOD				
	NASHVILLE	DENVER	NYC	TOTAL
We frequently prepare meals a day or more in advance	39%	40%	42%	41%
We frequently eat prepared or frozen meals to save time	30%	28%	28%	28%
When household members eat out it is usually spur of the moment, or planned with less than 48 hours' notice	72%	77%	68%	71%

TABLE 41: RESPONDENTS WHO "DISAGREE" OR "SOMEWHAT DISAGREE" WITH THE FOLLOWING STATEMENTS RELATED TO CONSUMING FOOD				
	NASHVILLE	DENVER	NYC	TOTAL
We frequently prepare meals a day or more in advance	42%	46%	40%	42%
We frequently eat prepared or frozen meals to save time	58%	63%	57%	59%
When household members eat out it is usually spur of the moment, or planned with less than 48 hours' notice	12%	15%	14%	14%

3.7 ATTITUDES AND BELIEFS AROUND WASTING **FOOD**

Although more than half of respondents say they regularly engage in strategies to waste less food, such as eating leftovers and freezing food, and agree that it is important to them to finish all food put on their plates for a meal (see Table 38: Respondents Who "Always" or "Most of the Time" Do the Following to Conserve Food in an Average Week), a majority also prefer fruits and vegetables with no blemishes and nearly half feel less guilty about wasting food if it has been in the refrigerator for a long time (see Table 42). More than half (58 percent) feel less guilty about wasting food if it is composted. Nearly twothirds of respondents wish they had more time to spend on preparing and cooking food, and a large majority (85 percent) agree that having regular household meals is important, and that preparing food for friends or family makes them feel good (see Table 42).

TABLE 42: RESPONDENTS WHO "AGREE" OR "SOMEWHAT AGREE" WITH THE FOLLOWING STATEMENTS RELATED TO ATTITUDES ABOUT FOOD				
	NASHVILLE	DENVER	NYC	TOTAL
I prefer fruits and vegetables with no blemishes	47%	55%	64%	59%
I feel less guilty about wasting food that has been in the refrigerator for a long time	45%	46%	45%	45%
I feel less guilty about wasting food if it is composted	66%	56%	58%	58%
It is important that we finish all food that is put on our plates for a meal	66%	59%	65%	63%
I would like to have more time to spend on preparing and cooking food	70%	58%	61%	61%
Having regular family or household meals is important	84%	86%	84%	85%
Generally, preparing food for friends and/or family makes me feel good	88%	87%	83%	85%

TABLE 43: RESPONDENTS WHO "DISAGREE" OR "SOMEWHAT DISAGREE" WITH THE FOLLOWING STATEMENTS RELATED TO ATTITUDES ABOUT FOOD

	NASHVILLE	DENVER	NYC	TOTAL
I prefer fruits and vegetables with no blemishes	33%	23%	17%	21%
I feel less guilty about wasting food that has been in the refrigerator for a long time	34%	36%	38%	37%
I feel less guilty about wasting food if it is composted	13%	15%	17%	16%
It is important that we finish all food that is put on our plates for a meal	18%	21%	18%	19%
I would like to have more time to spend on preparing and cooking food	17%	19%	19%	19%
Having regular family or household meals is important	3%	3%	4%	3%
Generally, preparing food for friends and/or family makes me feel good	4%	4%	5%	4 %

Seventy-six percent of survey respondents believe they throw out less food than the average American (see Table 44), which is comparable to findings in the study by Neff et al. 12 in which 73 percent of respondents reported that they discard less than the average American household. This result seems consistent with our respondents' beliefs (70 percent across the three cities) that they could reduce food waste in their home only a little or not at all through changes in behavior (see Table 26: Assessment of Amount of Food Currently Discarded at Household That Could be Avoided). This suggests a need for more education on consumer food waste, which should not only incorporate tips on wasting less food, but also clarify the scope and nature of the problem, especially at the consumer level.

TABLE 44: RESPONSES TO "DO YOU THINK THE AMOUNT OF EDIBLE FOOD YOU THROW OUT IS MORE THAN, THE SAME AS, OR LESS THAN THE AVERAGE AMERICAN?"*

	NASHVILLE	DENVER	NYC	TOTAL
A Lot Less	43%	41%	42%	42%
A Little Bit Less	33%	35%	34%	34%
The Same	16%	17%	15%	16%
A Little Bit More	5%	5%	5%	5%
A Lot More	1%	3%	1%	2%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

Although the majority believes they are already wasting less food than average (see Table 44), and 70 percent felt they could reduce food waste in their home only a little or not at all through changes in behavior (see Table 26: Assessment of Amount of Food Currently Discarded at Household That Could be Avoided), 78 percent of respondents nevertheless indicated their household believes that reducing the amount of food they throw away would be good, and 70 percent intend to reduce the amount of food their household throws away (see Tables 45 and 46). This perhaps indicates that although survey respondents felt they could only make minor changes in the amount of food discarded, they intended to make those changes even if small. Nearly a quarter of respondents felt that the actions of their individual household would not make a meaningful difference in the amount of food being wasted. Even though the amount of food wasted by a single household is only a small fraction of the overall amount of food wasted, reducing consumer food waste requires all households to participate, both for the cumulative impact and to help to make conserving food a social norm. These results suggest consumer education should note that the overall impact of wasting less food is not just about reducing the quantity wasted by individual households, but in creating cumulative impact, including creating a cultural shift in our attitudes and behaviors toward food, which can lead to changes farther up the supply chain as well.

Seventy-six percent of survey respondents believe they throw out less food than the average American.

These results suggest consumer education should note that the overall impact of wasting less food is not just about reducing the quantity wasted by individual households, but in creating cumulative impact, including creating a cultural shift in our attitudes and behaviors toward food, which can lead to changes farther up the supply chain as well.

TABLE 45: RESPONDENTS WHO "AGREE" OR "SOMEWHAT AGREE" WITH THE
FOLLOWING STATEMENTS RELATED TO THEIR HOUSEHOLD'S FOOD WASTE

	NASHVILLE	DENVER	NYC	TOTAL
In the past year, my household has made an effort to reduce the amount of food we throw away	53%	59%	59%	58%
My household has complete control over reducing the amount of food we throw away	68%	76%	68%	70%
People around me believe my household should reduce the amount of food we throw away	12%	16%	15%	15 %
My household believes that reducing the amount of food we throw away would be good	79%	84%	74%	78 %
My household intends to reduce the amount of food we throw away	63%	76%	68%	70%
Given the amount of food that is thrown away in this country, the actions of my household won't make a meaningful difference in the amount of food being wasted	24%	23%	24%	23%

TABLE 46: RESPONDENTS WHO "DISAGREE" OR "SOMEWHAT DISAGREE" WITH THE FOLLOWING STATEMENTS RELATED TO THEIR HOUSEHOLD'S FOOD WASTE						
	NASHVILLE	DENVER	NYC	TOTAL		
In the past year, my household has made an effort to reduce the amount of food we throw away	21%	14%	16%	16%		
My household has complete control over reducing the amount of food we throw away	14%	9%	11%	11%		
People around me believe my household should reduce the amount of food we throw away	54%	53%	53%	53%		
My household believes that reducing the amount of food we throw away would be good	5%	3%	4%	4%		
My household intends to reduce the amount of food we throw away	8%	5%	6%	6%		
Given the amount of food that is thrown away in this country, the actions of my household won't make a meaningful	61%	62%	53%	57%		

difference in the amount of food being wasted

3.7.1 Knowledge of Wasted Food Issues

A majority of survey respondents claimed to be familiar with issues related to wasted food (Table 47). Most frequently, respondents learned about wasted food through social media, word of mouth, television, documentaries, and classes/school, though several also reported learning about wasted food though radio or books (Table 48). Showings of the film "Just Eat It" were tracked specifically in Nashville, as several showings of this film in Nashville have been sponsored by NRDC's Nashville Food Waste Initiative to raise awareness locally of the issue of wasted food (12 percent of Nashville respondents reported having learned about wasted food from that film).

TABLE 47: WHETHER OR NOT RESPONDENTS ARE FAMILIAR WITH ISSUES RELATED TO WASTED FOOD*				
NASHVILLE DENVER NYC TOTAL				
Yes	70%	71%	74%	72%
No	28%	27%	25%	26%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

TABLE 48: HOW SURVEY RESPONDENTS LEARNED ABOUT WASTED FOOD				
	NASHVILLE	DENVER	NYC	TOTAL
Social Media	32%	33%	36%	34%
Online Ad	8%	4%	7%	6%
Billboard	0%	0%	3%	2%
Radio	16%	16%	15%	15%
Word of Mouth	29%	27%	34%	32%
Direct Email	9%	2%	5%	4%
Documentary	28%	28%	29%	29%
Television	20%	31%	34%	31%
Book	13%	8%	16%	13%
Class/Schooling	12%	19%	22%	20%
Showing of "Just Eat It" in Nashville	12%	N/A	N/A	N/A
Other	14%	21%	22%	21%

In addition to the above, other ways respondents cited they learned about wasted food included:

- Events hosted by NRDC
- Jobs at or research for organizations working on reducing waste and/or hunger
- Living in another country where residents cannot afford to waste food
- Family members, particularly older generations



Further, several respondents noted that for them, not wasting food is "common sense" or otherwise based on their own life experiences and knowledge. One respondent added, "I grew up with this knowledge. Is there something new?"

Awareness of the effects of wasting food in their homes was consistent across the three cities (see Table 49). A majority agreed that reducing their household's food waste would save money and reduce various environmental impacts, though respondents were less in agreement that reducing their household's food waste was connected to feeding hungry people or improving their household's health. These results may suggest that focusing public education and messaging campaigns related to reducing food waste on saving money and/or the environment will resonate more with consumers.

TABLE 49: RESPONDENTS WHO "AGREE" OR "SOMEWHAT AGREE" THAT REDUCING THEIR HOUSEHOLD'S FOOD WASTE WOULD DO THE FOLLOWING				
	NASHVILLE	DENVER	NYC	TOTAL
Save household money	88%	89%	85%	87%
Save energy	79%	74%	72%	73%
Save water	80%	68%	68%	69%
Decrease landfill use	82%	84%	81%	82%
Decrease carbon emissions	80%	73%	74%	74%
Feed hungry people	42%	43%	47%	45%
Improve household's health	47%	41%	40%	41%

3.8 COMPARING DEMOGRAPHICS, ATTITUDES AND BEHAVIOR WITH WASTED FOOD GENERATION

The following analysis compares per capita-level total and edible food waste generated (as determined by kitchen diaries) to household demographics and attitudes and behaviors collected in the first survey. To do this, simple statistical tests were used to determine if different groups of people are more or less likely to waste food in terms of food waste generation per capita. Additionally, tests were run to determine relationships between demographics, attitudes, and behaviors. For more information on the specific statistical analyses, see Appendix H: Comparing Demographics with Wasted Food Generation and Appendix I: Comparing Attitudes and Behaviors with Wasted Food Generation.

For this comparison, we found that per capita is the appropriate level of analysis compared to household, because household size confounds the correlations. Specifically, we found that many demographics are closely related to household size. For example, in our study population, households in which ethnicity of members was primarily identified as white have a lower average household size compared to non-white households. So an analysis at the household level would likely show higher food waste generation in non-white households, solely because there are more people in those households. However, doing the same analysis at the per capita level may indicate that for those two groups, food waste generation may be lower in the non-white households.

Part of the challenge underlying this research is that not much similar research has been previously conducted; as more of this type of research is conducted in the future, it will be easier to identify trends and potentially aggregate data for better extrapolation. For more information on determining statistical significance and variables tested, see Appendix H: Comparing Demographics with Wasted Food Generation and Appendix I: Comparing Attitudes and Behaviors with Wasted Food Generation. However, these analyses are still important indicators of areas where future research might yield more specific results, as highlighted in several of the examples below.

3.8.1 Comparing Demographics with Wasted Food Generation

Most of the significant relationships we found at the demographic level applied to one city only. Few of the relationships found applied to all three cities. Statistically significant relationships are detailed below. For a more complete list of variables tested and statistically significant results, see Appendix H: Comparing Demographics with Wasted Food Generation.

3.8.1.1 Comparing Household Composition with Wasted Food Generation

Household size was found to be related to amount of food wasted in all three cities, though with slight variations. The general trend is that smaller households waste more food per capita. In Nashville, single-person households waste more food per capita (total and edible) than multi-person; Nashville households with three or fewer people also waste more edible food per capita than households with four or more members. In NYC, single-person households waste more total food per capita than households with more than one member, but no such difference was found with edible food; NYC households with three or fewer people also waste more edible food per capita than households with four or more members. For all three cities, households with three or fewer people waste more total food per capita than households with four or more members.

When household size is divided into three groups (one person, two to four people, five or more people), our analysis shows that as household size increases, per capita total food waste generation decreases (see Table 50).

TABLE 50: AVERAGE FOOD WASTE GENERATION PER CAPITA IN POUNDS PER WEEK BY HOUSEHOLD SIZE (DENVER AND NYC*)				
DENVER NYC				
Living Alone	3.3 lbs/person/wk	2.9 lbs/person/wk		
2 to 4 People 2.8 lbs/person/wk 2.1 lbs/person/wk				
5 or More People I.5 lbs/person/wk I.5 lbs/person/wk				

^{*} Note that Nashville's sample size was too small to be included in this comparison.

Whether households included children under 18 was also linked in some cases with wasted food generation. For both Nashville and Denver, households without children tend to generate more wasted food per capita (total and edible) than households with children. There was no significant difference in this category for NYC. This result is interesting, as several respondents noted the effects of having children on their wasted food generation and two respondents even suggested adding a column to the kitchen diary to track items dropped on the floor or otherwise wasted by children. It is possible that, even though children are perceived as wasting more than adults, they waste less simply because they consume less. Our data do not provide a way to determine more information, so this highlights a potential area for future study.

3.8.1.2 Comparing Age with Wasted Food Generation

Our analysis found that age was sometimes related to wasted food generation, both in terms of average age of household and maximum age of household. Counter to some previous studies (e.g. Friedl and Omann, 200514), in several cases, households where maximum or average age was in the millennial range (19-34) generated less wasted food per capita than non-millennials. For example, in both Nashville and NYC, households with either maximum or average age in the millennial range (19-34) generate less total wasted food per capita as well as edible for Nashville than nonmillennials. In addition, for NYC, households with average age greater than 65 waste more total food per capita than households with average age less than 65. Analyses for Denver did not show any relationships between age and wasted food generation. For NYC, as maximum age of household increases, at least in our three groups, per capita food waste generation also increases.

TABLE 51: AVERAGE FOOD WASTE GENERATION PER CAPITA IN POUNDS PER WEEK BY AGE GROUP (NYC)			
	NYC		
Millennials (18-34) 1.9 lbs/person/wk			
Middle (35-64) 2.3 lbs/person/wk			
Older (65+) 2.5 lbs/person/wk			

To better understand these results, we also conducted statistical tests on the differences in how frequently those different age groups eat at home versus away from home; we speculated that, for example, if millennials eat out more frequently than non-millennials, it is possible they waste less food at home because they consume less food at home. Our analysis showed that, for NYC, households with a maximum age of less than 35 (millennials) are more likely to cook/prepare two or fewer dinners at home per week than households with a maximum age of 35 and above, which seems to suggest that at least for dinner, NYC millennials do eat out more. On the other hand, our analysis also showed that NYC households with a maximum age of less than 35 (millennials) are less likely to agree and somewhat agree that they eat out spur of the moment than households with a maximum age of 35 and above. This does not necessarily mean that NYC millennials do not eat dinner out more frequently than non-millennials, just that eating out is less likely to be "spur of the moment." This illuminates some potential areas for future study to better determine whether there are relationships between age, amount of food wasted at home, and frequency of eating/ preparing meals at home versus outside the home.

3.8.1.3 Comparing Race/Ethnicity, Primary Language, and National Origin with Wasted Food Generation

For the most part, race/ethnicity, primary language spoken at home, and national origin were not related to amount of food wasted. There were some limited examples of relationships between race/ethnicity and amount of food wasted. In Nashville and NYC, white households (households in which all members identify as white) waste more total food per capita than non-white households. In Denver, non-Hispanic/Latino households waste more total food per capita than Hispanic/Latino households. As neither of these differences holds true for edible food, only total food, it is not clear whether this difference is based on higher waste rates for similar foods, or whether there may be differences in types of food consumed that link to higher waste rates, for example, if different types of food tend to be eaten that generate more inedible parts (note that this type of detail is also missing from the other relationships, pointing to potential avenues for future research). Other factors may also influence these results, such as increased efficiency in feeding more people (related to our finding in Section 3.8: Comparing Demographics, Attitudes and Behavior with Wasted Food Generation that non-white households in our study had on average more members than white households). Future research might analyze different combinations of race/ethnicity, income, amount spent on food, and other factors to determine other potential correlations.

3.8.1.4 Comparing Education Level with Wasted Food Generation

We compared households where at least one person has more than a high school education to households where no member has more than a high school education. For Denver and NYC, households where the highest level of education is high school waste less food per capita (total and edible) than other households.

3.8.1.5 Comparing Income Level and Expenditures on Food with Wasted Food Generation

Income level was not shown to be related to wasted food generation. For the most part, the amount spent on food for food eaten either at home or away from home also was not related to wasted food generation. We did find in Nashville that households spending more than \$201 per week on food eaten at home generate less wasted food per capita (total and edible) than those spending less than \$201 per week; however, as the sample size of those spending more than \$201 per week on food eaten at home was quite small, these results may not be as reliable.

3.8.2 Comparing Attitudes and Behavior with Wasted Food Generation

Given the extent of our survey data, there are many different variables and many different possibilities of testing for statistically significant relationships. We tested for statistical significance using several different combinations of variables, but there are still many other possible comparisons for which we did not test. In our analysis, although some behaviors appear to be linked to wasting less food (e.g. for Denver, using a car to shop for food more than once per week was linked with wasting more food per capita), others did not show statistically significant difference in our surveys, or showed statistically significant difference in a surprising direction (e.g. for NYC, there was a statistically significant relationship between households that plan meals before shopping and higher wasted food per capita). In several cases, findings showed up for one city only and not the other two. For the most part, our data are not sufficient to determine why significant relationships may exist, so these results may highlight potential areas for future research. For a more complete list of variables tested and statistically significant results, see Appendix I: Comparing Attitudes and Behaviors with Wasted Food Generation.

For both Denver and NYC, people who say they have "a lot" or "a fair amount" (the two highest categories) of avoidable food waste do waste more food (total and edible) per capita and are also more likely to say they waste more or the same amount of food than the average American. However, we did not find a connection between respondents who believed they wasted more than the average American and food waste generation. We found no link between wasted food generation and households that know about the issue of wasted food.

For Nashville and Denver, we found no significant difference in the amount of food wasted between households that currently compost food waste versus households that do not currently compost. (Note that this comparison was between data derived from kitchen diaries on per capita food waste generation, compared to households that self-identified in the surveys as participating in composting; Section 3.5.1.2: Compost Bin Digs compared data from trash and compost collected for bin digs, so those different data sources have slightly different results.) In NYC, people who say their household composts are more likely to say they waste less than the average American, but those households waste more total food per capita than households that say they do not compost. For both Denver and NYC (Nashville was not included in this categorical analysis), people who say they compost are more likely to say they feel less guilty about wasted food if it is composted. This is reflected in our primary survey data, which showed that more than half of respondents (58 percent) feel less guilty about wasting food if it is composted (see Table 42: Respondents Who "Agree"

or "Somewhat Agree" with the Following Statements Related to Attitudes about Food).

Some statistically significant differences showed up as opposites for different cities. For example, in NYC, households that use a borrowed car for food shopping (versus those that do not) waste more food (total and edible) per capita, but in Nashville, households that do not use a borrowed car for food shopping waste more food (total and edible) per capita. Although our data do not provide sufficient information to determine why this is the case, it is possible that this is an example of geographic variation in food waste behaviors because of different lifestyles more prevalent in different areas; e.g. residents of NYC may be less likely to own cars than residents of Nashville, or to use cars for most food shopping. In another example, NYC households that always or most of the time try to use all parts of food waste more total food per capita than those that sometimes, rarely, or never use all parts of food, although Denver households that claim they sometimes/rarely/never try to use all parts of food waste more total food per capita than those who do so always or most of the time. It is possible that the relationships differ for different cities and that these and other counterintuitive results may offer more fodder for additional research.

3.9 FOLLOW-UP SURVEYS

In addition to the primary survey, which was administered before the kitchen diary period, a second follow-up survey was administered after the kitchen diary period. The second survey was much shorter and focused on changes in attitudes and motivations as a direct result of participating in the kitchen diary as well as feedback on their participation. A total of 631 respondents fully completed the second survey (71 in Nashville, 203 in Denver, and 357 in NYC).

3.9.1 Comparison between Survey I and Survey 2

A subset of questions asked in the first survey given to participants (completed before the kitchen diary period) was repeated in the second survey, given to participants upon completion of the study. The purpose of these questions was to ascertain if the completion of the kitchen diary changed respondents' perceptions of the amount of food wasted in their home and/or their attitudes towards wasted food. A total of 610 participants (71 in Nashville, 191 in Denver, and 348 in NYC) completed both surveys, and their responses were analyzed to ascertain whether they remained the same, and if not, in what direction they shifted (e.g. more strongly disagreed).

For the most part, responses to repeated questions were consistent with previous responses given, which may indicate that participating in the study did not in and of itself greatly affect those perceptions. In some instances, however, shifts in the direction of changed responses

may reflect changes in behavior or awareness because of participating in the study. For example, in the second survey, 32 percent agreed more strongly compared with their response in the first survey that in the past year, their household made an effort to reduce the amount of food thrown away; this may specifically refer to behavior occurring during study participation (see Table 52). In addition, 29 percent agreed more strongly that their household intends to reduce the amount of food thrown away, again perhaps reflecting an increased commitment to reducing food waste resulting from study participation (see Table 53). (See Appendix J: Survey 1 and 2 Comparison and Survey 2 Unique Questions for detailed comparison between the first and second surveys.)

TABLE 52: DIRECTIONAL CHANGE IN RESPONSES TO SURVEY 2 COMPARED WITH SAME QUESTION IN SURVEY I ("HOW STRONGLY DO YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENT: IN THE PAST YEAR, MY HOUSEHOLD HAS MADE AN EFFORT TO REDUCE THE AMOUNT OF FOOD WE THROW AWAY")*

	NASHVILLE	DENVER	NYC	TOTAL
Respondent agreed more strongly	42%	24%	34%	32%
Stayed the same	41%	50%	50%	49%
Respondent disagreed more strongly	17%	26%	14%	18%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

TABLE 53: DIRECTIONAL CHANGE IN RESPONSES TO SURVEY 2 COMPARED WITH SAME QUESTION IN SURVEY I ("HOW STRONGLY DO YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENT: MY HOUSEHOLD INTENDS TO REDUCE THE AMOUNT OF FOOD WE THROW AWAY")*

	NASHVILLE	DENVER	NYC	TOTAL
Respondent agreed more strongly	28%	20%	33%	29%
Stayed the same	58%	55%	50%	53%
Respondent disagreed more strongly	14%	25%	13%	17%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

In some cases, shifts in the direction of changed responses were counterintuitive; for example, when asked in the second survey whether the amount of edible food the respondent throws out is more than, the same as, or less than the average American, 62 percent of respondents retained the same answer as in the first survey, 12 percent indicated their perception of the amount of edible food they throw away compared to the average American was more than previously responded, and 25 percent indicated their



perception of the amount of edible food they throw away compared to the average American was less than previously responded (see Table 44 and Table 54). In other words, after completing the study, 25 percent of respondents believed they waste even less food compared with the average American than they had previously indicated.

TABLE 54: DIRECTIONAL CHANGE IN RESPONSES TO SURVEY 2 COMPARED WITH SAME QUESTION IN SURVEY I ("DO YOU THINK THE AMOUNT OF EDIBLE FOOD YOU THROW OUT IS MORE THAN, THE SAME AS, OR LESS THAN THE AVERAGE AMERICAN?")*

	NASHVILLE	DENVER	NYC	TOTAL
Perception of amount of edible food thrown away compared to average American increased	8%	11%	12%	12 %
Stayed the same	73%	56%	64%	62%
Perception of amount of edible food thrown away compared to average American decreased	18%	33%	22%	25%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

This unexpected result is corroborated by one of the questions unique to the second survey, which asked participants for their level of agreement with the following statement: "After measuring the food that was discarded in our household, I now believe that our household wastes more than I previously thought" (see Table 55). Although 25 percent of respondents agreed with that statement, 58 percent disagreed, meaning that more than half of respondents felt after completing the study that they wasted less than they had previously assumed. As one respondent noted, "I waste more than I want, but less than I feared."

TABLE 55: LEVEL OF AGREEMENT WITH THE FOLLOWING STATEMENT: "AFTER MEASURING THE FOOD THAT WAS DISCARDED IN OUR HOUSEHOLD. I NOW BELIEVE THAT OUR HOUSEHOLD WASTES MORE THAN I PREVIOUSLY

	NASHVILLE	DENVER	NYC	TOTAL
Agree	8%	7%	10%	9%
Somewhat Agree	17%	17%	15%	16%
Neither Agree Nor Disagree	13%	11%	19%	16%
Somewhat Disagree	20%	25%	20%	21%
Disagree	42%	39%	35%	37%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

It is possible that because of participating in the study, some participants may have wasted less food than they would otherwise through increased awareness or a sense of being scrutinized, which may have contributed to the sense that they wasted less than previously thought. As one respondent noted, "I thought we would waste more but because we were doing this study, I wanted to eat the food we have. My husband would look at expiration dates and put the food about to expire toward the front of the fridge. It made us think about it and will probably do it more in the future."

Another possibility is that in the process of measuring and assessing their own food waste, participants compared their food waste visually to other types of materials wasted. Food waste on average is heavier than other typically discarded materials of the same size (e.g. packaging), so packaging such as cardboard and plastic may appear to the respondent to be more substantial than food waste, simply because it is larger in volume. Although this study's research methods were designed to capture discards by weight, and to affect the participants' normal food discard practices as little as possible (i.e. after recording, they were expected to discard as usual, as opposed to being asked to collect discarded food separately), it is possible that perceptions of relative amounts of food wasted compared to other materials wasted may still have been affected by this difference in volume. The perception of food being a relatively small volume of discards in comparison to other materials discarded may have skewed respondents' estimation of the relative proportion of food in terms of weight, which is how municipal waste materials are generally measured. This illuminates a potential area for future study, which might examine how participants assess how much waste they discard with respect to different types of materials.

See Appendix J: Survey 1 and 2 Comparison and Survey 2 Unique Questions for detailed comparison between the first and second surveys.

3.9.2 Open-Ended Questions and Participant Feedback

The second survey also included several unique questions designed to obtain participant feedback on the residential study process and assess whether they had implemented any behavior changes because of participating in the study. Per Table 56, half of participants agreed that measuring the food discarded in their household changed how much they throw away, which may have contributed to the assessment of some of them that they discard less than previously thought, and which may also suggest that the amount of food tracked as discarded in kitchen diaries might be less than it would have been prior to the intervention of study participation.

TABLE 56: LEVEL OF AGREEMENT WITH THE FOLLOWING STATEMENT: "MEASURING THE FOOD THAT WAS DISCARDED IN OUR HOUSEHOLD **CHANGED HOW MUCH WE THROW AWAY"***

	NASHVILLE	DENVER	NYC	TOTAL
Agree	21%	18%	19%	19%
Somewhat Agree	28%	31%	31%	31%
Neither Agree Nor Disagree	17%	21%	22%	21%
Somewhat Disagree	23%	11%	12%	13%
Disagree	11%	18%	15%	16%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

Most respondents discussed the study with people both inside and outside their households. Sixty-nine percent indicated that they spoke to a member of the household "a couple of times" or "many times" because of participating in the study, while another 49 percent indicated that they spoke to someone outside the household "a couple of times" or "many times" (see Tables 57 and 58).

TABLE 57: RESPONSES TO THE QUESTION: "HOW FREQUENTLY DID YOU TALK TO A MEMBER OF YOUR HOUSEHOLD ABOUT FOOD WASTE BECAUSE **OF PARTICIPATING IN THE STUDY?"***

	NASHVILLE	DENVER	NYC	TOTAL
Never	21%	23%	18%	20%
One Time	4%	6%	13%	10%
A Couple of Times	34%	40%	37%	38%
Many Times	41%	30%	29%	31%

^{*}Percentages may not add up to 100% due to rounding and blank responses.



TABLE 58: RESPONSES TO THE QUESTION: "HOW FREQUENTLY DID YOU TALK TO SOMEONE OUTSIDE OF YOUR HOUSEHOLD ABOUT FOOD WASTE **BECAUSE OF PARTICIPATING IN THE STUDY?"***

	NASHVILLE	DENVER	NYC	TOTAL
Never	14%	29%	32%	29%
One Time	14%	20%	21%	20%
A Couple of Times	54%	42%	38%	41%
Many Times	18%	8%	6%	8%

^{*}Percentages may not add up to 100% due to rounding and blank responses.

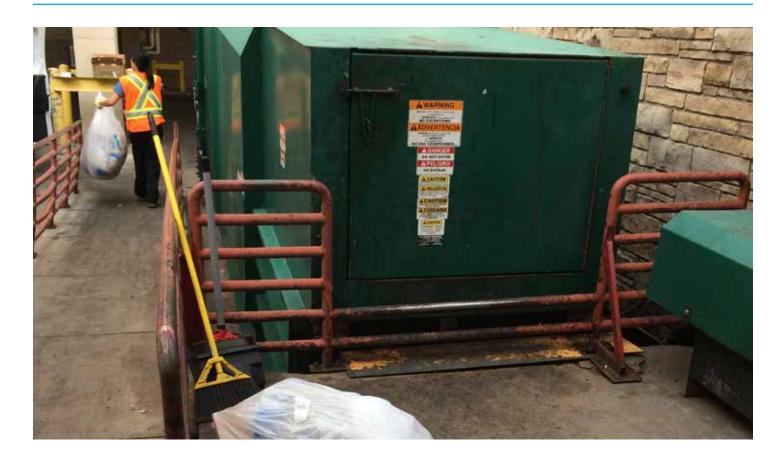
Respondents also answered several open-ended questions, including about the study process itself. When asked what (if anything) participants learned from participating in the study, more than 100 participants noted that their household wastes less food than they previously thought or is doing a good job of not wasting. Eighty-six respondents said they were more aware of the substantial quantities of food thrown away, and 38 noted that participating increased their desire to compost. Related to the hypothesis that the proportion of food relative to other materials may be perceived as smaller, one participant noted, "It's the packaging, not the food, that's the biggest waste." Several other respondents mentioned the issue of packaging and suggested it might be a more substantial source of waste than food. Similarly, other respondents suggested that household food waste is less substantial than waste in other sectors (e.g. restaurants, grocers, and schools). As one participant put it, "I think that while residential food waste is certainly a problem, it isn't THE problem. Most of the food waste comes before the

consumer takes it home." While the retail sector is one of the largest contributors to food waste along the supply chain, consumers are an equal if not greater source of food waste. 15 It is possible that, because restaurants and grocers produce more waste per location than individual households, and because some foodservice and retail practices are associated with wasting food (e.g. keeping display bins fully stocked), some respondents perceive them as a greater contributor to overall food waste. This suggests that household-level food waste prevention programs should include education on the scope of wasted food in households and the extent to which consumers contribute to the problem.

When asked what if anything would have made it easier to participate in the study, including completing the kitchen diary, most respondents (more than 200) answered "nothing," although many noted they would have liked to have had an online or electronic version of the kitchen diary and/or more space to write on the diary. Several respondents noted they appreciated the opportunity to participate and/or learn more about the issue of food waste. As one put it, "I learned that each individual is in complete control of how much food they throw away. The food we throw away directly relates to many other important factors in the world we live in today. Thank you for allowing me to be a part of this study and helping me realize the impact and control I have over the food I throw away."

For more details on the responses to Survey 2, including a sample of quotes from participants, see Appendix J: Survey 1 and 2 Comparison and Survey 2 Unique Questions.

Chapter 4: Industrial, Commercial, Institutional (ICI) **Assessment**



In addition to the residential assessment, this study also conducted an estimate of how much food is being wasted at the baseline level in the industrial, commercial, and institutional (ICI) sectors in the study cities. The description of the ICI assessment that follows includes a method of estimating the amounts of food likely to be wasted in specific sectors, including the residential sector. See Chapter 2 for more information on the complete study overview and Chapter 3 for coverage of the residential assessment.

4.1 ICI OVERVIEW

Previous studies and regional business information were used to estimate the amount of food wasted in the ICI sector in Nashville, Denver, and New York City (NYC). To groundtruth these estimates, selected ICI sector facilities in these cities had their trash (and sometimes compost) collected to determine the quantity of food wasted by food type and edibility. The purpose of these bin digs was to provide a snapshot of the waste generated by ICI sector facilities to compare results with the ICI estimates. Additionally, a short survey was administered to participating facilities to collect basic information on the

facility as well as information on their current food waste related efforts and activities. Results from the bin digs and surveys are not intended to be representative of the entire ICI sector in our study cities. Nonetheless, an assessment of this nature can help cities better understand the amount of food waste likely generated in their boundaries and develop collaborations with businesses to deploy tools and strategies to first reduce wasted food, then rescue surplus food, and finally to recycle any remaining food scraps.

4.2 ICI METHODOLOGY

The Food Loss and Waste Accounting and Reporting Standard (FLW Standard¹⁶) provides a framework for accounting for and reporting on food loss and waste. The graphics below describe the scope of the ICI estimates and the ICI bin digs using the FLW Standard.

For additional details on ICI methodology, including more details in conformance with the FLW Standard, see Appendix B: Conformance with FLW Standard (ICI), Appendix C: Baseline Assessment Field Methodology, Appendix K: ICI Bin Digs Conversion Factors, and Appendix L: ICI Estimates Conversion Factors.

FIGURE 4: BASELINE FOOD WASTE ASSESSMENT: ICI ESTIMATES (FOOD LOSS AND WASTE ACCOUNTING AND REPORTING STANDARD)

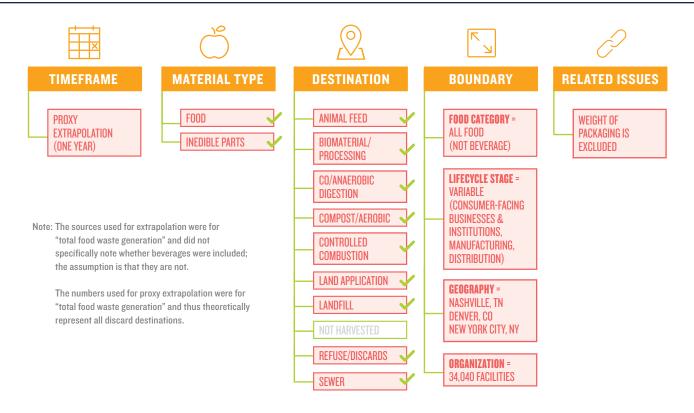
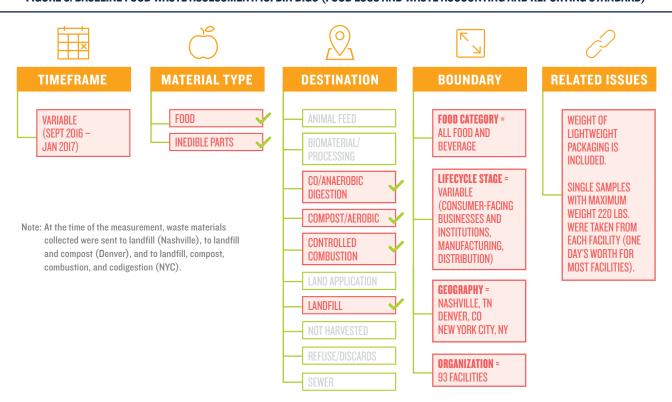


FIGURE 5: BASELINE FOOD WASTE ASSESSMENT: ICI BIN DIGS (FOOD LOSS AND WASTE ACCOUNTING AND REPORTING STANDARD)



4.2.1 ICI Baseline Food Waste Generation Estimates

The ICI food waste estimates were performed for Nashville, Denver, and NYC. Only facilities within the city limits, including all five boroughs of NYC, were considered. The estimates include edible food and its associated inedible parts, which are not separated in the analysis (i.e. there is no separate estimate for edible food). The estimates were based on proxy extrapolation, meaning in this case that we used available proxy data (e.g. number of beds, number of students, revenue) to create an estimate of food waste generation based on conversion factors from previous studies. (See Appendix B: Conformance with FLW Standard [ICI] and Appendix L: ICI Estimates Conversion Factors for more information on proxy data and methods used.) Because they are based on proxy extrapolation, the estimates do not represent a specific timeframe; however, the estimates were based on industrial, commercial, and institutional facilities operating for one year (total food waste generation in tons per year). The numbers used for proxy extrapolation are for total food waste generation and thus theoretically represent all discard destinations, although at the time of study, collected waste materials in Nashville and Denver were only sent to landfill or compost and waste materials in NYC were sent to landfill, compost, combustion, or anaerobic digestion/codigestion.

4.2.1.1 Facilities Included in Estimates

The estimates included food items discarded by the following sectors:

- Colleges & Universities
- Correctional Facilities
- Events & Recreation Facilities
- Food Manufacturing & Processing
- Food Wholesalers & Distributors
- Grocers & Markets
- Health Care (Hospitals and Nursing Homes)
- Hospitality (Hotels)
- K-12 Schools
- Restaurants & Caterers

The following types of ICI facilities were not included in the estimates, even though they may substantially contribute to total food waste generation in the cities. However, some of the following were included in bin digs. (See Section 4.2.2.1: Facilities Included in Bin Digs.)

- Convenience Stores (due to lack of information on food waste generation)
- Food Banks and Pantries (due to lack of information on food waste generation)
- Coffee Shops (due to lack of information on food waste generation)

- Airports (due to lack of information on food waste generation)
- Corporate Cafeterias (due to lack of information on food waste generation and locations)

4.2.1.2 Converting Facility-Level Information to Food Waste Estimates

To conduct ICI food waste generation estimates, information on the types of facilities in each geographic area was obtained using several databases, both public and proprietary. Information on location, sales, number of employees, number of students, square footage, and/or number of beds at each facility was obtained to estimate food waste generation, whenever possible. The information collected from the database was "cleaned" to remove duplicates, facilities outside of the sectors of interest, and facilities located outside of the city limits.

For each sector, conversion factors were used to convert facility-level information to food waste generation estimates (see Appendix B: Conformance with FLW Standard [ICI] and Appendix L: ICI Estimates Conversion Factors for lists of conversion factors). The sources were compared to other potential sources of information, including some of the limited number of food waste characterizations completed by local and state governments (see Appendix L: ICI Estimates Conversion Factors).

The main pieces of facility-level information used to estimate food waste generation for each sector are:

- Colleges & Universities (# of students)
- Correctional Facilities (# of inmates/beds)
- Events & Recreation Facilities (# of seats)
- Food Manufacturing & Processing (revenue)
- Food Wholesalers & Distributors (revenue)
- Grocers & Markets (# of employees)
- Health Care (# of beds for hospitals; revenue for nursing homes)
- Hospitality (Hotels) (# of employees)
- K-12 Schools (# of students, grade levels)
- Restaurants & Caterers (# of employees)

4.2.1.3 Limitations of ICI Estimate Data

The formulas used in these estimates should not be used to determine an individual facility's food waste generation or to identify specific facilities for outreach. The conversion factors used are sector-based averages of food waste generation. The average represents an entire sector of diverse facilities with wide-ranging food waste generation rates. Additionally, this method cannot be used to track progress in reducing food waste; the data generated by

these methods represent an estimate of sector-based food waste generation that should be used as a baseline estimate only.

The conversion factors used for this analysis were identified by the U.S. Environmental Protection Agency (EPA) in its report entitled "Technical Methodology for the U.S. EPA Wasted Food Opportunities Map (Version 1.0)". 17 (See Appendix L: ICI Estimates Conversion Factors for specific sources linked to each conversion factor.) Some of the factors were based on data and sources more than a decade old and others were based on data with a small sample size of facilities. Although these conversion factors are based on some of the best existing data, the conversion factors used in this analysis should still be used with caution. Overall, there is little research that would allow us to confidently determine whether these conversion factors are or are not indicative of industry-level averages. More research must be done to determine this.

Acknowledging that there are other potential sources of food waste generation information, we compared the EPA's conversion factors to other sources of information, including waste characterizations completed by local and state governments. A sensitivity analysis was performed for some of the facility types to determine the potential impact of specific conversion factors on the entire food waste generation estimate. Although we believe that the most appropriate conversion factors were selected for this analysis, the alternate estimations derived from the scenarios used to conduct the sensitivity analysis can be used as a range to show certainty if desired. (See Appendix L: ICI Estimates Conversion Factors for detailed scenarios and conversion factors derived from the sensitivity analysis.)

Additionally, the formulas we used were derived from food waste characterization studies, of which there have been a very limited number to date. (See Appendix L: ICI Estimates Conversion Factors for full citations for studies used in this analysis.) Many waste characterization studies do not include specific analysis of food waste separate from other organic waste, and those that do generally do not subdivide food waste into specific subcategories, such as estimates of the amount of food waste which was potentially edible or avoidable. Consequently, the formulas derived from these studies do not provide a way to estimate how much of the food generated by the ICI sector may have been edible, only estimates of total waste generated. (See NRDC's report Modeling the Potential to Increase Food Rescue: Denver, New York City and Nashville for information on how to estimate the amount of food that may be suitable for donation.)18

4.2.2 ICI Bin Digs

Bin digs were performed in Nashville, Denver, and NYC to help understand how much and what types of food are discarded from institutional, commercial, and industrial

facilities. Samples of trash and compost, when available, were collected from each facility for off-site sorting. Additionally, facilities were asked to fill out a survey which included basic information to aid in sample pickup coordination, facility characteristics such as number of employees and annual revenue, and information on current food- and food waste-related behaviors. Participating facilities received a free food waste characterization and a subsequent confidential report providing recommendations specific to their facility.

4.2.2.1 Facilities Included in Bin Digs

The following types of facilities were recruited to participate in the bin digs:

- Airports*
- Colleges & Universities
- Corporate Cafeterias*
- Correctional Facilities
- Events & Recreation Facilities
- Food Manufacturing & Processing
- Food Rescue Organizations*
- Food Wholesalers & Distributors
- Grocers & Markets
- Health Care (Hospitals)
- Hospitality (Hotels)
- K-12 Schools
- Restaurants & Caterers

*These sectors were included in bin digs but were not included in the ICI estimates, primarily due to lack of information on food waste generation.

Facilities were recruited using databases of businesses and other publicly available information; recruitment was accomplished using existing relationships and cold calls in each of the cities. In some cases, we worked with city staff to identify businesses and sectors of interest to them. Facilities provided basic information on their trash collection as well as access to their waste bins on the collection day. The facilities were recruited with the goal of working with at least one to four facilities per city from each sector listed above.

4.2.2.2 Sampling Strategy

Waste was collected from each facility on their regular trash collection day or the evening before and taken to an off-site location to be sorted by a field team. If facilities currently compost using a hauler, waste material from their compost bins was also collected and sorted. Samples of up to 200 pounds were collected from each facility. Most facilities had one day's worth or a portion of one

day's worth of trash collected. When samples collected did not represent an entire day's worth of waste material, the amount of waste that facility would typically generate in a day was estimated if possible from the proportion of total material collected and used to derive annual generation estimates, as outlined in Appendix K: ICI Bin Digs Conversion Factors. Sorting protocols and categories were the same as for residential bin digs. Facilities that discarded wasted food in ways other than trash or compost were either asked to collect those materials for our collection or provide information on their discards to other destinations.

4.2.2.3 Material Categories Used for Bin Digs

Both edible food and associated inedible parts were included in the ICI bin digs. For the bin digs, food materials were sorted into ten categories, including one for inedible parts using the definition described in Section 3.2.4: Definitions Related to Edibility. One category specifies unidentifiable food. The other eight categories subcategorize edible food. The sorting categories used for ICI bin digs were identical to the categories used for residential bin digs (see Table 2: Categories by Food Type for Bin Digs).

TABLE !	TABLE 59: CATEGORIES BY FOOD TYPE FOR BIN DIGS						
	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	Edible - Meat & Fish	Uncooked or cooked meat (with mostly edible components) unmixed with other types of food	Boneless chicken breast, salmon fillet				
3	Edible – Dairy & Eggs	Solid dairy or egg products unmixed with other food types or in original form	Cheese, yogurt, fried egg				
4	Edible – Vegetables & Fruits	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	Edible - Baked Goods	Baked goods and bread-like products unmixed with other food types or in original form, including pastries	Bread, tortillas, pastries				
6	Edible - Dry Foods	Cooked or uncooked grains, pastas, legumes, nuts, or cereals unmixed with other food types or in original form	Rice, cereal, pasta				
7	Edible – Snacks, Condiments, & Other	Includes confections, processed snacks, condiments, and other miscellaneous items	Condiments, candy, granola bars, sauces, jellies				
8	Edible - Liquids/Oils/Grease	Items that are liquid, including beverages	Sodas, milk, oil, juice				
9	Edible - Cooked/Prepared Items/ Leftovers	Items that have many food types mixed together as part of cooking or preparation	Lasagna, sandwiches, leftovers				
10	Unidentifiable	Used only if necessary					

Additionally, waste that was not food was sorted into the following categories:

- 1. Food-Soiled Paper;
- 2. Yard Trimmings;
- 3. Glass:
- 4. Recyclable Paper and Cardboard (not food-soiled);
- 5. Metals:
- 6. Rigid Plastics;
- 7. Plastic Films and Composites; and
- 8. All Other Materials.

While categorization of these materials was not the focus of the waste audit, collecting this additional information on wastage rates of commonly recyclable and other materials provides additional context and data on the types of materials found in the waste overall. (See Appendix C: Baseline Assessment Field Methodology for more details on waste sorting.)

4.2.2.4 Individual ICI Facility Reports

Each ICI facility participating in the bin digs received a confidential report including information on how much of each material was found in their trash and compost, when applicable, with additional breakdown of food waste into the ten categories listed above. The individual reports also included a narrative description of findings, as well as sample photographs of collected waste where available. In addition, the reports included city-specific general recommendations for food waste prevention, food donation, and food scrap recycling, as well as customized recommendations for each facility. Reception of these reports from participating facilities was positive, with several facilities noting they would use the findings to guide further investigation or changes to their food waste practices. A sample of the ICI facility reports can be found in Appendix M: Sample Individual Facility ICI Report.

4.2.2.5 Limitations of ICI Bin Dig Data

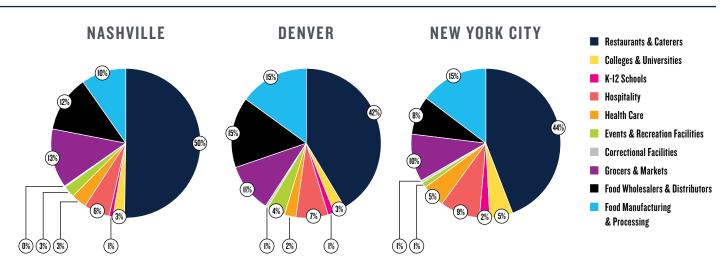
Bin digs were only conducted one time and generally represented one day's worth of waste materials from each facility. As such, these bin digs are snapshots and may not represent a facility's normal waste generation pattern. Additionally, the samples collected were a maximum of 200 pounds of material each; for larger facilities with non-homogeneous waste (e.g. grocers), a single 200-pound sample may not have been representative of that facility's waste. When it was obvious that the sampled material did not represent a facility's normal waste pattern, the bin dig results were not extrapolated. (See Appendix K: ICI Bin Digs Conversion Factors for more information on bin dig extrapolation.)

4.3 ICI ESTIMATE RESULTS

Although ICI estimates showed enough variance between the three cities to warrant separate studies for each city, some trends emerged. Each city's largest estimated contributing ICI sector to food waste generation is restaurants and caterers, with other substantial contributors including food wholesalers and distributors, food manufacturing and processing, grocers and markets, and hospitality (see Table 60). For more detailed breakdowns of each sector estimate per city, including numbers of facilities in each sector, see Appendix N: ICI Sectors.

TABLE 60: ESTIMATED FOOD WASTE GENERATED BY SECTOR (ICI ONLY)						
	NASHVILLE		DENVER		NYC	
	FOOD WASTE GENERATION (TONS/YEAR)	% OF Total	FOOD WASTE GENERATION (TONS/YEAR)	% OF TOTAL	FOOD WASTE GENERATION (TONS/YEAR)	% OF Total
Restaurants & Caterers	59,993	50%	45,158	42%	262,226	44%
Colleges & Universities	3,223	3%	2,736	3%	30,115	5%
K-12 Schools	876	1%	1,296	1%	12,895	2%
Hospitality (Hotels)	6,773	6%	7,675	7%	52,113	9%
Health Care	3,794	3%	2,683	2%	28,752	5%
Events & Recreation Facilities	2,996	3%	4,197	4%	7,520	1%
Correctional Facilities	469	0%	568	1%	2,976	1%
Grocers & Markets	15,299	13%	11,480	11%	61,310	10%
Food Wholesalers & Distributors	14,271	12%	16,757	15%	49,122	8%
Food Manufacturing & Processing	11,586	10%	15,980	15%	86,296	15%
TOTAL	119,280	100%	108,530	100%	593,325	100%

FIGURE 6: ESTIMATED FOOD WASTE GENERATED BY SECTOR (ICI ONLY)



Each city's largest estimated contributing ICI sector to food waste generation is restaurants and caterers, with other substantial contributors including food wholesalers and distributors, food manufacturing and processing, grocers and markets, and hospitality.

4.3.1 Breakdown of Restaurants and Caterers

Within the restaurant and caterer section, full service restaurants are estimated to generate the most food waste, followed by limited service restaurants ("full service"19 and "limited service"20 are used here as defined in the North American Industry Classification System, or NAICS). As the same conversion factor is used for all establishments

in this sector, this does not mean that different amounts of waste are generated based on facility type; instead, this breakdown reflects an amount of food waste generated dependent on the number of establishments in each subsector. As there are more full service restaurants in each of the three cities than any other type of restaurant or caterer establishment studied, that subsector is estimated to generate the most food waste.

TABLE 61: BREAKDOWN OF RESTAURANTS AND CATERERS						
	NASHVILLE		DENVER		NYC	
TYPE OF RESTAURANT/CATERER	FOOD WASTE GENERATION (TONS/YEAR)	% OF Total	FOOD WASTE GENERATION (TONS/YEAR)	% OF TOTAL	FOOD WASTE GENERATION (TONS/YEAR)	% OF Total
Cafeterias, Grill Buffets, & Buffets	329	1%	57	0%	2,785	1%
Caterers	2,328	4%	1,493	3%	7,392	3%
Full Service	42,389	71%	35,102	78%	205,372	78%
Limited Service	14,948	25%	8,507	19%	46,677	18%
TOTAL	59,994	100%	45,159	100%	262,226	100%

4.3.2 Adding Residential Sector Estimates to ICI Estimates

To derive full-city estimates including the residential sector, we used the average per capita total food waste generation figures from our calculations for each city, as detailed in Section 3.4.2: Quantity of Food Wasted Per Capita, and multiplied these generation factors by the population of each city (using 2016 estimates from the U.S. Census Bureau²¹). The per capita food waste generation factors and population estimates we used to calculate our combined estimate were:

Nashville:

- Food waste generation: 3.4 pounds/person/week
- Population: 660,388²²

Denver:

- Food waste generation: 4.2 pounds/person/week
- Population: 693,060²³

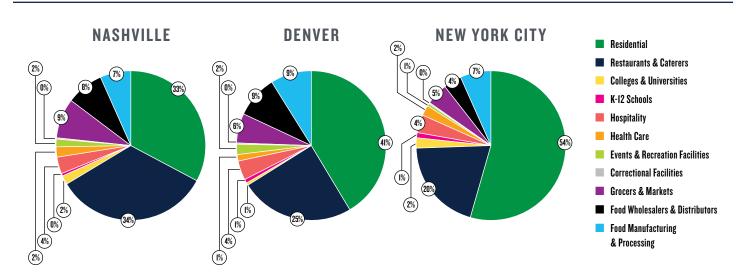
New York City:

- Food waste generation: 3.2 pounds/person/week
- Population: 8,537,673²⁴

When the residential sector is included in the sector estimates, it is the largest contributor in Denver and NYC; in Nashville, the residential sector represents a close second to restaurants and caterers, which are the largest contributor in that city (see Table 62). For more detailed breakdowns of each sector estimate per city including the residential sector, see Appendix O: ICI and Residential Combined.

TABLE 62: ESTIMATED FOOD WASTE GENERATED BY SECTOR (INCLUDING RESIDENTIAL SECTOR)						
	NASHVILLE		DENVER		NYC	
	FOOD WASTE GENERATION (TONS/YEAR)	% OF Total	FOOD WASTE GENERATION (TONS/YEAR)	% OF Total	FOOD WASTE GENERATION (TONS/YEAR)	% OF Total
Residential	58,378	33%	75,682	41%	710,334	54%
Restaurants & Caterers	59,993	34%	45,158	25%	262,226	20%
Colleges & Universities	3,223	2%	2,736	1%	30,115	2%
K-12 Schools	876	0%	1,296	1%	12,895	1%
Hospitality (Hotels)	6,773	4%	7,675	4%	52,113	4%
Health Care	3,794	2%	2,683	1%	28,752	2%
Events & Recreation Facilities	2,996	2%	4,197	2%	7,520	1%
Correctional Facilities	469	0%	568	0%	2,976	0%
Grocers & Markets	15,299	9%	11,480	6%	61,310	5%
Food Wholesalers & Distributors	14,271	8%	16,757	9%	49,122	4%
Food Manufacturing & Processing	11,586	7 %	15,980	9%	86,296	7%
TOTAL	177,658	100%	184,212	100%	1,303,659	100%

FIGURE 7: ESTIMATED FOOD WASTE GENERATED BY SECTOR (ICI AND RESIDENTIAL)



Although the residential sector and the restaurant sector are the largest estimated contributors to food waste in all three cities, these are also the sectors with the most members, which can create challenges in tackling food waste in those sectors related to the need to involve a large number of entities, each of which may be producing a relatively small amount of waste. Cities should prioritize tackling food waste based on their own resources and goals, whether to address the highest producing sectors versus those with lower waste contribution but with fewer members, how to incorporate consumer education, etc.

4.4 ICI BIN DIG RESULTS

When feasible, findings from the bin digs were extrapolated to generate annual food waste generation estimates. Two methods of extrapolation were used based on available information: 1) If the bin dig represented all or a known portion of food waste discarded for a known period of time, the amount was extrapolated for an entire year based on the number of days a facility operates per year (if the portion of waste material collected was not known, the bin dig was not extrapolated); and/or 2) If the bin dig represented all trash and/or compost materials discarded

by that facility and the facility provided annual estimates of total waste generation in their survey, the percentage of total trash or compost material that food represented by weight in the bin dig was multiplied by the estimate of total food waste generated per year. In some cases, both methods could be used to generate an estimate and numbers are presented as a range. For most cases, there was only enough information and/or the bin dig only allowed for extrapolation using one method. However, if it was evident that the sampled material did not represent a facility's normal waste pattern, the bin dig results were not extrapolated.

Using estimated annual food waste generation, conversion factors were estimated for each facility, whenever possible. As applicable by facility type, conversion factors include food waste generation per: 1) employee; 2) bed; 3) student; 4) \$ of revenue; 5) rooms; and 6) meals. (See Table 63 for examples of the ranges of conversion factors calculated by facility type, and Appendix B: Conformance with FLW Standard [ICI] and Appendix K: ICI Bin Digs Conversion Factors for the full list of conversion factors calculated.)

TABLE 63: SELECTED BIN DIG CONVERSION FACTORS BY SECTOR						
	LOW END OF RANGE	HIGH END OF RANGE				
Colleges & Universities	162 lbs/employee/yr	931 lbs/employee/yr				
Corporate Cafeterias	5 lbs/employee/yr	80 lbs/employee/yr				
Events & Recreation Facilities	150 lbs/employee/yr	4,200 lbs/employee/yr				
Food Rescue Organizations	1,823 lbs/employee/yr	10,455 lbs/employee/yr				
Health Care (Hospitals)	32 lbs/employee/yr	3,500 lbs/employee/yr				
K-I2 Schools	I2 lbs/student/yr	50 lbs/student/yr				
Restaurants & Caterers	82 lbs/employee/yr	5,200 lbs/employee/yr				

Generally, the data derived from our bin dig samples appeared to corroborate that the factors we used in our estimates were reasonable, particularly given the limited data available and wide variations in individual facility waste generation, such as shown in Table 63. The bin digs also provided some interesting insights on a sector basis. For example, the amount of wasted food generated by events and recreation facilities greatly varies, at least partly due to the varying types and uses of these facilities (e.g. events and recreation facilities participating in bin digs included sports arenas, zoos, convention centers, and special events). Large variations in waste generation also occur throughout the year in some individual facilities based on event frequency and type (e.g. sports facilities may host sports games, concerts, and other events).

Our bin digs included some sectors that were not included in our city-level food waste estimates. For example, corporate cafeterias and breakrooms were not included in the estimates due to lack of available information on food waste generation and locations. However, our bin dig results suggest that this sector could be a substantial generator of wasted food. Food rescue organizations were also not included in our city-level food waste estimates due to lack of available information on food waste generation. Although this sector is not likely to be a large generator of food waste, our bin dig results suggest that individual facilities within this sector may also be substantial generators of wasted food. (See Appendix K: ICI Bin Digs Conversion Factors for more information on bin dig results.)

Chapter 5: Selected Recommendations for Cities Based on Research Findings



Cities today are increasingly focused on using data for decision-making and policy development. Many cities are more aggressively collecting data as well as ensuring data are open source and transparent. For any city wishing to reduce the amount of food wasted, estimating a baseline of amounts currently being wasted is a critical first step. Without understanding some basic information about how much food is being wasted and where that waste occurs, it is challenging to assess progress and to develop plans to tackle food waste, which should ideally follow the EPA Food Recovery Hierarchy in prioritizing prevention and rescue over other strategies. Developing detailed assessments which provide insight on food wasted by sector, by discard destination, by loss reason, and by food type, including breakdowns of edible, avoidable, and/ or rescuable food, provide additional data that can help in structuring effective interventions to reduce wasted food. For example, if a city is considering initiating or expanding food scrap recycling, before allocating resources to expanding recycling collection or infrastructure, the city should first consider to what extent the need for food scrap recycling might be reduced by allocating resources to preventing wasted food in the first place and to rescuing surplus food. The templates and tools available from this baseline food waste research can be used by cities to conduct their own assessments of the amounts and types of food wasted in their municipality. The findings can help cities identify interventions and strategies to limit the amount of food wasted.

Similarly, few cities have tried to estimate how much surplus food beyond what is currently being donated could potentially be rescued and directed to people in need. Having data on this untapped potential clarifies the scale and sources of rescuable food and, along with information on what types of surplus food are currently needed in the community, can inform strategies for increasing participation in food donation efforts and bolstering food rescue infrastructure. It also highlights what portion of the city's "meals gap" could potentially be addressed through increased food donation from preconsumer surplus. See NRDC's report Modeling the Potential to Increase Food Rescue: Denver, New York City and Nashville for more information on conducting a food rescue assessment.²⁵

In addition to conducting a city-wide baseline food waste assessment and food rescue assessment, our study illuminated some areas where cities might be able to provide education, tools, or other resources to help address the problem of wasted food. Note that the recommendations provided here are not a comprehensive list of recommendations for cities wishing to address wasted food; this is a limited set of recommendations deriving from our report findings. Please see NRDC's wasted food resources²⁶ for additional information. Cities should also consider working with federal agencies, state agencies, and other cities to collaborate on sharing and developing tools, resources, and infrastructure that can be customized by municipalities.

5.1 RECOMMENDATIONS FOR CITIES REGARDING OUTREACH TO RESIDENTIAL SECTOR

Seventy-six percent of all residential survey respondents in all three cities believe they waste less food than the average American, showing the need for increased consumer outreach and educational campaigns on food waste. Cities should provide consistent information in multiple locations (e.g. on city websites, in advertising space, on public transit vehicles/kiosks) for residents on the scale of the problem of food waste, as well as on how to waste less food (including tips on shopping, storing, cooking, and composting food). Resources that can be useful for city-based food waste consumer education include Save the Food²⁷ and Food: Too Good to Waste.²⁸

Several survey respondents noted that they believe household food waste is not as great of a contribution to overall food waste as waste in retail and other sectors, with restaurants and groceries specifically mentioned. This suggests that household-level food waste prevention programs should include education on the scope of wasted food in households and the extent to which consumers contribute to the problem. In addition, nearly a quarter of our survey respondents felt that the actions of their individual household would not make a meaningful difference in the amount of food being wasted. Even though the amount of food wasted by a single household is only a small fraction of the total amount of food wasted across the supply chain, this suggests consumer education should note that the overall effect of wasting less food at the consumer level is not just about reducing the quantity wasted by individual households, but about creating a cultural shift in attitudes and behaviors toward food, which can lead to changes farther up the supply chain as well.

Most survey respondents agreed that reducing their household's food waste would save money and reduce various environmental impacts, though respondents were less in agreement that reducing their household's food waste was connected to feeding hungry people or improving their household's health. These results may suggest that focusing public education and messaging campaigns related to reducing food waste on saving money and/or the environment will resonate more with consumers.

The data collected on the most commonly wasted foods can be used to guide specific consumer educational campaigns or outreach. For example, coffee is one of the most frequently wasted foods at the household level; outreach/ education on how to reduce food waste could include tips on how to waste less coffee (e.g. by refrigerating excess coffee, freezing coffee in ice cube trays, or making smaller quantities). Additionally, many of the most wasted food categories related to fruits or vegetables, including parts considered questionably edible, although many respondents incorrectly identified those parts of food wasted as inedible. Given that a majority (68 percent, per Section

3.4.3: Wasted Food by Edibility) of wasted food tracked in diaries was potentially edible, including questionably edible, outreach/education could also focus on providing information on how to use those parts of food.

Cities with composting programs should make sure to incorporate messaging about the importance of preventing wasted food into their composting outreach. Our research indicates that people tend to feel less guilty/concerned about wasting food if they compost it. Additionally, in NYC, households participating in composting or organics collection were more likely to generate higher quantities of wasted food in total than those not participating in composting. Consequently, composting outreach should highlight that preventing food waste is preferable to composting it, to help counter a potential increase in the amount of food wasted overall arising from adding or expanding food scrap recycling at the city level. Further, outreach and education on composting could include not just information regarding city-provided food scrap recycling and wasted food prevention, but also information on home composting, which keeps food scraps out of the municipal system entirely, saving resources associated with transportation and processing.

5.2 RECOMMENDATIONS FOR CITIES REGARDING **WORKING WITH ICI SECTOR**

The tools and estimates provided in this report can serve as a guide to cities in conducting their own research, or at minimum, using our research to provide a rough baseline estimate of how much food waste is estimated to occur in each ICI sector. Cities conducting their own research should use our tools and refer to the Food Loss and Waste Protocol²⁹ for additional tools and guidance on assessing food loss and waste. Estimating how much food waste is likely occurring in each ICI sector can be matched with a city's goals to direct efforts in line with the food recovery hierarchy to subsectors where those efforts will be most effective in reducing waste and leveraging city resources. For example, if a city is interested in working with an entire sector to reduce the most food waste overall at the city level, then targeting restaurants, which were the highestgenerating ICI sector in our study cities, might make the most sense (e.g. through a mayoral restaurant food waste challenge). If the city has fewer resources and is hoping to target only a few key generators, they should use the ICI data to determine where to get the most "bang for the buck" (e.g. event centers). If the city is already working with a sector on other food policy initiatives, it may make sense to add food waste to that programming.

5.2.1 Support for Food Rescue Organizations

One area where cities might be able to assist in reducing the discarding of food (and potentially increasing the usable portion of donated food) is to provide assistance and resources to food banks. Although they are not necessarily among the largest generators of food waste, food banks are occasionally unable to use food that is donated to them, and are put in the position of needing to landfill a portion of the food they receive; this means that some of the food that is considered "donated" (and therefore diverted from landfill) by donor organizations ends up in the landfill. Sometimes food banks divert non-usable food to composting, but often packaged food in particular must be landfilled, as food banks do not have the capability to depackage the food (which is generally required for composting). Cities can work with food banks to find ways to provide depackaging equipment, improve donation quality, or otherwise determine ways to reduce the amount of food needing to be discarded by food banks. Cities can also work with rescue organizations to assess what types of food are currently needed in the system and help identify ways to maximize or expand existing rescue infrastructure where specific needs are identified.

5.2.2 Increasing Donations of Surplus Food

Cities can catalyze increased donation of food surpluses through strategies such as:

- Streamlining and disseminating City Health Department guidance on donating food safely (e.g. see the guidance for Nashville developed through NRDC's Nashville Food Waste Initiative³⁰)
- Training and engaging health inspectors to encourage food donation
- Raising awareness among area businesses about food insecurity issues and the potential benefits of donating
- Providing grants and other assistance to increase food recovery infrastructure in the community

5.2.3 Conducting On-Ground ICI Assessments

If a city is interested in doing on-ground ICI food waste assessment studies, particularly bin digs, these studies may need to be tailored by sector to be most effective. For example, larger facilities with non-homogeneous waste (e.g. grocers) are difficult to analyze effectively with a single sample bin dig - the different types and quantities of waste generated may need to be analyzed via several samples, larger samples, samples taken at different times/ days, etc. to provide a complete and accurate picture of the amounts and types of food discarded.

5.2.4 Sample Recommendations for Cities to **Provide to Businesses**

Cities can provide information to businesses on ways to waste less food, including specific ways they can leverage city resources to reduce the amount of food discarded,

which ideally will help businesses save money as well as reduce ecological impacts. For example, cities can make available on their websites recommendations for businesses such as the following general recommendations we provided for NYC ICI facilities participating in bin digs. Denver and Nashville received similar recommendations with customization for the individual city where appropriate. (See Appendix M: Sample Individual Facility ICI Report for a complete sample of an individual facility report template.)

SAMPLE RECOMMENDATIONS FOR NYC

- PREVENT WASTED FOOD: Preventing food from being wasted in the first place is the best way to save your business money while benefiting the environment. Measuring wasted food will empower your staff to better manage this issue. For more information, see the Environmental Protection Agency's Tools for Assessing Wasted Food³¹ and Leanpath³² for software to track the amounts, causes and costs of wasted food in institutional foodservice and restaurant environments. Educating your customers and staff can also help reduce food waste; consider participating in Save the Food,³³ a national public service campaign on food waste.
- DONATE SURPLUS FOOD: Donating food can yield valuable tax benefits, is protected from liability by federal law, and is a way your business can help address food insecurity in NYC. Organizations that receive or help direct donated food in NYC include City Harvest,34 Rock and Wrap it Up,35 and Rescuing Leftover Cuisine.³⁶ You can also check out the City of New York directory³⁷ to find food pantries.
- RECYCLE FOOD SCRAPS: After maximizing waste prevention and food donation, you can help keep food waste out of the landfill by sending it to a composter or anaerobic digester. As of July 19, 2016, certain New York City businesses are required by law to separate their organic waste (see the DSNY website³⁸ for more information). Businesses covered by this law are given the option to arrange for collection by a private carter, transport organic waste themselves, or process the material on site (e.g. through composting or anaerobic digestion). Businesses both covered by and exempt from the organics separation requirement may find this resource sheet³⁹ useful.

For more information on the environmental impacts associated with food waste, please see NRDC's food waste resources.40

5.3 RECOMMENDATIONS FOR CITIES FROM RESIDENTIAL STUDY PARTICIPANTS

Residential study participants also offered some suggestions for cities. Our second residential survey asked the open-ended question, "What do you think [your city] can do to help residents waste less food?" A summary of the most frequently suggested types of ideas for each city (including the number of respondents who made similar suggestions), along with a sample of comments, is below (also see Appendix J: Survey 1 and 2 Comparison and Survey 2 Unique Questions). Note that while most respondents offered some suggestions that could be implemented by cities, several also expressed that they weren't sure what a city could do to reduce food waste because it was more of an individual issue. Many suggestions also pertained to organics recycling, while suggestions regarding prevention were not mentioned as frequently. Both of those examples highlight the need for cities to prioritize focus on the importance of prevention and implementation of prevention strategies.

5.3.1 Responses to "What do you think Nashville can do to help residents waste less food?"

- Provide education on issues of food waste (28) respondents), e.g.
 - Promote awareness of food waste through the Mayor's office and issue a challenge for the community to strive to reduce food waste
 - Focus on education in elementary schools
 - Promote outreach through neighborhood association groups
- Provide tips for reducing food waste (10 respondents),
 - Smaller and more frequent shopping trips
 - Meal planning
 - Date labels
- Composting or anaerobic digestion (20 respondents), e.g.
 - Make cheaper
 - Make available city-wide
 - Offer deals on compost bins
 - Provide neighborhood compost sites
- Make it possible to buy food in smaller portions in stores and restaurants, especially for small households (4 respondents)

"They could start an ad campaign with slogans like: 'Save your cash, don't throw food in the trash!', 'Food didn't come to Nashville for a bachelorette party, don't let it get wasted!', or 'Truth be told, that bread is old, but it still is viable if you scrape off the mold!""

"Educate Nashvillians on what the causes of wasted food are and what the consequences of that are- I need suggestions for creating less waste that is the result of inedible parts of fruits and vegetables. It would also be helpful if there were smaller portions that meet the needs of single households available when purchasing fruits like melon and vegetables like spinach."

"Nashville needs to make healthy food more affordable, so people don't have to wait until it goes on sale and 'stock up.' That leads to waste (at least in our household)."

5.3.2 Responses to "What do you think Denver can do to help residents waste less food?"

- Provide education on issues of food waste (57) respondents)
- Provide tips for reducing food waste (14 respondents)
- Composting (71 respondents), e.g.
 - Make cheaper or free
 - Make available city-wide
- Make it possible to buy food in smaller portions in stores and restaurants, especially for small households (7 respondents)
- Do more studies and surveys on food waste (9 respondents)
- Don't really know how a city can help since it is more of an individual issue (4 respondents)
- Provide incentives (3 respondents)
- Focus on restaurants and grocers to reduce food waste (6 respondents)

"Currently we pay a separate fee to have curbside compost pickup. We think it should be included in our current waste management fees for trash and recycle pickup. It might encourage more people to participate."

"Reminders in the produce section of the store of how long certain items may last in the fridge and maybe a fun campaign that includes in-store reminders to buy what you need. "

"I think a huge part of food waste stems from restaurants and grocery stores. I think there need to be more programs in place for food that is wasted from those venues, to disseminate those products to people who might need them."



"I think that while residential food waste is certainly a problem, it isn't THE problem. Most of the food waste comes before the consumer takes it home. I've volunteered with Denver Food Rescue and seen how much grocery stores get rid of that is still 100 percent edible EVERY DAY and I know that even more (especially produce) never even makes it to the grocery store because it isn't pretty enough."

5.3.3 Responses to "What do you think New York City can do to help residents waste less food?"

- Provide education on issues of food waste (77 respondents), e.g.
 - Education in schools
 - Billboards, ads, etc.
- Provide tips for reducing food waste (19 respondents)
- Composting (81 respondents), e.g.
 - Make cheaper or free
 - Make available city-wide
- Make it possible to buy food in smaller portions in stores and restaurants, especially for small households (19 respondents)
- Do more studies and surveys on food waste (11 respondents)

- Don't really know how a city can help since it is more of an individual issue (5 respondents)
- Focus on restaurants and grocers to reduce food waste (8 respondents)

"Run ads kind of similar to the ones in the early 2000's: like the one with the dinosaurs that taught kids to not let the water run while brushing your teeth, or the talking trash cans that taught you how to recycle cardboard, plastic and metal. Something actually fun and not guilt trippy?"

"Make it easier to compost and recycle —like many NYCers I live in a small place and mice and cockroaches come up often. That means we keep our trash on a specific counter. Since we have to already split up our paper recycling, and have trash, there is no room for four bins!!! When we lived in San Francisco and we could throw all recycling in one bin, we composted a lot more often."

"The problem is the grocery stores—it can be hard to buy some things in small quantities."

"Make it easier to buy fresh food more frequently, discouraging bulk/excess purchasing. More blame is on the retail economy than the consumer."

"Make them aware of the size of the total problem. Make it clear that even though it seems that each family's waste is a tiny percentage of the whole, it all adds up, so everyone should do their bit. It's the same idea as voting, or lowering the amount of electricity, gas and gasoline we use."

6. Opportunities for Future Research



The issues surrounding food waste are complex: food is wasted in all stages of the food supply chain, including farms, manufacturers, retailers, and consumers. Food waste intersects with several complex systems that range from hyperlocal to international, including food systems and waste systems; surplus food is a social issue (including access to food and impacts of economic inequity), an environmental issue (including upstream and downstream impacts), and a financial issue (including costs of inefficiencies borne by governments, businesses, and consumers). Nonetheless, wasted food as an issue of concern is a relatively new concept; there is still much room for research and analysis related to the many facets of the problem.

Part of the challenge underlying the research for this report is that not much similar research has been previously conducted, especially in the United States. More research is needed to help analyze and measure wasted food in consistent ways that enable action across the entire hierarchy of preventing and diverting wasted food. Most current municipal diversion policies and

waste characterizations of food waste tend to help drive food waste recycling, but are less helpful in prioritizing and assessing success in wasted food prevention and the redistribution of surplus food. To achieve the broadest environmental benefits related to wasting less food, municipalities should conduct research on and set goals related to reducing the total generation of wasted food (not just disposal), as well as climate goals that address more impacts from wasted food than just landfill methane. As more research in this vein is conducted in the future, it will be easier to identify trends and potentially aggregate data for better extrapolation.

6.1 OPPORTUNITIES FOR ADDITIONAL RESIDENTIAL RESEARCH

Conducting the baseline food waste assessment illuminated many potential areas for future study, several of which have been highlighted throughout this report. Some of these opportunities related to the residential sector are summarized below.

6.1.1 Conducting Additional Comparisons Using NRDC Data

The data we collected for this report may yield more information in the future, as we discover more ways to interpret and compare our findings. Given the extent of our baseline assessment data, there are many different variables and many different possibilities of testing for statistically significant relationships. We tested for statistical significance using several different combinations of variables, but there are still many other possible relationships for which we did not test, and many other variables for which it is possible to test. For example, comparisons could be conducted by grouping participants based on responses (e.g. grouping people based on their food beliefs and behaviors instead of on traditional demographics). In addition, when testing for statistically significant relationships, our data were not always sufficient to determine why relationships may exist, so these results may highlight potential areas for future research. (See Section 3.8: Comparing Demographics, Attitudes and Behaviors with Wasted Food Generation for discussion of statistically significant relationships from survey data.)

6.1.2 Further Understanding Edibility and **Questionable Edibility**

Our definitions of edibility—in particular, questionable edibility—may suggest further avenues for research on what exactly consumers consider edible, perhaps in conjunction with educational campaigns focusing on "questionably edible" food and how to use that food. (See Section 3.2.4: Definitions Related to Edibility.)

6.1.3 Impacts Related to Beverages

This study, unlike most previous studies of wasted food, tracked beverage discards as well as food discards. There may be an opportunity to research further the extent to which beverages are discarded; e.g. coffee was identified as a frequently wasted item in our study, but this may be influenced by the relative weight of coffee grounds (in the case of total food wasted) as well as by methods of making coffee or habits pertaining to coffee consumption. Studies focusing more on details of beverage preparation, consumption, and discard may illuminate more nuances related to discarding beverages.

6.1.4 Effect of Composting on Amount of Food Wasted

Although the small number of our compost samples limited our ability to derive relationships between composting and wasting food, it appeared from our bin dig data that the households participating in city composting did dispose of less food in the trash than households not participating in city composting. What we were unable to determine, however, was whether the composting households discarded less food overall (to compost and trash combined) than the households not participating in city composting. In contrast, from kitchen diary and survey data, households in NYC that identified as composting wasted more total food per capita (sent to all destinations) than households that did not identify as composting. Particularly because the data from our survey indicates that more than half of respondents (58 percent) feel less guilty about wasting food if it is composted (see Table 42: Respondents Who "Agree" or "Somewhat Agree" with the Following Statements Related to Attitudes about Food), this highlights a potential area for future research. (See Section 3.5.1.2: Compost Bin Digs for more discussion of the bin dig data pertaining to compost, and Section 3.8.2: Comparing Attitudes and Behaviors with Wasted Food Generation for comparisons between kitchen diaries and surveys regarding compost.)

6.1.5 Effect of Refrigerator/Freezer Cleaning and Storage on Amount of Food Wasted

Based on kitchen diary data, it is likely that very few respondents performed refrigerator clean-outs during the study period; survey data also indicated that only 44 percent of respondents agree that they perform refrigerator clean-outs at least every other week (see Table 33: Respondents Who "Agree" or "Somewhat Agree" with the Following Statements Related to Refrigerator Use). One hypothesis for the low frequency of date labels as a reason for discarding food is that date labels are more frequently used to determine whether or not to throw out food during refrigerator clean-outs, as compared to regular daily activity. Our study also did not track freezer cleanouts; it is possible that a substantial quantity of the food respondents noted they froze before the date on the label may have been ultimately discarded even if frozen first. More research on the impacts of date labels, particularly related to refrigerator or freezer cleanouts, might further clarify how and when date labels are used by consumers to determine whether food should be eaten. (See Section 3.5.2.1: Date Labels.)

6.1.6 Comparing In-Home to Out-of-Home Food Wasting

As only at-home food waste discards were recorded in diaries (with the exception of optional narrative comments on out-of-home discards), our study does not provide information that would allow us to compare at-home to out-of-home food wasting. This may suggest an area for subsequent research. (See Section 3.5.3: Food Wasted by Meal.)

6.1.7 Influence of Merchandising on Food Shopping

Some wasting of food at the consumer level is related to packaging, unit sizes, merchandising, and other factors that may influence shopping for food (see, for example, Section 3.6.1: Shopping for Food). Better understanding how these factors influence consumer behavior can help in designing effective interventions.



6.1.8 Influence of Primary Food Decisionmaker **Relative to Household Food Waste**

Most survey respondents noted that there is at least one person in their household who is a skilled cook, and that the household member who most frequently prepares food most often improvises meals based on what food is available. Nearly one-third of respondents felt that the primary cook in the household frequently makes too much food (see Section 3.6.3: Preparing Food). There may be additional opportunity to research the extent to which one household member makes the bulk of decisions related to household food preparation, with an eye toward opportunities to develop tools and programming targeting these household decision-makers.

6.1.9 Effect of Children on Wasting Food

In our analysis, for both Nashville and Denver, households that did not include any children (persons under 18) tended to generate more wasted food per capita (total and edible) than households with children. There was no significant difference in this category for NYC. This result is interesting, particularly as several respondents noted the effects of having children on their wasted food generation (two respondents even suggested adding a column to the kitchen diary to track items dropped on the floor or otherwise wasted by children). This highlights a potential area for future study, particularly given that other studies (e.g. Friedl and Omann, 200541) have found that families with younger children report greater amounts of food waste. (See Section 3.8.1.1: Comparing Household Composition with Wasted Food Generation.)

6.1.10 Relationships Between Age and Behaviors Related to Wasting Food

Our analysis found that participant age was sometimes related to wasted food generation, both in terms of average age of household and maximum age of household. Interestingly, in several cases, households where maximum or average age was in the millennial range (19-34) were

shown to generate less wasted food per capita than non-millennials. We also conducted statistical tests on the difference between how frequently those different age groups eat at home versus away from home; for NYC, households with a maximum age of less than 35 (millennials) are more likely to cook/prepare two or fewer dinners at home per week than households with a maximum age of 35 and above, which seems to suggest that at least for dinner, NYC millennials do eat out more. On the other hand, our analysis also showed that NYC households with a maximum age of less than 35 (millennials) are less likely to agree and somewhat agree that they eat out spur of the moment than households with a maximum age of 35 and above. This does not necessarily mean that NYC millennials do not eat dinner out more frequently than non-millennials, just that eating out is less likely to be "spur of the moment." This illuminates some potential areas for future study to better determine whether there are relationships between age, amount of food wasted at home, and frequency of eating/preparing meals at home versus outside the home. (See Section 3.8.1.2: Comparing Age with Wasted Food Generation.)

6.1.11 Relationships Between Race/Ethnicity, Income and Behaviors Related to Wasting Food

We found some limited examples of relationships between race/ethnicity and amount of food wasted. In Nashville and NYC, white households (households in which all members identify as white) waste more total food per capita than non-white households. In Denver, non-Hispanic households waste more total food per capita than Hispanic households. As neither of these differences holds true for edible food, only total food, it is not clear whether this difference is based on higher waste rates for similar foods, or whether there may be differences in types of food consumed that link to higher waste rates, for example, if different types of food tend to be eaten that generate more inedible parts (note that this type of detail is also missing from the other relationships, pointing to potential avenues for future research). Other factors may also influence these results, such as increased efficiency in feeding more people (related to our finding in Section 3.8: Comparing Demographics, Attitudes and Behaviors with Wasted Food Generation that non-white households in our study had on average more members than white households). Future research might analyze different combinations of race/ethnicity, income, amount spent on food, and other factors to determine other potential correlations. (See Section 3.8.1.3: Comparing Race/Ethnicity, Primary Language, and National Origin with Wasted Food Generation.)

6.1.12 Additional Research on Attitudes and Behaviors Related to Wasting Food

Some statistically significant relationships between attitudes and behavior and wasted food generation showed

up as opposites for different cities. For example, in NYC, households that use a borrowed car for food shopping (versus those that do not) waste more food (total and edible) per capita, but in Nashville, households that do not use a borrowed car for food shopping waste more food (total and edible) per capita. In another example, NYC households that always or most of the time try to use all parts of food (versus those that do it sometimes, rarely, or never) waste more total food per capita, while Denver households that claim they sometimes/rarely/never try to use all parts of food waste more total food per capita. While it is possible that the relationships differ for different cities, it is also possible that these and other seemingly inconsistent results may offer more fodder for additional research. (See Section 3.8.2: Comparing Attitudes and Behaviors with Wasted Food Generation.)

6.1.13 Contextualizing Self-Reporting of Amounts of Food Wasted

After completing the study, 25 percent of respondents to the second survey indicated that their perception of how much food they waste compared with the average American was less than they had previously indicated. Several respondents also mentioned that they believed packaging waste was more substantial than food waste. The perception of food being a relatively small volume of discards in comparison to other materials discarded may have skewed respondents' estimation of the relative proportion of food in terms of weight, which is how municipal waste materials are generally measured. This illuminates a potential area for future study, which might examine how participants assess how much waste they discard with respect to different types of materials. (See Section 3.9.1: Comparison between Survey 1 and Survey 2 for more discussion of comparisons between the two surveys.)

6.2 OPPORTUNITIES FOR ADDITIONAL ICI RESEARCH

Conducting the baseline food waste assessment illuminated many potential areas for future study, several of which have been highlighted throughout this report. Some of these opportunities related to the ICI sector are summarized below.

6.2.1 Conversion Factors for ICI Sectors

The conversion factors we used for our ICI estimate were identified by the U.S. Environmental Protection Agency in their report "Technical Methodology for the U.S. EPA Wasted Food Opportunities Map (Version 1.0)."42 The conversion factors used are sector-based averages of food waste generation. The average represents an entire sector of diverse facilities with wide-ranging food waste generation rates. In addition, some of the factors were based on data and sources more than a decade old and others were based on data with a small sample size of

facilities. While these conversion factors are based on some of the best existing data, there is very little research that would allow us to confidently determine whether EPA's conversion factors are or are not indicative of industrylevel averages. More research must be done to determine this. (See Section 4.2.1.2: Converting Facility-Level Information to Food Waste Estimates for more discussion of the limitations of ICI estimate data.)

6.2.2 Researching Additional ICI Sectors

Our bin digs included some sectors that were not included in our city-level food waste estimates, even though they may substantially contribute to total food waste generation in the cities:

- Convenience Stores (due to lack of information on food waste generation)
- Food Banks and Pantries (due to lack of information on food waste generation)
- Coffee Shops (due to lack of information on food waste generation)
- Airports (due to lack of information on food waste generation)
- Corporate Cafeterias (due to lack of information on food waste generation and locations)

For example, corporate cafeterias and breakrooms were not included in the estimates due to lack of available information on food waste generation and locations. However, bin dig results suggest that this sector could be a substantial generator of wasted food. Food rescue organizations were also not included in our city-level food waste estimates, due to lack of available information on food waste generation. Although this sector is not likely to be a large generator of food waste, our bin dig results suggest that individual facilities within this sector may also be substantial generators of wasted food. More study is merited to acquire data on food waste generation in these sectors. (See Sections 4.2.1.1: Facilities Included in Estimates and 4.4: ICI Bin Dig Results for more discussion of sectors that were or were not included in our analysis.)

6.2.3 Edibility and Loss Reasons in ICI Sector

Our ICI estimates did not provide the ability to break down estimated baseline food waste generation by edibility. Although NRDC separately researched and published methods for estimating the amount of food from ICI sectors that may be suitable for rescue/donation, there still may be some need to estimate how much food generated in ICI sectors was potentially edible, with an eye toward identifying possible reduction strategies. Another way to approach this area of research may be to focus on determining the reasons for food loss or waste in ICI sectors.

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