**GREENWASTE COMPOSTING**

***a. Source Category Description***

Greenwaste composting includes the diversion of yard waste, food waste, and other biogenic waste from landfills to composting facilities. Estimates of emissions of volatile organic compounds (VOC), ammonia (NH3), and three hazardous air pollutants (HAPs), acetaldehyde; methanol; and naphthalene, from greenwaste composting are based on the amount of food and yard waste composted. Composting of biogenic waste is currently not included in emissions estimates for this category as activity data on this waste type is not available.

For this source category, the following SCC was assigned:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SCC** | **SCC Level 1** | **SCC Level 2** | **SCC Level 3** | **SCC Level 4** |
| 2680003000 | Waste Disposal, Treatment, and Recovery | Composting | Greenwaste | All Processes |

Note that this source category does not include the composting of biosolids from wastewater treatment plants or manure management facilities. There are separate SCCs for biosolids (2680001000) and for a mixture of greenwaste and biosolids (2680002000). EPA is not currently estimating emissions for these SCCs. If S/L/Ts report any emissions for the mixture SCC, emissions from the greenwaste portion of that mixture may be duplicative of some or all of the EPA emissions estimates described here. Note also that this source category estimates emissions from composting facilities but does not estimate emissions from backyard composting.

***b. Activity Data***

The amount of greenwaste composted was estimated using data from two EPA reports, *Advancing Sustainable Materials Management: 2013 Fact Sheet*1, and *Food Waste Management in the United States, 2014.2* *Advancing Sustainable Materials Management: 2013 Fact Sheet* presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2013, and is used to calculate yard waste composted. *Food Waste Management in the United States, 2014* presents the amount of state-level food waste composted.

The EPA data on total yard MSW recovered for 2013, and 2014 population data was used to estimate per capita values of waste recovered for composting. Approximately 0.35 lbs. per person per day of yard waste are recovered for composting. Please note that EPA data on waste recovered for composting does not include backyard composting. This number was multiplied by the population in each state in 2014 from the U.S. Census Bureau3, and estimates the annual amount of yard waste recovered for composting in each state.

EPA reports the amount of food waste composted at the state level in the report *Food Waste Management in the United States, 2014*. These values are shown in Table 1. EPA collected these data from state environmental websites and contacts with state agencies. The data year for each state is listed and represents the latest data available. The data were not altered from the original reference for use in this methodology.

Table 1. State-level food waste composting.

| **State** | **Food Composted (tons)** | **Data Year** |  | **State** | **Food Composted (tons)** | **Data Year** |
| --- | --- | --- | --- | --- | --- | --- |
| California | 715,119 | 2012 |  | Nevada | 35,869 | 2014 |
| Colorado | 29,130 | 2013 |  | New Hampshire | 110 | 2012 |
| Connecticut | 4,644 | 2013 |  | New Jersey | 28,634 | 2012 |
| Delaware | 17,626 | 2013 |  | New York | 44,405 | 2013 |
| Florida | 158,711 | 2014 |  | North Carolina | 38,014 | 2014 |
| Georgia | 8,021 | 2014 |  | Ohio | 81,450 | 2014 |
| Hawaii | 39,287 | 2014 |  | Oregon | 50,143 | 2013 |
| Indiana | 13,525 | 2013 |  | Pennsylvania | 56,851 | 2013 |
| Iowa | 4,334 | 2010 |  | Rhode Island | 150 | 2014 |
| Kansas | 1,127 | 2010 |  | South Carolina | 4,277 | 2014 |
| Maine | 1,658 | 2010 |  | Tennessee | 1,500 | 2013 |
| Maryland | 69,643 | 2014 |  | Texas | 188 | 2012 |
| Massachusetts | 2,753 | 2014 |  | Vermont | 14,738 | 2013 |
| Michigan | 8,700 | 2013 |  | Virginia | 2,454 | 2014 |
| Minnesota | 46,751 | 2013 |  | Washington | 65,221 | 2013 |
| Mississippi | 242 | 2013 |  | Wisconsin | 8,677 | 2013 |
| Missouri | 16,000 | 2014 |  | Total | 1,569,952 |  |

Source: US EPA

Users have two options to alter data in order to more accurately match local conditions. Users have the option to input a value of per capita yard waste recovered that more accurately characterizes the area for which they are estimating emissions. Additionally, if users have access to county level compost data from their state they may input this into the spreadsheet to be used in place of the estimated waste values in the final emissions calculations.

Comprehensive national data on the county locations of composting facilities is not available. As a result, the analysis uses an assumption that the yard waste composting facilities are co-located with solid waste landfills, and food waste is composted within the county where it is collected. Note that user input county level compost data is not allocated.

***c. Activity Allocation Procedure***

State-level yard waste composting was allocated to the county-level using employment. Specifically, state-level activity data were multiplied by the ratio of county- to state- level number of employees at solid waste landfills (NAICS code 562212).

Employment data were obtained from the U.S. Census Bureau’s 2014 County Business Patterns (CBP).5 Due to concerns with releasing confidential business information, the *CBP* does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. To estimate employment in counties with withheld data, the following procedure was used for NAICS code 562212.

1. County level data for counties with known employment were totaled by state.
2. #1 subtracted from the state total reported in state-level *CBP*.
3. Each of the withheld counties was assigned the midpoint of the range code (e.g., A:1-19 employees would be assigned 10).
4. These midpoints were then summed to the state level.
5. #2 was divided by #4 as an adjustment factor to the midpoints.
6. #5 was multiplied by #3 to get the adjusted county-level employment.

Note that step 5 adjusts all counties with withheld employment data by the same state-based proportion. It is unlikely that actual employment corresponds exactly with this smoothed adjustment method, but this method is the best option given the availability of the data.

For example, take the 2006 *CBP* data for NAICS 31-33 (Manufacturing) in Maine provided in Table 2.

**Table 2. 2006 County Business Pattern for NAICS 31-33 in Maine**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **fipsstate** | **fipscty** | **naics** | **empflag** | **emp** |
| 23 | 001 | 31---- |  | 6,774 |
| 23 | 003 | 31---- |  | 3,124 |
| 23 | 005 | 31---- |  | 10,333 |
| 23 | 007 | 31---- |  | 1,786 |
| 23 | 009 | 31---- |  | 1,954 |
| 23 | 011 | 31---- |  | 2,535 |
| 23 | 013 | 31---- |  | 1,418 |
| 23 | 015 | 31---- | F | 0 |
| 23 | 017 | 31---- |  | 2,888 |
| 23 | 019 | 31---- |  | 4,522 |
| 23 | 021 | 31---- |  | 948 |
| 23 | 023 | 31---- | I | 0 |
| 23 | 025 | 31---- |  | 4,322 |
| 23 | 027 | 31---- |  | 1,434 |
| 23 | 029 | 31---- |  | 1,014 |
| 23 | 031 | 31---- |  | 9,749 |

1. The total of employees not including counties 015 and 023 is 52801.
2. The state-level *CBP* reports 59,322 employees for NAICS 31----. The difference is 6,521.
3. County 015 is given a midpoint of 1,750 (since range code F is 1000-2499) and County 023 is given a midpoint of 17,500.
4. State total for these two counties is 19,250.
5. 6,521/19,250 = 0.33875.
6. The adjusted employment for county 015 is 1,750\*0.33875 = 593. County 023 has an adjusted employment of 17,500\*0.33875 = 5,928.

State level data in this NAICS code are withheld for multiple states, so a similar procedure was first performed going from the U.S. level to the state level. For example, known state-level employees were subtracted from the U.S. total yielding the total withheld employees. Next the estimated midpoints of the withheld states were added together and compared (by developing a ratio) to the U.S. total withheld employees. The midpoints were then adjusted by the ratio to give an improved estimate of the state total.

***d. Controls***

There are no controls assumed for this category.

***e. Emission Factors***

Emission factors are reported in Table 3 below. Emission factors for VOCs and ammonia (NH3) are taken from the South Coast Air Quality Management District’s Draft Staff Report on the Proposed Amended Rule 1133.1 and Proposed Rule 1133.3; Rule 1133.3 concerns emission reductions from greenwaste composting operations.6 The emissions factors for the HAPs (acetaldehyde, methanol, and naphthalene) are taken from Kumar et al.7

**Table 3. Emission Factors for Composting of Greenwaste (2680003000)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Pollutant** | **Pollutant Code** | **Emission Factor** | **Emissions Factor Units** | **Emission Factor**  **Reference** |
| VOC | VOC | 4.67 | lbs./ton | Reference 6 |
| Ammonia | NH3 | 0.66 | lbs./ton | Reference 6 |
| Acetaldehyde | 75070 | 0.0014 | lbs./lbs. VOC | Reference 7 |
| Methanol | 67561 | 0.1279 | lbs./lbs. VOC | Reference 7 |
| Naphthalene | 91203 | 0.005 | lbs./lbs. VOC | Reference 7 |

***f. Emissions***

County-level VOC and NH3 emissions were calculated by multiplying the total amount of greenwaste recovered for composting per year by an emission factor. HAP emissions were calculated by multiplying the total amount of VOC emissions by a speciation factor.

***g. Example Calculations***

VOC emissions in Autauga County, Alabama from composting of greenwaste:

Population of Autauga County in 2014 = 55,395

Greenwaste recovered for composting (lb/person/day) = 0.35

Number of days in a year = 365

Factor to convert from lbs to tons = 1/2000

2014 greenwaste composting activity in Autauga County = 55,395 \* 0.35 \* 365 \* 1/2000

= 3,538 tons

VOC emissions = Greenwaste composted \* VOC emission factor

VOC emission factor = 4.67 lb/ton

VOC emissions from composting in Autauga County = 3.538 tons \* 7.42 lbs/ton \* 1 ton/2000 lbs

= 8.26 tons

***h. Changes from 2011 Methodology***

Emissions from this source category were not estimated by EPA in 2011.

***i. Puerto Rico and US Virgin Islands Emissions Calculations***

2014 Census Data does not exist for the US Virgin Islands. Emissions are calculated using the same method described above using 2010 data.3

***j. References***

1. U.S. EPA, [*Advancing Sustainable Materials Management: Facts and Figures Report*](https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management)*,* "," (accessed May 2019).

2. U.S. EPA, 2016. [*Food Waste Management in the United States, 2014*](https://www.epa.gov/sites/production/files/2016-12/documents/food_waste_management_2014_12082016_508.pdf)*.* Office of Resource Conservation and Recovery.

3. U.S. Census Bureau, [Decennial Censuses, 2010 Census: Summary File 1](https://www2.census.gov/census_2010/04-Summary_File_1/).

4. U.S. Census Bureau. [*Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014, 2014 Populations Estimates*](https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml)*,* (accessed May 2019).

5. U.S. Census Bureau. [*2014 County Business Patterns*](https://www.census.gov/data/datasets/2014/econ/cbp/2014-cbp.html), (accessed May 2019).

6. South Coast Air Quality Management District. 2011. [*Draft Staff Report on Proposed Amended Rule 1133.1 (chipping and grinding activities) and Proposed Rule 1133.3 (emissions reductions from greenwaste composting operations),*](https://www.arb.ca.gov/DRDB/AV/CURHTML/R1133.pdf)(accessed May 2019).