

# New York State Pollution Prevention Institute

**RIT** | Golisano Institute for  
**Sustainability**

*Final Report for:*

## ***New York State Department of Environmental Conservation***

### ***Guidance for Waste Estimation of Food Scraps Generators***

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## **Disclaimer and Funding Statement**

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This report on Guidance for Waste Estimation of Food Scraps Generators (the “Report”) was created by RIT’s NYSP2I under the funding and direction of the NYSDEC as part of NYSP2I’s plan of work and upon request from NYSDEC. All sources, reviews, data, and estimated food waste figures or methodologies used by NYSP2I are described and cited in the Report. Generally, the data and methodologies used were obtain by publicly available sources or commercially available sources, standard estimating practices, and other methods described in the Report. The opinions, results, findings and/or interpretations of the statements contained herein as a part of this Report are intended for information purposes that can be used and cited by the NYSDEC, stakeholders, and food waste generators in New York State. The accuracy, findings, and suggestions in the Report are the sole responsibility of RIT and do not necessarily represent the opinions, interpretations, or policy of New York State. Information on the applicability of the New York State Food Donation and Food Scraps Recycling Law (Food Scraps Law) and the NYSDEC’s role in implementing the Food Scraps Law can be found on the NYSDEC website. By statute, the NYSDEC must determine the actual methodology it will use for regulatory implementation. Some of the Report has been modified for public presentation and clarity purposes from an earlier version of this report, titled, “Guidance for Food Scraps Generators List Creation” that was provided to NYSDEC in 2020.

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## **A. Executive Summary**

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The New York State Pollution Prevention Institute (NYSP2I) at Rochester Institute of Technology (RIT) conducted research per the request of the NYS Department of Environmental Conservation (NYSDEC), to develop draft methodology for identifying and estimating food waste generation rates for business types subject to the New York State Food Donation and Food Scraps Recycling Law (Food Scraps Law).

The objective of this research was to generate guidance about food waste estimation methodology utilizing widely accessible factors for a list of sectors approved by NYSDEC that may be subject to the Food Scraps Law, and provide a benchmark of research and industry experience.

In order to approximate waste generation rates, appropriate factors (e.g. amount of food waste generated per employee per year) are required. NYSP2I gathered baseline information, performed an analysis and identified preferred options for the factor estimates. NYSP2I researched and documented calculation factors for the different sector categories subject to the Food Scraps Law (food wholesale and distribution, food retail, post-secondary schools, hospitality, correctional facilities, and restaurants), assessed the validity of each factor option, and determined the preferred factor alternative, which is summarized in Table 3. Food manufacturers and processors were excluded from the analysis as NYSDEC indicated they would determine the waste generation estimation methodology separately. Additionally, industries where preferred factors were not able to be identified are not included in this Report.

At the request of NYSDEC, the analysis of estimation factors was limited to those tied to widely accessible information (for free or at a minimal cost), such as the number of employees or full time students. There are other calculation methods for estimating food waste at a given business based on factors such as the number of meals served, number of visitors, and trash volume, however, given the limited access to such information on a state-wide scale, these factors types were omitted from the analysis. Additionally, NYSDEC requested identification of the most appropriate factor that yielded an exhaustive list of businesses for NYSDEC to review under the Food Scraps Law, recognizing that businesses have the opportunity to apply for a waiver with

NYSDEC under the terms of the Food Scraps Law if they can verify they do not generate 2 tons or more food waste.

For other food service generators, such as malls, office parks, entertainment venues and recreation facilities, preferred factors which rely on readily available information (e.g. employee counts) were not able to be identified. For these generator categories, a minimum number of studies have been performed, variation business to business is high, or research recommended factors leverage non-public or hard to obtain information, e.g. number of meals served, number of visitors, number of stadium seats, etc. A few of the studies also indicated that generating estimates for these sectors would not be valuable given the large spread of results across the industry. As a result, NYSP2I summarized research available for other food service sectors and provided it to DEC for their own analysis.

An earlier version of this report was submitted to NYSDEC for comment. Feedback was received on choices for two of the factor categories: correctional institutions and postsecondary schools. Modifications have been made and are noted in the Results section.

As a part of this analysis, NYSP2I requested assistance from the Center for EcoTechnology (CET) to provide selection guidance for waste generation factors for the key sector categories with which it has industry experience and relevant business data. The CET report is included in its entirety in Appendix A; their results are discussed throughout the narrative below.

## B. Introduction

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In March of 2019, New York passed a statewide Food Donation and Food Scraps Recycling Law (Food Scraps Law). Under the law, effective January 1, 2022, large food scraps generators, outside of New York City, are required to donate excess food and recycle remaining food scraps if there is an available facility within 25 miles with capacity. Under the law, NYSDEC is required to develop methodology for listing food scrap generators that will be subject to comply. NYSP2I was asked to assist NYSDEC with such methodology by providing guidance about food waste estimation methodology for sectors that may be subject to the Food Scraps Law so that NYSDEC could have relevant resources available to determine the final strategy.

At the request of NYSDEC, the analysis of estimation factors was limited to those tied to widely accessible information, such as the number of employees or full time students. There are other calculation methods for estimating food waste at a given business based on factors such as number of meals served, number of visitors, and trash volume, however, given the limited access to this information on a state-wide scale, these factors types were omitted from the analysis. Additionally, NYSDEC requested identification of the most appropriate factor that also yielded an exhaustive list of businesses for NYSDEC to review under the Food Scraps Law, recognizing that businesses have the opportunity to apply for a waiver with NYSDEC under the Food Scraps Law if they can verify they do not generate two tons or more food waste.

The business categories included in this analysis are provided in Table 1. These categories and subcategories were reviewed and agreed upon by NYSDEC before NYSP2I proceeded with the analysis. The category of “food manufacturing and food processing” was not included in the analysis performed by NYSP2I; after several conversations with NYSDEC, food manufacturers and processors have been excluded as NYSDEC has decided they will determine and manage the methodology separately. This category is more complex from most in that (1) very few studies exist with sound estimates for the category, (2) the sub-sectors within food manufacturing are very diverse in their waste generation volumes and types, and (3) the wasted food itself may be in the form of a liquid, solid, or a mix, packaged or unpackaged.

**Table 1:** Generator categories included in analysis

Category	Sub Category
Food Wholesale and Distribution	Food Wholesale and Food Distribution
Food Retail	Supercenters
	Supermarkets and Convenience Stores
Postsecondary Schools	Non-Residential
	Residential
Hospitality	Hospitality
Correctional Institutions	Correctional Facilities
	County Jails
Restaurants	Full Service
	Limited Service

There are five other states with state-wide food scraps laws, Vermont, Massachusetts, Rhode Island, Connecticut, and California. Information about each state law can be found in the report, *Bans and Beyond: Designing and Implementing Organic Waste Bans and Mandatory Organics Recycling Laws*, created by CET and Harvard Law School's Food Law and Policy Clinic.<sup>1</sup> Although each state's laws vary in scale and requirements, each consistently place the responsibility on the food scraps generators to determine if they are required to comply with the law, i.e. do they generate or dispose of enough waste to meet the minimum threshold indicated in the law, e.g. two tons of food scraps per week. Resources or assistance are provided to businesses to help determine eligibility in several of the states, for example RecyclingWorks in Massachusetts offers an online calculator and technical assistance and California maintains an interactive waste calculator. Ulster County recently passed a Food Waste Prevention and Recovery Act, becoming one of a handful of municipalities passing bans or recovery laws across the country. The county is following New York's path by requiring the County to notify generators that they are subject to comply rather than putting the responsibility on generators to self-identify.<sup>2</sup>

As a part of this analysis, NYSP2I requested assistance from the Center for EcoTechnology (CET) to provide selection guidance for waste generation factors for the key sector categories it has industry experience and relevant business data. The CET report is included in its entirety in Appendix A; their results are discussed throughout the narrative below.

<sup>1</sup> Toolkit is available here: <https://wastedfood.cetonline.org/wp-content/uploads/2019/07/Harvard-Law-School-FLPC-Center-for-EcoTechnology-CET-Organic-Waste-Bans-Toolkit.pdf>

<sup>2</sup> <https://ulstercountyny.gov/environment/food-waste-prevention-and-recovery-act>



## C. Objective

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The objective of this research was to generate guidance about food waste estimation methodology for a list of sectors approved by NYSDEC that may be subject to the Food Scraps Law utilizing widely accessible factors. To meet this objective, the following work was performed.

## D. Work Performed and Results

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### Methods

#### *Identifying Calculation Factors*

In order to determine the preferred factor estimation methodology for each sector category, existing options were gathered and reviewed from academic literature, government-funded reports, as well as research from non-profits and other consultants. Some factor alternatives were quickly removed from further analysis due to their lack of validity as reliable sources. Examples of immediate disqualifiers included: a factor for multiple sector categories, use of a factor type that is not publically available or not readily employed to estimate waste generation (e.g. percentage of disposed waste), and minimal or no information about how the factor estimate was generated.

After reviewing reports and studies identified on food waste estimation and characterization, data was compiled and organized. Information captured included notes about the methodology used to determine estimation factors; original source(s) for each factor; generator category (e.g. food processors, supermarkets, hotels); and NAICS and SIC codes for each generator category when provided. Each report included factors for multiple generator types, but not every report included factors for all generator types. Some reports relied on primary data such as site visits, direct measurement of food waste, and examination of waste disposal and diversion records. Other reports relied on secondary data from previous reports or academic literature. Table 2 below summarizes the main sources identified with relevant factor information.

**Table 2:** Sources for generator estimates

Source Name	Report(s) [1]	Report Notes
Rethink Food Waste Through Economics and Data (ReFED)	- A Roadmap to Reduce US Food Waste by 20% (2016)	- Aggregator of multiple sources for the different generator categories - Primary data (from surveys) for distributors included
Business for Social Responsibility (BSR)	- Analysis of US Food Waste Among Food Manufacturers, Retailers, and Restaurants (2014)	- Primary data from business surveys
Cascadia Consulting Group (CCG)	- Waste Disposal and Diversion Findings for Selected Industry Groups (2006) - 2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California (2015)	- Primary data collected from interviews, site visits, and waste sorts - Primary data collected from interviews, site visits, and waste sorts
National Resources Defense Council (NRDC)	- Estimating Quantities and Types of Food Waste at the City Level (2017)	- Primary data collected from interviews as well as waste sorts - Factors from other sources utilized as a comparison to primary data collected
Environmental Protection Agency (EPA)	- Excess Food Opportunities Map Version 2.0 (2019)	- Aggregator of multiple sources for the different generator categories - Estimate created for universities from secondary data
NYSP21	- Organic Resource Locator (2018)	- Aggregator of multiple sources for the different generator categories
RecyclingWorks	- Food Waste Estimation Guide (2018)	- Aggregator of multiple sources for the different generator categories
Draper/Lennon, Inc.	- Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions (2001) - Identification, Characterization, and Mapping of Food Waste and Food Waste Generators in Massachusetts (2002)	- Aggregator of multiple sources for the different generator categories, primary data included in certain instances - Aggregator of multiple sources for the different generator categories, primary data included in certain instances

[1] Full citations for each report are included in the References section of this report

### Selection of Preferred Factors

Each factor included was qualitatively evaluated, starting with reviewing and assessing the underlying research or other work performed to create the factor estimate. Those factors and

sources were analyzed using a variety of criteria: age of study, referencing by prominent sources (e.g. ReFED), validity of estimate generation (e.g. was there primary data gathered or was the factor generated from a single data point), how closely aligned the factor was to other estimates for the same category, and conclusions drawn from CET's analysis, which is included in its entirety in Appendix A.

## **Results**

NYSP2I reviewed the identified studies to determine the preferred factor for each sector category. Each section below includes the factor options reviewed as well as the preferred factor option with supporting information for each business category. A summary of all the preferred factors selected for each category is shown in Table 3.

While the following summary of preferred factors per sector category draws from well cited and reputable studies, there is inherent variability due to: rounding, data collection methods, individual business practices, documented number of employees, etc. that will affect the accuracy of the estimate. For some of the businesses, this estimation variability is insignificant because their waste generation rate is much higher (or lower) than the waste threshold for the Food Scraps Law. The uncertainty is much more relevant for businesses with waste estimates within the margin of error of the Law's minimum. Without access to the final source databases, an analysis to investigate the percentage of businesses that fall in this range was not performed.

As stated previously, an earlier version of this section of the report was submitted to NYSDEC for review and feedback. Changes to the preferred factors have been made for correctional institutions and postsecondary schools. The corresponding sections have been updated to reflected NYSDEC's feedback.

**Table 3: Preferred factor estimates per sector category**

#	Category	Sub-Category	Normalized Factor Type	Normalized Factor Estimate	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
1	Food Wholesale and Distribution	Food Wholesale and Distribution	lb/employee/yr	22,400	Energy Trust	2010	Portland Metropolitan Industrial Food Waste Study Report	- Extrapolated data from interviewed and confirmed with research	-ReFED (2016)
2	Retail	Supermarkets and Convenience Stores	lb/employee/yr	3,000	Draper/ Lennon, Inc.	2001	Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions	- Estimate was created as the result of analyzing survey data from generators and reviewing literature	-ReFED (2016) -NRDC (2017) -RecyclingWorks (2018) -Organic Resource Locator (2018) -EPA Food Opportunities Map (2019)
2	Retail	Supercenters	lb/employee/yr	1,000	ReFED	2016	A Roadmap to Reduce US Food Waste by 20% (2016)	- Extrapolated data from interviews, confirmed with research	-Organic Resource Locator (2018) -EPA Food Opportunities Map (2019)
3	Postsecondary Schools	Residential	lb/student/yr	142	Draper/ Lennon, Inc.	2001	Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions	- 0.35 lb/meal/student estimate generated from analyzing literature data - 405 meals/student/year estimate generated from surveying universities - 142 lb/student/yr estimate combines the lb/meal and meals/student to create a usable factor	-Organic Resource Locator (2018) -RecyclingWorks (2018)
3	Postsecondary Schools	Non-Residential	lb/student/yr	38	Draper/ Lennon, Inc.	2001	Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions	- 0.35 lb/meal/student estimate generated from analyzing literature data - 108 meals/student/year estimate generated from surveying universities - 38 lb/student/yr estimate combines the lb/meal and meals/student to create a usable factor	-Organic Resource Locator (2018) -RecyclingWorks (2018)
4	Hospitality	Hospitality	lb/employee/yr	1,983	CCG	2006	Waste Disposal and Diversion Findings for Selected Industry Groups	- Primary data collected from interviews, site visits, and waste sorts	-NRDC (2017) -EPA Food Opportunities Map (2019)
5	Correctional Institutions	County Jails and Other Institutions	lb/inmate/day	1	Marion	2000	Composting 12,000 Tons of Food Residuals a Year	- Original report (BiCycle Magazine article) not able to be located. Appears to have been a write up about audit(s) performed at NYS Correctional Facilities to determine a generation rate.	-ReFED (2016) -NRDC (2017) -RecyclingWorks (2018) -Organic Resource Locator (2018) -EPA Food Opportunities Map (2019)
5	Correctional Institutions	NYS Correctional Facilities	lb/inmate/day	0.65	NYS DOCCS	2013	DOCCS Compost Operations and pounds per person	- Data provided by DEC	
6	Restaurant	Full Service	lb/employee/yr	3,000	Draper/ Lennon, Inc.	2002	Identification, Characterization, and Mapping of Food Waste and Food Waste Generators in Massachusetts	- Original source data includes both limited and full service restaurants but this factor is often cited as a full service only estimate	-ReFED (2016) -NRDC (2017) -Organic Resource Locator (2018) -RecyclingWorks (2018) -EPA Food Opportunities Map (2019)
6	Restaurant	Limited Service	lb/employee/yr	2,200	Mercer	2013	Assessment of Food Waste Generation in Mercer County, New Jersey	- Estimate generated from the disposal rate for fast food restaurants in CCG (2006) study where the amount diverted is primarily grease waste	-ReFED (2016) -RecyclingWorks (2018)

#### 1. Food Wholesale and Food Distribution

***Preferred factor: 22,400 lb/employee/year***

***Minimum for 2 tons/week: 9 employees***

Within the food wholesale and distribution sector, there have been very few studies conducted, summarized below in Table 4, and at times, food wholesale and distribution factors have been combined with either retail or manufacturing, which conflates the result. Draper/Lennon, Inc. (2001) did not include a factor estimate for this sector because company name and identifier code (e.g. SIC or NAICS) were not enough to reasonably estimate the resulting waste generation. Processes vary by sub-sector, e.g. fish wholesalers as compared to packaged frozen food distributors, and in-plant practices (e.g. on-site processing) and there is not sufficient publicly available information to know and interpret these nuances. This variation can be illustrated through the Energy Trust (2010) study which is cited by ReFED (2016) with a factor of 22,400 lb/employee/year. This estimate is based on a survey of five wholesalers (NAICS Code 4244: Grocery and Related Product Merchant Wholesalers) in Portland, Oregon. The range of estimates generated from each business was from 72 lb/employee/year to 41,000 lb/employee/year. Another commonly referenced factor for food wholesale and distribution is from BSR (2014) which is 0.01 lb/revenue/year for wholesale and retail based on company survey data. Despite this factor being utilized often, it estimates waste for two very different sectors (wholesale and retail), indicating again that there is not a lot of publicly available information about wholesale and distribution separately.

Below is a summary of the main factors identified for this industry. Given the overall lack of quality factor data, the best path forward for this sector may be to use the preferred factor as a starting point. Leveraging research from the Energy Trust (2010), nine or more employees is a reasonable factor to use to generate an initial list to work off of with this sector. More information may be needed by each business or at least each business type in order to further refine waste estimates.

**Table 4:** Factor options for food wholesale and distribution

Normalized Factor Type	Normalized Factor Estimate	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
lb/revenue/yr	0.01	BSR	2014	Analysis of US Food Waste Among Food Manufacturers, Retailers, and Wholesalers	- Collection of food retail and wholesale sectors - Estimate generated from survey data from businesses across the country	-NRDC (2017) -EPA Food Opportunities Map (2019)
lb/employee/yr	1,054	CCG	2006	Waste Disposal and Diversion Findings for Selected Industry Groups	- Primary data collected from interviews, site visits, and waste sorts - Estimate for non-durable wholesalers, which includes non-food businesses - Factor will inherently be lower than food waste estimate per employee for food only wholesalers	
lb/establishment/yr	94	Okazaki et al.	2008	Characterization of Food Waste Generators: A Hawaii Case Study	- Primary data collected from surveys	-EPA Food Opportunities Map (2019)
lb/employee/yr	22,400	Energy Trust	2010	Portland Metropolitan Industrial Food Waste Study Report	- Extrapolated data from interviewed and confirmed with research	-ReFED (2016)

## 2. Food Retail

- Supermarkets and convenience stores

**Preferred factor: 3,000 lb/employee/year**

**Minimum for 2 tons/week: 69 employees**

For the retail sector, there were three studies worth analyzing, as shown below in Table 5. The Draper/Lennon, Inc. (2001) factor for supermarkets and convenient stores is most cited in reports, including ReFED (2016), NRDC (2017) and RecyclingWorks (2018). Despite the general acceptance of this factor as the standard, the report is almost 20 years old and was not based on primary data. It was an estimate created from literature published in the 1990s. That being said, CET gathered data from ten grocers they previously worked with, from New York, Connecticut, and Massachusetts, and found that the 3,000 lb/employee/year estimate from Draper/Lennon, Inc. (2001) was the closest factor estimate available in most cases, see Appendix A for more information, as such it was selected as the preferred factor.

Normalized Factor Type	Normalized Factor Estimate	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
lb/employee/yr	3,000	Draper/ Lennon, Inc.	2001	Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions	- Estimate was created as the result of analyzing survey data from generators and reviewing literature	-ReFED (2016) -NRDC (2017) -RecyclingWorks (2018) -Organic Resource Locator (2018) -EPA Food Opportunities Map (2019)
lb/employee/yr	4,625	CCG	2006	Waste Disposal and Diversion Findings for Selected Industry Groups	- Primary data collected from interviews, site visits, and waste sorts	-Kessler Consulting (2012) -EPA Food Opportunities Map (2019)
lb/employee/yr	4,037	CCG	2015	2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California	- Primary data collected from interviews, site visits, and waste sorts	-EPA Food Opportunities Map (2019)
lb/employee/yr	1,700	NRDC	2017	Estimating Quantities and Types of Food Waste at the City Level	- Data collected from a single small grocery store	

**Table 5:** Factor options for supermarkets and convenience stores

- Supercenters

**Preferred factor: 1,000 lb/employee/year**

**Minimum for 2 tons/week: 208 employees**

There were two main studies that provided estimates for supercenters or big box stores specifically, they are shown below in Table 6. Of the two, the ReFED (2016) estimate is the preferred factor. The first estimate provided in the table below by CCG (2006) will be inherently lower than the actual waste value because the study included supercenters that did not sell food. The ReFED (2016) factor should be a much more reasonable estimate, as it is based on data and information from supercenters that sell food.

**Table 6:** Factor options for supercenters

Normalized Factor Type	Normalized Factor Estimate	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
lb/employee/yr	530	CCG	2006	Waste Disposal and Diversion Findings for Selected Industry Groups	- Primary data collected from interviews, site visits, and waste sorts	-EPA Food Opportunities Map (2019)
lb/employee/yr	1,000	ReFED	2016	A Roadmap to Reduce US Food Waste by 20% (2016)	- Extrapolated data from interviews, confirmed with research	-Organic Resource Locator (2018) -EPA Food Opportunities Map

### 3. Postsecondary Schools

- Residential

**Preferred factor: 142 lb/student/year**

**Minimum for 2 tons/week: 1,465 students**

- Non-Residential

**Preferred factor: 38 lb/student/year**

**Minimum for 2 tons/week: 5,474 students**

The EPA Excess Food Opportunities Map cites several factors for postsecondary schools, many of which have been published in academic literature. A few of these estimates were limited to post-consumer waste from a single dining facility on campus and as such EPA extrapolated an estimate to include the total campus waste. The academic literature factors were not included in this analysis. Instead, the focus was on the reports that have consistently been used throughout the rest of the report, CCG (2006), CCG (2015), Draper/Lennon, Inc. (2001) and EPA (2019), as shown below in Table 7. Both CCG studies utilized employee counts whereas other sources utilize a combination of number of students, number of meals served, and waste per meal to determine total waste, as shown below in Equation 1 (a) and (b).

**Equation 1:** Postsecondary food waste estimation factor equations

$$(a) \text{ residential food waste lb./year} = \# \text{ of students} \times \frac{405 \frac{\text{meals}}{\text{student}}}{\text{year}} \times 0.35 \frac{\text{lb food waste}}{\text{meal}}$$

$$(b) \text{ non-residential food waste lb./year} = \# \text{ of students} \times \frac{108 \frac{\text{meals}}{\text{student}}}{\text{year}} \times 0.35 \frac{\text{lb food waste}}{\text{meal}}$$

Given that there is publically available data for student enrollment and that employee counts may not as closely correlate to waste generation, the preferred factor method utilizes student enrollment to estimate waste. In Draper/Lennon, Inc. (2001), residential and non-residential schools were separated into two categories given that the number of meals served between those two models will vary. These factors were used by both the Organic Resource Locator (2018) and RecyclingWorks (2018). According to the CET report, provided in Appendix A, EPA's weighted average factor for meals/student/year for residential and non-residential institutions (resulting in



an overall factor of 59 lb/student/year) more closely aligns with actual waste values from colleges and universities. CET postulated that this value from EPA better accounted for meals eaten off campus for residential and non-residential institutions. If available, actual data for meals served per student, instead of utilizing EPA’s weighted average, provided a more accurate estimate. At NYSDEC’s request residential and non-residential factor methods were kept separate.

**Table 7:** Factor options for postsecondary schools

Sub-Category	Normalized Factor Type	Normalized Factor	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
Residential and Non-Residential	lb/employee/yr	1,560	CCG	2006	Waste Disposal and Diversion Findings for Selected	- Primary data collected from interviews, site visits, and waste sorts	-ReFED (2016)
Residential and Non-Residential	lb/employee/yr	1,000	CCG	2015	2014 Generator-Based Characterization of	- Primary data collected from interviews, site visits, and waste sorts	
Residential and Non-Residential	lb/student/yr	22	CCG	2015	2014 Generator-Based Characterization of	- Primary data collected from interviews, site visits, and waste sorts	-EPA Food Opportunities Map (2019)
Residential	lb/student/yr	142	Draper/Lennon, Inc.	2001	Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions	- 0.35 lb/meal/student estimate generated from analyzing literature data - 405 meals/student/year estimate generated from surveying universities - 142 lb/student/yr estimate combines the lb/meal and meals/student to create a usable factor	-Organic Resource Locator (2018) -RecyclingWorks (2018)
Non-Residential	lb/student/yr	38	Draper/Lennon, Inc.	2001	Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions	- 0.35 lb/meal/student estimate generated from analyzing literature data - 108 meals/student/year estimate generated from surveying universities - 38 lb/student/yr estimate combines the lb/meal and meals/student to create a usable factor	-Organic Resource Locator (2018) -RecyclingWorks (2018)
Residential and Non-Residential	lb/student/yr	59		2019	Excess Food Opportunities Map Version 2.0 (2019)	- EPA combined the two Draper/Lennon (2001) lb/meal/student/yr estimates - This estimate also uses the 0.35 lb/meal estimate from Draper/Lennon (2001)	-EPA Food Opportunities Map (2019)

#### 4. Hospitality

**Preferred factor: 1,983 lb/employee/year**

**Minimum for 2 tons/week: 105 employees**

Hospitality is another industry sector where the waste generation rates will depend significantly on the types of on-site facilities and accommodations that are included with the hotel, e.g. a restaurant, conference and event spaces, etc. The variability is such that the CET report did not identify a factor that consistently estimated waste from the sample of five hotels analyzed. Establishment of specific information such as number of guests per year and types of services and accommodations provided on-site at the hotel may give greater insight into the waste generated. There were five potential factors identified for the hospitality industry, as shown below

in Table 8. The factor from Tetra Tech (2015) was removed almost immediately because the factor includes data from food service and hotels which will likely skew the resultant factor. Mercer (2013) created an estimate, 1,500 lb/employee/year for waste generation based on findings from the CCG (2006) report where an estimated 1,983 lb/employee/year of food waste is generated, of which 1,421 lb/employee/year is disposed of and not recycled. Based on the values presented from the CCG (2006) report, it appears that Mercer (2013) leveraged the disposal rate rather than the generation rate to create its own generation factor for the hospitality industry. RecyclingWorks (2018) took the average of the CCG (2015) and Mercer (2013) factors to generate its own estimate of 1,305 lb/employee/year. As CET explained in its report, the variability in this sector makes it difficult to feel confident in a single value; a range is a better representation of potential waste estimates. As such, based on the CCG (2015) and CCG (2006) reports, that resulting range is between 1,194 and 1,983 lb/employee/year. Given the desire by NYSDEC to develop a more exhaustive list of businesses to review and analyze, the preferred factor is the CCG (2006) estimate of 1,983 lb/employee/year with a closer look at the businesses that fall close to the 2 tons/week threshold.

**Table 8:** Factor options for hospitality

Normalized Factor Type	Normalized Factor Estimate	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
lb/employee/yr	997	Tetra Tech	2015	2014 ICI Waste Characterization Program	- Estimate combines food service and hotels	-EPA Food Opportunities Map
lb/employee/yr	1,194	CCG	2015	2014 Generator-Based Characterization of Commercial Sector Disposal and	- Primary data collected from interviews, site visits, and waste sorts	-EPA Food Opportunities Map (2019)
lb/employee/yr	1,305	Recycling Works	2018	Food Waste Estimation Guide	- Estimated value generated from taking the average of	
lb/employee/yr	1,500	Mercer	2013	Assessment of Food Waste Generation in Mercer County, New Jersey	- Estimate generated from CCG (2006) hotel data. The factor is closer to the CCG (2006) disposal rate (1,421 lb/employee/yr) rather than total generation rate (1,983 lb/employee/yr) even though the factor is meant to represent generation rate	-ReFED (2016) -Organic Resource Locator (2018)
lb/employee/yr	1,983	CCG	2006	Waste Disposal and Diversion Findings for Selected Industry Groups	- Primary data collected from interviews, site visits, and waste sorts	-NRDC (2017) -EPA Food Opportunities Map (2019)

## 5. Correctional Institutions

- County Jails and Other Institutions

***Preferred factor: 1 lb/inmate/day***

***Minimum for 2 tons/week: 570 inmates***

The most widely utilized factor for correctional institutions is 1 lb/inmate/day. There have been a number of studies or estimates recorded over the last 20 or more years. The EPA's Excess Food Opportunities Map (2019) has a number of them cited and when averaged, the resulting estimate is approximately 1 lb/inmate/day which is an indicator that the estimate itself is fairly robust. A summary of the factors analyzed for this report are included in Table 9.

- New York State Correctional Facilities

***Preferred factor: 0.65 lb/inmate/day***

***Minimum for 2 tons/week: 877 inmates***

Based on feedback provided by NYSDEC, correctional facilities run by the NYS Department of Correctional and Community Supervision (DOCCS) have an average rate of food waste per inmate that statistically significantly different than county jails and other institutions. This is due to installation of cook-chill technology in the kitchens. The preferred factor of 0.65 lb/inmate/day reflects actual data, from compost collection, that was provided by DOCCS to NYSDEC from 2013.

**Table 9:** Factor options for county jails and correctional facilities

Sub-Category	Normalized Factor Type	Normalized Factor Estimate	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
County Jails and Other Institutions	lb/inmate/day	1	Marion	2000	Composting 12,000 Tons of Food Residuals a Year	- Original report (BiCycle Magazine article) not able to be located. Appears to have been a write up about audit(s) performed at NYS Correctional Facilities to determine a generation rate.	-ReFED (2016) -NRDC (2017) -RecyclingWorks (2018) -Organic Resource Locator (2018) -EPA Food Opportunities Map (2019)
NYS Correctional Facilities	lb/inmate/day	0.65	NYS DOCCS	2013	DOCCS Compost Operations and pounds per person	- Data provided by DEC	
County Jails and Other Institutions	lb/inmate/day	1.2	Kessler Consulting	2004	Waste Reduction and Recycling Guide for Florida Correctional Facilities	- Primary data collected from waste sorts	-EPA Food Opportunities Map (2019)
County Jails and Other Institutions	lb/inmate/day	1.25	Mendrey	2013	Correctional Facility Composting in Washington State	- Factor takes the average of estimate provided by Washington Department of Corrections of 1 to 1.5 lb/inmate/day generation	-EPA Food Opportunities Map (2019)

## 6. Restaurants

- Full Service Restaurants

**Preferred factor: 3,000 lb/employee/year**

**Minimum for 2 tons/week: 69 employees**

There have been a few studies performed over the years on restaurants, a summary of those analyzed for this report are included in Table 10. In some cases, limited and full service restaurants were estimated together and in others they are estimated separately. The most widely utilized factor for full service restaurants was 3,000 lb/employee/year from Draper/Lennon, Inc. (2002). CCG (2006) collected primary data for this sector category to generate an estimate of 3,392 lb/employee/year, after grease trap waste was removed, the generation rate is 2,910 lb/employee/year. This result from CCG (2006) reinforced the robustness of the 3,000 lb/employee/year factor estimate. Additionally, based on a sample size of five full service restaurants, CET found the closest consistent factor estimate was 3,000 lb/employee/year, see Appendix A for more information. CET's analysis also found that when number of meals served information is available (utilizing 0.5 lb/meal for waste generation) in addition to employee counts, the two factors results can be averaged to lead to a more accurate estimate.

**Table 10:** Factor options for full service restaurants

Sub-Category	Normalized Factor Type	Normalized Factor Estimate	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
Full Service	lb/employee/yr	3,000	Draper/Lennon, Inc.	2002	Identification, Characterization, and Mapping of Food Waste and Food Waste Generators in Massachusetts	- Original source data includes both limited and full service restaurants but this factor is often cited as a full service only estimate	-ReFED (2016) -NRDC (2017) -Organic Resource Locator (2018) -RecyclingWorks (2018) -EPA Food Opportunities Map (2019)
Full Service	lb/employee/yr	3,392	CCG	2006	Waste Disposal and Diversion Findings for Selected Industry Groups	- Primary data collected from interviews, site visits, and waste sorts - Of the total, 478 lb/employee/yr is diverted at the businesses studied, this results in a 2,910 disposal rate, which should constitute most if not all of the food waste generated.	-EPA Food Opportunities Map (2019)
Full Service	lb/employee/yr	1,406	NRDC	2017	Estimating Quantities and Types of Food Waste at the City Level	- Estimate averaged across three full service restaurants from bin digs and/or self reported data -Data may be skewed by the significant difference in data values from bin dig to self reporting	
Limited and Full Service	lb/revenue/yr	0.033	BSR	2014	Analysis of US Food Waste Among Food Manufacturers, Retailers, and Wholesalers	- Collection of limited and full service restaurants - Estimate generated from survey data from businesses across the country	-EPA Food Opportunities Map (2019)
Limited and Full Service	lb/employee/yr	2,756	CCG	2015	2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California	- Primary data collected from interviews, site visits, and waste sorts	-EPA Food Opportunities Map (2019)

○ Limited Service Restaurants

**Preferred factor: 2,200 lb/employee/year**

**Minimum for 2 tons/week: 94 employees**

There were only a few studies with primary data which analyze limited service restaurants separate from full service restaurants. The two referenced below with primary data, in Table 11, are from NRDC (2017) and CCG (2006). In the CCG (2006) report, the total food waste generation was 2,494 lb/employee/year. When factoring in the 300 lb/employee/year of grease trap waste that was recycled, the food waste generation was 2,191 lb/employee/year. NRDC (2017) did not explicitly define a new factor estimate for this sector, however, averaging data from the four limited service restaurants analyzed, resulted in an estimate of 2,163 lb/employee/year.

The preferred factor noted above was from the third source, Mercer (2013), which did not include any primary data of its own, has been cited by other resources including ReFED (2016) and RecyclingWorks (2018). This estimate of 2,200 lb/employee/year was created by Mercer (2013) from the disposal rate from CCG (2006) study of 2,191 lb/employee/year. Findings from CET's research also indicate 2,200 lb/employee/year is a reasonable factor estimate.

**Table 11:** Factor options for limited service restaurants

Sub-Category	Normalized Factor Type	Normalized Factor	Report/ Study Source	Date	Report/ Study Name	Notes on Data	Where Cited
Limited Service	lb/employee/yr	2,200	Mercer	2013	Assessment of Food Waste Generation in Mercer County,	- Estimate generated from the disposal rate for fast food restaurants in CCG (2006) study where the amount diverted is	-ReFED (2016) -RecyclingWorks (2018)
Limited Service	lb/employee/yr	2,494	CCG	2006	Waste Disposal and Diversion Findings for Selected Industry Groups	- Primary data collected from interviews, site visits, and waste sorts - Of the total, 300 lb/employee/yr is diverted at the businesses studied, this results in a 2,191 disposal rate, which should constitute most if not all of the food waste generated.	-EPA Food Opportunities Map (2019)
Limited Service	lb/employee/yr	2,163	NRDC	2017	Estimating Quantities and Types of Food Waste at the City Level	- Estimate averaged across four limited service restaurants from bin digs and/or self reported data - Data may be skewed by the significant difference in data values from bin dig to self reporting	

## E. Conclusions

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Leveraging the extensive research and knowledge of NYSP2I and first hand experiences from CET, an analysis was performed on the factor options for each sector of businesses and institutions subject to the Food Scraps Law. Preferred factors for each (food wholesale and distribution, food retail, post-secondary schools, hospitality, correctional facilities and restaurants) were identified with supporting evidence provided for the selections in each respective section and summarized in Table 3. In an earlier version of this report, NYSDEC reviewed and commented on two categories in which methodology changes were requested, correctional institutions and postsecondary schools. Those adjustments have been made and are noted as such in their respective sections.

## F. Appendix

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### Appendix A: CET Estimation Report

## G. References

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- BSR. (2014). *Analysis of U.S. Food Waste among Food Manufacturers, Retailers, and Restaurants*. Retrieved from Food Waste Reduction Alliance:  
[https://www.foodwastealliance.org/wp-content/uploads/2014/11/FWRA\\_BSR\\_Tier3\\_FINAL.pdf](https://www.foodwastealliance.org/wp-content/uploads/2014/11/FWRA_BSR_Tier3_FINAL.pdf)
- CCG. (2006). *Waste Disposal and Diversion Findings for Selected Industry Groups*. Retrieved from CalRecycle: <https://www2.calrecycle.ca.gov/Publications/Details/1184>
- CCG. (2015). *2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California*. Retrieved from CalRecycle:  
<https://www2.calrecycle.ca.gov/WasteCharacterization/PubExtracts/2014/GenSummary.pdf>
- Draper/Lennon, Inc. (2001). *Identifying, Quantifying, and Mapping Food Residuals from Connecticut Businesses and Institutions*. Retrieved from Connecticut DEEP:  
<https://www.ct.gov/deep/lib/deep/compost/ssomfile/ssomreport.pdf>
- Draper/Lennon, Inc. (2002). *Identification, Characterization, and Mapping of Food Waste and Food Waste Generators in Massachusetts*. Retrieved from Massachusetts DEP:  
<https://www.mass.gov/doc/study-identification-characterization-mapping-of-food-waste-generators-in-massachusetts-2002/download>
- Energy Trust. (2010, April 19). *Portland Metropolitan Industrial Food Waste Study Report*. Retrieved from Energy Trust: [https://www.energytrust.org/wp-content/uploads/2016/12/100419\\_Portland\\_Area\\_Food\\_Waste\\_Study.pdf](https://www.energytrust.org/wp-content/uploads/2016/12/100419_Portland_Area_Food_Waste_Study.pdf)
- EPA. (2019, March). *Excess Food Opportunities Map Version 2.0 – Technical Methodology*. Retrieved from EPA: [https://www.epa.gov/sites/production/files/2019-02/documents/efom\\_v2\\_technical\\_methodology\\_march\\_2019.pdf](https://www.epa.gov/sites/production/files/2019-02/documents/efom_v2_technical_methodology_march_2019.pdf)
- Hoover, D. (2017). *Estimating Quantities and Types of Food Waste at the City Level*. NRDC. Retrieved from <https://www.nrdc.org/sites/default/files/food-waste-city-level-report.pdf>
- Kessler Consulting. (2004, January). *Waste Reduction and Recycling Guide for Florida Correctional Facilities*. Retrieved from CalRecycle:  
<https://www2.calrecycle.ca.gov/Docs/Web/112485>
- Marion, J. (2000). Composting 12,000 tons of food residuals per year. *BioCycle*.
- Mendrey, K. (2013, August). Correctional Facility Composting In Washington State. *BioCycle*,



54(8), 32. Retrieved from <https://www.biocycle.net/2013/08/21/correctional-facility-composting-in-washington-state/>

Mercer, A. (2013, January). *Assessment of Food Waste Generation in Mercer County, New Jersey*. Retrieved from:

<https://envirostewards.rutgers.edu/alumniassociation/PDFs/An%20Assessment%20of%20Food%20Waste%20Generated%20in%20Mercer%20County%20122%2013.pdf>

New York State Department of Corrections and Community Supervision. (2013, February).

Requested from New York State Department of Environmental Conservation.

NYSP2I. (2018). *References for Organic Resource Locator Data*. Retrieved:

[https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/images/orl\\_reference\\_table\\_new\\_factors040218.pdf](https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/images/orl_reference_table_new_factors040218.pdf)

Okazaki, W., Turn, S., & Flachsbar, P. (2008). Characterization of food waste generators: A Hawaii case study. *Waste Management*, 28(12), 2483–2494. doi:

10.1016/j.wasman.2008.01.016

RecyclingWorks. (2018). Food Waste Estimation Guide. Retrieved January 27, 2020, from

<https://recyclingworksma.com/food-waste-estimation-guide/>

ReFED. (2016). *A Roadmap to Reduce US Food Waste by 20%*. Retrieved from:

[https://www.refed.com/downloads/ReFED\\_Report\\_2016.pdf](https://www.refed.com/downloads/ReFED_Report_2016.pdf)

TetraTech. (2015, June 1). *2014 ICI Waste Characterization Program*. Retrieved from Metro Vancouver: [http://www.metrovancouver.org/services/solid-](http://www.metrovancouver.org/services/solid-waste/SolidWastePublications/FinalReport-2014ICIWasteCharacterizationProgram3-Jun-15.pdf)

[waste/SolidWastePublications/FinalReport-2014ICIWasteCharacterizationProgram3-Jun-15.pdf](http://www.metrovancouver.org/services/solid-waste/SolidWastePublications/FinalReport-2014ICIWasteCharacterizationProgram3-Jun-15.pdf)



A Study Prepared in Support of New York State's Food Scraps Recycling Law Preparation  
Submitted to: The Pollution Prevention Institute, Rochester Institute of Technology ◊ January 2020

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## Introduction

In support of the NYSDEC's task of compiling a list of commercial entities that will be covered by New York's impending organics disposal ban, CET reviewed a number of food waste estimation tools, including our own Food Waste Estimator, as well as tools used by the NRDC and U.S. EPA. Our goal was to assess the relative accuracy of these estimators by comparing results to primary data from businesses with which we've worked. In total, CET has conducted approximately 750 instances of technical assistance for food waste, impacting prevention, donation, and diversion practices at over 1000 locations across Massachusetts, Connecticut, and Rhode Island, Pennsylvania, New York and beyond. We have further analyzed the efficacy of the estimators in terms of whether the multipliers are publicly available or require contact with the entity. The following report provides an overview of the tools included in our analysis, results of our comparative assessment, and recommendations for NYSDEC based on these findings and informed by our field experience.

## Food Waste Generation Methodologies

### RecyclingWorks in MA

The [Food Waste Estimator](#) is a tool developed by CET on behalf of the Massachusetts Department of Environmental Protection's RecyclingWorks in Massachusetts program, which CET administers. The tool was designed for estimating relative levels of food waste generation by entities that do not have food waste diversion programs in place or are interested in improving or expanding efforts at their location. The tool comprises metrics for ten key food waste generating sectors:

- Assisted living
- Colleges & universities
- Corporate cafeterias
- Correctional facilities
- Elementary & secondary schools
- Grocers
- Hospitals
- Lodging & hotels
- Restaurants (full-service and limited-service)
- Venues & events

For each sector, metrics were compiled from published reports and studies and vetted against CET's field experience; these were last updated in May 2018. The tool includes three to four different metrics for estimating food waste for each sector, such that one can derive an estimate by averaging or triangulating numbers derived from multiple metrics. While using multiple metrics has its merits, employee number is a good fit for DEC's purposes of generating a list of entities covered by the NYS Food Law. It is not only publicly available, but unlike some other metrics, it will yield an estimate of total food waste generation regardless of whether the entity has a diversion program in place.

## EPA Excess Food Opportunities Map

The [U.S. EPA Excess Food Opportunities Map](#) uses commercially and publicly available data to estimate excess food generation rates for nearly 1.2 million commercial, industrial, and institutional establishments in the U.S. The Map was last updated in 2019 and includes entities with North American Industry Classification System (NAICS) codes for the following sectors:

- Correctional facilities
- Educational institutions
- Food manufacturers and processors
- Food wholesale and retail
- Healthcare facilities
- Lodging & hotels
- Restaurants and food services

The EPA conducted a literature review to identify formulas for excess food generation rates for each sector. Because multiple generation factors exist for each sector, the Map presents a low and a high estimate of each establishment's food waste. Establishment-level data for most industries is accessed from [Hoover's, Inc.](#), a business information database. This data includes contact information, location details (geo-coordinates and physical addresses), establishment type (headquarters, branch, or single location), revenue (\$USD), and number of employees.

While the Map is fairly comprehensive, some entities are missing due to the fact that they are associated with an excluded NAICS code, or may be too new to have been included in the data EPA acquired from Hoover's, the Department of Homeland Security, and the National Center for Education Statistics.

## NRDC

NRDC recently published a study of food waste in three U.S. cities, New York City, Nashville, and Denver.<sup>1</sup> In this study, NRDC used the Food Loss and Waste Standard (FLW) for estimating commercial and institutional waste. Entities types include:

- Colleges & Universities
- Correctional Facilities
- Food Manufacturing & Processing
- Food Wholesalers & Distributors
- Grocers
- Healthcare
- Hospitality
- K-12 schools
- Restaurants & caterers
- Venues & recreation facilities

NRDC adopted its conversion factors from the U.S. EPA's [Technical Methodology for the U.S. EPA Excess Food Opportunities Map](#).<sup>2</sup> NRDC utilized waste audits and self-reported data for a sample of facilities in order to ground-truth published food waste generation factors. NRDC extrapolated this data to calculate the expected annual wasted food generation and compared that to the primary generation factor(s) derived from previous studies.

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<sup>1</sup> NRDC (2017). "Estimating Quantities and Types of Food Waste at the City Level".

<sup>2</sup> U.S. EPA (2018). "Excess Food Opportunities Map (Version 2.0) – Technical Methodology".

## Sector-Specific Food Waste Generation Factors & Analysis

The sector-specific food waste generation factors utilized by RecyclingWorks (CET), EPA, and NRDC overlap but are not identical for each establishment. In the following sections, we present comparisons between theoretical estimates and CET’s first-hand experience providing technical assistance (TA) to businesses and institutions in each sector. For this analysis, we omitted K-12 schools and health care sectors, as these establishments are not subject to New York State’s organics diversion mandate.

### Supermarkets

To estimate supermarket food waste generation, EPA chose eight primary research studies, most of which estimate food waste based on number of employees. RecyclingWorks and NRDC use a multiplier that is equal to the average of the EPA’s five generation factors based on number of employees.

Factor	Value	Source
<b>Employees</b> (Option 1) (lb/employee/yr)	3000	RecyclingWorks, NRDC, EPA
<b>Employees</b> (Option 2) (lb/employee/yr)	4620	EPA
<b>Employees</b> (Option 3) (lb/employee/yr)	4040	EPA
<b>Employees</b> (Option 4) (lb/employee/yr)	1000	EPA
<b>Employees</b> (Option 5) (lb/employee/yr)	540	EPA
<b>Employees</b> (Option 6) (lb/employee/yr)	5577	CalRecycle
<b>Disposed waste</b> (% total by wt)	63%	RecyclingWorks
<b>Revenue</b> (lb/\$/yr)	0.01	EPA

### Key considerations and insights

- NRDC notes that there has been a reduction in employee size for grocers since this factor was established, so the amount of food waste per employee may have increased over time.
  - This concern is not supported by data in Table 2.
- In CET’s experience, many supermarkets have some type of wasted food diversion program in place, such as donation, so the generation factor based on total disposed waste may result in an underestimate of food waste generation.
  - This trend is supported by data in Table 2.
- The amount of food waste generated by grocers and supermarkets relies heavily on the facility’s inventory and operations. In particular, the percentage of perishable inventory and whether the store has a prepared foods section, can significantly influence food waste generation.

In Table 2 we compare food waste generation estimates based on employee count (assuming 3000 lb/employee/year), disposed waste (63% by weight), and outputs of the EPA’s Map, with actual estimates based on CET’s first-hand experience with the supermarkets and grocers (n=72 food waste TAs for the sector, impacting practices in upwards of 300 locations). In general, the EPA Map average estimate, also equivalent to the Employee metric of 3000 lb/employee/year, yields the result closest to the observed value.

**Table 2. Comparative analysis of food waste generation for grocers using different estimation metrics. Refer to Table 1 for conversion factors.**

	<b>NY Grocer</b>	<b>NY Grocer</b>	<b>NY Grocer</b>	<b>NY Grocer</b>	<b>MA Grocer</b>	<b>MA Grocer</b>	<b>MA Grocer</b>	<b>MA Grocer</b>	<b>CT Grocer</b>	<b>CT Grocer</b>
RW/NRDC Employees (t/yr)	112.5	127.5	100.5	48	-	34.5	105	150	-	-
RW Disposed Waste (% total by wt) (t/yr)	43	88.5	-	27.6	-	-			-	-
EPA Map (t/yr)	0-232	0-316	0.59 - 117	0.48-117	0-371	0-117	9.6-147	49.9-232	0-385	0-522
<b>Actual Generation (from interviews, data, observation) (t/yr)</b>	<b>77.8 (=2074 lb/emp. yr)</b>	<b>108 (=2541 lb/emp. yr)</b>	<b>100.5 (=2074 lb/emp. yr)</b>	<b>37.8 (=2362 lb/emp. yr)</b>	<b>189.8 (= 3061 lb/emp. yr)</b>	<b>18 (=1565 lb/emp. yr)</b>	<b>90 (= 2571 lb/emp. yr)</b>	<b>73 (= 1460 lb/emp. yr)</b>	<b>72.7 (=1135 lb/emp. yr)</b>	<b>187.4 (=2154 lb/emp. yr)</b>
Most Accurate Factor (comparison to actual)	Employee ( <u>Option 1</u> <sup>o</sup> , over-estimate)	Employee ( <u>Option 1</u> , over-estimate)	Employee ( <u>Option 1</u> )	Employee ( <u>Option 1</u> , over-estimate)	EPA Map average (Employ. <u>Option 1</u> )	Employee ( <u>Option 5</u> <sup>o</sup> , slight under estimate; Option 1, large over-estimate)	Employee ( <u>Option 1</u> , over-estimate)		EPA Map low-end (Employ. <u>Option 5</u> )	EPA Map average (Employ. <u>Option 1</u> )
Notes	40 yd <sup>3</sup> /week compost. Surplus bakery and frozen meats donated.	24 yd <sup>3</sup> food waste/mo. Donate 0.5 pallet meat, shopping cart bakery 1x/2 wks.		EPA map showed different company name.	Self-report: compost (135) and donation (54.8 tons)	Data provided for compost only. Assume compost is capturing 50% food waste.	Field staff observed		Self-report: animal feed (43) and donation (29.7)	Self-report: animal feed (144.5) and donation (42.9)

<sup>o</sup>See Table 1.

## Recommendation

As a first cut, using the widely cited 3000 lb/employee/yr metric should lead to a comprehensive, if overly inclusive, list of grocers and supermarkets covered by the NYS organics mandate. At the 2 ton/week threshold, this would entail including all grocers with  $\geq 70$  employees.

## Restaurants & Caterers

To estimate restaurant and catering food waste generation, EPA chose five primary research studies; generation factors are based on the number of employees or revenue. RecyclingWorks and NRDC also reference one of these factors (3000 lb/employee/yr). In addition, the RecyclingWorks tool distinguishes between full- and limited-service restaurants, and often relies on number of meals served, with separate factors for full service and limited service restaurants.

<b>Meals served – full service</b> (lb/meal)	1	RecyclingWorks
<b>Meals served – limited service</b> (lb/meal)	0.5	RecyclingWorks
<b>Employees (Option 1)</b> (lb/employee.yr)	3000	NRDC, EPA, RecyclingWorks, CalRecycle
<b>Employees (Option 2)</b> (lb/employee.yr)	2200 (limited service)	RecyclingWorks
<b>Employees (Option 3)</b> (lb/employee.yr)	2760	EPA
<b>Employees (Option 4)</b> (lb/employee.yr)	3392 (full service)	EPA
<b>Disposed waste – full service</b> (% total by wt)	66%	RecyclingWorks
<b>Disposed waste-limited service</b> (% total by wt)	51%	RecyclingWorks
<b>Revenue (lb/\$/yr)</b>	0.033	EPA

## Key considerations and insights

- If the restaurant has a high-volume bar, employee count may overly inflate the food waste estimate.
- Restaurant metrics, including employee count and meals, can vary significantly with time of year, particularly those in seasonal destinations and college towns.
- The EPA Map appears to be particularly incomplete for the restaurant sector, likely because of the high frequency of restaurant openings and closings.
  - This trend is supported by data in Table 4.

In Table 4, we compare food waste generation estimates based on the EPA Map, number of meals served, number of employees, and CET's first-hand experience with restaurants (n=99 food waste TAs for the sector). As shown, in instances where data for meals served and employees are both available, the closest estimate tends to result from averaging the two. However, in light of NYSDEC's interest in finding reasonable metrics that are publicly available, employee count is the best factor.

**Table 4. Comparative analysis of food waste generation for restaurants using different estimation metrics. Refer to Table 3 for conversion factors.**

	<b>MA Full-Service</b>	<b>MA Full-Service</b>	<b>MA Buffet</b>	<b>NY Full-Service</b>	<b>NY Full-Service</b>	<b>NY Ltd-Service</b>	<b>NY Ltd-Service</b>	<b>NY Ltd-Service</b>
RW Employees (t/yr)	27	97.5	11	60	7.5	16.5	49.5	22
RW Meals (t/yr)	33.8	-	-	32.8	8.3	13	39	7.2
EPA Map (t/yr)	0.97-1.5	29.9-36	7.6-18	1.5-10.2	3.4-8.5	27.6-33.9	18.2-43.5	4.6-25
<b>Actual Generation (from interviews, data, observation) (t/yr)</b>	<b>3.4 (= 378 lb/emp.yr)</b>	<b>71(1420 lb/emp.yr)</b>	<b>10 (=2857 lb/emp.yr)</b>	<b>46.4 (=2320 lb/emp.yr)</b>	<b>7.9 (=3160 lb/emp.y)</b>	<b>14.8 (=1973 lb/empl.yr)</b>	<b>65.3 (=2902 lb/emp.yr)</b>	<b>13.9 (=1390 lb/emp.yr)</b>
Most Accurate Factor (comparison to actual)	EPA Map but underestimate	Employees	Employees	Employees & Meals	Employees	EPA Map Median	Employees	EPA Map Median
Notes	Self report generating 1.4 t pre-consumer waste per year. Assumed to be 40% of total.				EPA map high estimate is also very close to accurate		EPA map showed old business name	

### Recommendation

For five out of eight samples above, employee count results in estimates reasonably close to those CET calculated based on interviews, customer-provided data, or on-site observations. Therefore, CET recommends using the RecyclingWorks conversion factors of 3000 lb/employee/yr for full-service and 2200 lb/employee/yr for limited-service restaurants. In employee equivalents, this means full-service restaurants with  $\geq 75$  employees and limited-service operation with  $\geq 90$  employees would be subject to NYS's organics mandate.

As noted above, the EPA Map does not appear to be as reliable as other tools for the restaurant sector. Despite using higher multipliers for food waste per employee, the EPA Map consistently underestimates food waste generation by between 25 and 96%. This indicates that the EPA's employment data are not always accurate. Furthermore, the frequency at which restaurants are missing from the Map also makes it a less reliable tool for determining covered entities for the restaurant sector than perhaps for other sectors.

### Food Manufacturers & Distributors

To estimate food waste generation among manufacturers and distributors, EPA used three primary research studies and derived generation factors tied to revenue. The RecyclingWorks tool does not include factors for food manufacturers; however, CET has cited a metric from CalRecycle's [Waste Characterization Tool](#). The factors most commonly found in the literature are shown in Table 5.

<b>Employees</b> (Option 1) (lb/employee.yr)	1400	CalRecycle
<b>Employees</b> (Option 2) (lb/employee.yr)	2398	Metro Vancouver
<b>Revenue</b> (Option 1) (lb/\$.yr)	0.053	NRDC, EPA
<b>Revenue</b> (Option 2) (lb/\$.yr)	0.062	EPA
<b>Revenue</b> (Option 3) (lb/\$.yr)	0.17	EPA

### Key considerations and insights

- Food waste generation is highly dependent on the manufactured product (e.g. bakery vs. meat processor)
  - This is supported by the data in Table 5, where no one multiplier emerges as the most accurate across businesses.
- In CET's experience (n=99 food waste TAs for the sector), food manufacturers may not be as important from an enforcement perspective because most tend to have food waste prevention and recovery systems in place, even in the absence of a disposal ban. Since the manufacturers tend to generate predictable and homogenous waste streams, recovery is often more cost effective than paying disposal fees.

- Based on CET’s random sampling, the EPA Map appears to have several gaps for the food manufacturing sector and may not be a reliable tool for generating a list of covered entities within this sector.

**Table 6. Comparative analysis of food waste generation for food manufacturers using different estimation metrics. Refer to Table 5 for conversion factors.**

	<b>NY Pasta Manufacturer</b>	<b>NY Baked Goods Manufacturer</b>	<b>NY Baked Goods Manufacturer</b>	<b>NY Manufacturer</b>	<b>CT Manufacturer</b>	<b>CT Manufacturer</b>
CalRecycle Employees (t/yr)	7	245	42	192.5	49	2.8
Metro Vancouver Employees (t/yr)	12	420	72	330	84	5
Revenue (t/yr)	-	-	-	-	90	-
EPA Map (t/yr)	16.7-53.6	-	-	-	39.8-127.5	4.3-147
<b>Actual Generation (from interviews, data, observation) (t/yr)</b>	<b>6.75</b>	<b>1466</b>	<b>42</b>	<b>337</b>	<b>12</b>	<b>12.6</b>
Most Accurate Factor (comparison to actual)	CalRecycle Employees	No Match	CalRecycle Employees	Metro Vancouver Employees	No match	EPA Map
Notes	Self-reported data. Collects food scraps for animal feed and has donation program	Not listed in EPA Map. Self-reported data. Collects food scraps for animal feed.	Not included in EPA Map	Not listed in EPA Map. Food scraps collected for composting and re-used in manufacturing process	Owner estimates \$18 mil revenue. EPA Map listed as different company name	Disposed waste is 90% organics.

### Recommendation

Based on the results in Table 6, CET has not identified a factor that is consistently reliable for estimating food manufacturer food waste. For about 50% of samples there was no reliable match between observed values and estimates, and for 50% either CalRecycle’s or Metro Vancouver’s employee metric got within a reasonable range of the observed value. Using the employee factors as a first cut, food manufacturers with between 87 and 148 employees would be covered by the ban, based on the Metro Vancouver and CalRecycle multipliers, respectively.

### Lodging & Hotels

To estimate food waste generated by the hospitality industry, EPA chose four studies that provide excess food generation factors based on number of employees. The RecyclingWorks tool cites a generation factor based on number of employees, and also has factors based on number of rooms, number of guests, and disposed waste. The factors used by these and other tools are show below.



<b>Table 7. Food waste generation factors for the hospitality sector.</b>		
<b>Rooms</b> (lb/room.yr)	345.64	RecyclingWorks, NRDC, EPA
<b>Guests</b> (lb/person.day)	1	RecyclingWorks
<b>Employees</b> (Option 1) (lb/employee.yr)	1305 <sup>a</sup>	RecyclingWorks
<b>Employees</b> (Option 2) (lb/employee.yr)	375	EPA
<b>Employees</b> (Option 3) (lb/employee.yr)	997	EPA
<b>Employees</b> (Option 4) (lb/employee.yr)	1197	EPA
<b>Employees</b> (Option 5) (lb/employee.yr)	1983-1984	EPA, NRDC
<b>Employees</b> (Option 6) (lb/employee.yr)	994	Metro Vancouver
<b>Employees</b> (Option 7) (lb/employee.yr)	1369	CalRecycle
<b>Disposed waste</b> (% total by wt)	36%	RecyclingWorks

<sup>a</sup>Average of ReFED's estimate (1500 lb/employee.yr) and CalRecycle's estimate (1110 lb/employee.yr)

### **Key considerations and insights**

- For smaller entities, or those that tend to have lower occupancy, number of guests produces a better estimate than number of rooms, disposed waste, or employees.
- The number of rooms factor doesn't account for food waste generation from other functions in the hotel such as conferences, weddings, etc.
  - This insight is supported by one example below, where actual food waste dwarfs the estimate yielded with the rooms factor.

In Table 8 below, we compare food waste generation estimates based on the EPA tool, RecyclingWorks, and CET's first-hand experience providing TA to hotels (n=39 food waste TAs for the sector). As shown, in two out of three instances the EPA Map underestimated food waste compared to first-hand data acquired by CET.

**Table 8. Comparative analysis of food waste generation for the hospitality sector using different estimation metrics. Refer to Table 7 for conversion factors.**

	<b>MA Hotel - Boutique</b>	<b>MA Hotel - Boutique</b>	<b>MA Hotel - Upscale</b>	<b>MA Hotel - Upscale</b>	<b>MA Hotel - 3-star</b>
Guests (t/yr)	-	-	-	-	-
Employees (t/yr)	-	40.5	261	-	55.4
Rooms (t/yr)	37	9.7	137	35.2	31.8
EPA Map (t/yr)	23.4-123.9	15-79.3	4.7-24.7	28.1-148.7	18.8-99.1
<b>Actual Generation (from interviews, data, observation) (t/yr)</b>	<b>156</b>	<b>26</b>	<b>65</b>	<b>57.2</b>	<b>39</b>
Most Accurate Factor (comparison to actual)	EPA, High-end		No match	EPA, Lower-avg.	Rooms or EPA, Lower-avg.
Notes	Self-reported data, includes composting tonnage but not donation	Self-reported data for composting. Busy restaurant attracts non-guests	Self-reported data, includes composting and food donation		On-site inspection of waste generation and hauling frequency

### Recommendation

In CET’s experience, food waste generation at hotels is quite site-specific due to the number of influencing variables: the extent to which the hotel hosts events (especially for non-resident guests), occupancy rates, and guest services (e.g., room service, full-service restaurants). This is reinforced by the fact that in each example in Table 8, a different factor aligns best with the actual food waste generation. Since three out of four examples generate a level of food waste that falls within the EPA Map estimates, this suggests that the employee factors – which are what the EPA uses – are among the strongest indicators. Using one of the EPA’s lower-end multipliers (997 lb/employee/yr), hotels with 209 employees would be covered by NY’s organics mandate, and using a higher-end multiplier (1984 lb/employee/yr), hotels with 105 employees would be covered.

### Venues

This sector typically includes convention centers, stadiums, theme parks, performing art centers, movie theaters, fairgrounds, special event sites (e.g. parades, sporting events, festivals), and other miscellaneous venues (e.g. museums, zoos). The EPA Map does not include this classification of facilities, although there are overlaps with the lodging and hotels sector. The RecyclingWorks tool references several generation factors for event venues that are derived from previous studies based on meals served, seats, guests/visitors, and total disposed waste. Additionally, NRDC references one study that derived a generation factor for this sector based on number of employees.

<b>Table 9. Food waste generation factors for venues &amp; events.</b>		
<b>Meals served</b> (lb/meal)	1	RecyclingWorks
<b>Seats</b> (lb/seat.day)	0.6	NRDC, RecyclingWorks
<b>Guests</b> (lb/person.day)	0.45	RecyclingWorks
<b>Employees</b> (lb/employee.yr)	2000	CalRecycle, Metro Vancouver
<b>Disposed waste</b> (% total by wt)	25%	RecyclingWorks

### **Key insights and considerations**

- Seasonality is important when estimating food waste generation for many establishments.
- Seat capacity vs. visitors is an important distinction. While capacity is the more readily available statistic, it doesn't always correlate with visitors.
- Because the sector is so diverse, it is difficult to apply a universal factor, such as seat capacity or employees, to estimate food waste generation.

CET does not have validated, observed waste generation data to compare to results generated by estimation tools for Venues.

### **Recommendation**

The NYSDEC may have to consider venues on an individual basis, evaluating first whether each is a venue type that serves food, and then applying estimation factors on a case-by-case basis.

### **Colleges & Universities**

To estimate college and university food waste generation, EPA analyzed ten studies, nine of which derived factors for food waste per meal served, and one which is based on food waste per student per year. EPA uses an average of the Meals Served multipliers, which is also the factor that RecyclingWorks and NRDC use. RecyclingWorks has two additional factors based on number of residential and non-residential students. All factors are presented in Table 10 below.

<b>Table 10. Food Waste Generation Factors for Colleges &amp; Universities.</b>		
<b>Meals served</b> (lb/meal)	0.35	NRDC, EPA, RecyclingWorks
<b>Students-all</b> (lb/student.yr)	22	EPA
<b>Students-residential</b> (lb/student.yr)	141.75	RecyclingWorks
<b>Students-non-residential</b> (lb/student.yr)	37.8	RecyclingWorks

### Key insights and considerations

- Weeks of operation is important for this sector since student populations vary dramatically over the course of the year. Colleges and universities are typically in session 30-32 weeks per year.
- The EPA Map may only show main campuses and it is unclear what food waste is generated by various other campus sites.
- Studies informing the EPA Map data derived an average of 169 meals served per student enrolled, inclusive of residential and non-residential students.

Table 11 presents a comparison of food waste estimates based on the EPA Map, RecyclingWorks, and CET’s first-hand experience providing TA to colleges and universities (n=32 food waste TAs for the sector).

<b>Table 11. Comparative analysis of food waste generation for colleges and universities using different estimation metrics. Refer to Table 10 for conversion factors. The schools are &gt;50% residential.</b>					
	<b>MA College</b>	<b>MA University</b>	<b>MA University</b>	<b>NY College</b>	<b>NY College</b>
Students (t/yr)	883	1182		112	142.4
Meals (t/yr)	190.2	1400	-	27.3	42.5
EPA Map (t/yr)	159.1-965.7	330.4-2005.1	69.7-422.9	145.7-884	44.2-268.3
<b>Actual Generation (from interviews, data, observation) (t/yr)</b>	<b>380</b>	<b>1200</b>	<b>176.6</b>	<b>20.8</b>	<b>52.3</b>
Most Accurate Factor (comparison to actual)	EPA Map average	Students	EPA Map average	Meals	Meals (default)
Notes	Data reported to EPA Food Recovery Challenge	Self-reported data	Self-reported.	Self-reported 7.3 tons of pre-consumer food waste collected annually. Assumed to be 35% of total.	Self-reported 18.3 tons of pre-consumer food waste collected annually. Assumed to be 35% of total.

### Recommendation

The results above suggest that meals served is a better estimator of food waste generation than student enrollment. Meals served, whether empirical or the EPA’s derived average of 169 meals per student per year, seems to better account for non-residential students, and meals taken off-campus than does the multiplier for number of students. As shown in Table 11, the student factor tends to over-estimate food waste generation. Therefore, one approach NYSDEC could take would be to assume 169 meals per student per year and 0.35 lb per meal, which would mean any college or university with at least 3500 students would be subject to the NY organics mandate.

## Correctional Facilities

To estimate food waste generation at correctional facilities, EPA analyzed six studies, all of which derived factors for food waste per inmate per day. Two of these studies were from the NYS Department of Correctional Services (though these were the most dated at 2000 and 2001). RecyclingWorks and NRDC use a factor based on number of inmates, and RecyclingWorks has a second factor that is based on disposed waste. All factors are presented in Table 12 below.

<b>Inmates (Option 1)</b> (lb/inmate.d)	1	NRDC, EPA, RecyclingWorks
<b>Inmates (Option 2)</b> (lb/inmate.d)	0.85 - 1.4	EPA
<b>Disposed waste</b> (% total by wt)	30%	RecyclingWorks

### Key considerations and insights

- Hoovers, Inc. does not provide data on the number of inmates at each correctional facility, but it does provide the number of employees at each facility and inmates can be estimated based on employee (EPA Map Technical Methodology).
  - County and city jails: 3.1 inmates/employee
  - State and federal prisons: 3.4 inmates/employee

CET has only two correctional facilities for which to offer a first-hand comparison (Table 13). In this particular example, the EPA Map resulted in a significant over-estimate, though we do not know if this is true for other cases.

	<b>NY Correctional facility</b>	<b>MA Correctional Facility</b>
Inmates (t/yr)	20.8	200.8
EPA Map (t/yr)	176-317.9	15.9-28.7
<b>Actual Generation (t/yr)</b>	<b>29.7</b>	<b>107</b>
Notes	Actual is based on self-reported data	Actual based on CET observation during meal service

### Recommendation

CET does not have enough first-hand data to make an informed recommendation for determining which correctional facilities in NY will be subject to the organics mandate. However, if the data above is indicative, it suggests that prisons with 3000 or more inmates would be covered.