



2020 National Emissions Inventory Technical Support Document: Waste Disposal – Open Burning – Residential Household Waste

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2020 National Emissions Inventory Technical Support Document: Waste Disposal - Open
Burning – Residential Household Waste

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Contents

List of Tables	i
35 Waste Disposal - Open Burning – Residential Household Waste.....	35-1
35.1 Sector Descriptions and Overview	35-1
35.2 EPA-developed estimates.....	35-1
35.2.1 Activity data	35-1
35.2.2 Allocation procedure.....	35-3
35.2.3 Emission factors	35-3
35.2.4 Controls.....	35-4
35.2.5 Emissions.....	35-4
35.2.6 Example calculations.....	35-4
35.2.7 Improvements/Changes in the 2020 NEI	35-5
35.2.8 Puerto Rico and U.S. Virgin Islands	35-5
35.3 References.....	35-5

List of Tables

Table 35-1: Annual RHW generated (tons/person) in the U.S. in 2015.....	35-2
Table 35-2: Sample calculations for CO and VOC emissions from open burning	35-4

35 Waste Disposal - Open Burning – Residential Household Waste

35.1 Sector Descriptions and Overview

This source category includes several types of intentional burning for waste disposal purposes, except for agricultural purposes. This source category includes open burning of municipal solid waste, land clearing debris, and different types of yard waste.

Open burning of yard waste is the purposeful burning of leaf and brush species in outdoor areas, and emission estimates for leaf and brush waste burning are a function of the amount of waste burned per year. Open burning of land clearing debris is the purposeful burning of debris, such as trees, shrubs, and brush, from the clearing of land for the construction of new buildings and highways. Emission estimates from open burning of land clearing debris are a function of the amount of material or fuel subject to burning per year. Open burning of residential household waste (RHW) is the purposeful burning of RHW in outdoor areas. Emission estimates for RHW burning are a function of the amount of waste burned per year.

35.2 EPA-developed estimates

The calculations for estimating the emissions from the burning of residential household waste (RHW) involve first estimating the amount of combustible waste generated in each county. The amount of waste generated in the U.S. is available from the EPA report, *Advancing Sustainable Materials Management: 2015 Fact Sheet* [ref 1]. The amount of county-level RHW burned is estimated by calculating the per capita amount of RHW generated using the national data from EPA and multiplying that by the number of people likely to burn waste in each county. The number of people likely to burn waste is based on the rural population in each county from the 2010 census. To estimate emissions from RHW burning, pollutant emissions factors are multiplied by the amount of combustible waste burned. Emissions factors for PM, VOC, and HAPs are from the literature, whereas emissions factors for CO, NOX, and SO2 are adjusted based on the ratio of total waste to combustible waste.

35.2.1 Activity data

The activity data for this source category is the amount of RHW burned in each county, which is estimated using data the EPA report *Advancing Sustainable Materials Management: 2015 Fact Sheet* [ref 1]. The report 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 2015.

Table 35-1 shows the total national-level waste generated by type and the corresponding per capita values. Per capita values of RHW subject to burning were developed based on EPA's total amount of waste generated in 2015. According to the 2010 version of the same EPA report, residential waste generation accounts for 55-65% of the total waste from the residential and commercial sectors [ref 2]; for the per capita calculation, the median value of 60% of total waste generated is assumed. This number is multiplied by the sums of the total and combustible waste, respectively. Each number is then divided by the U.S. population in 2020 (327 million people) [ref 3] to determine separate per capita

values for total and combustible waste. Note that yard waste is not included in either per capita value as emissions from the burning of yard waste are calculated in separate SCCs.

$$PC_{c\text{waste}} = \frac{\sum_{Com} W \times 0.60}{P_{y,US}} \quad (1)$$

$$PC_{t\text{waste}} = \frac{\sum_T W \times 0.60}{P_{US}} \quad (2)$$

Where:

- $PC_{c\text{waste}}$ = Per capita value of combustible waste in the U.S., in tons per person
- $PC_{t\text{waste}}$ = Per capita value of total waste in the U.S., in tons per person
- Com = Types of combustible waste (not including yard waste)
- T = All types of waste (not including yard waste)
- W = Annual weight of waste, in million tons
- $P_{y,US}$ = Population of the U.S. for year of inventory, in million people

The per capita value of combustible household waste is estimated to be 0.354 tons generated per person in 2015, and the per capita value of total waste is 0.420 tons generated per person.

Table 35-1: Annual RHW generated (tons/person) in the U.S. in 2015

Material	Weight Generated (million tons)	Total per person	Combustible per person
Paper	68.61	0.129	0.129
Glass	11.48	0.022	0
<u>Metals</u>			
Steel	17.69	0.033	0.0
Aluminum	3.53	0.007	0.0
Other nonferrous	2.04	0.004	0.0
Total Metals	23.26	0.044	0.0
Plastics	32.25	0.061	0.061
Rubber/leather	8.21	0.015	0.015
Textiles	16.22	0.031	0.031
Wood	16.12	0.030	0.030
Other	4.44	0.008	0.008
Total Materials	180.59	0.340	0.274
<u>Other wastes</u>			
Food	38.40	0.072	0.072
Yard	34.50	0.0	0.0
Miscellaneous inorganic	3.97	0.007	0.007
Total Other	76.87	0.080	0.080
TOTAL RHW	257.46	0.420	0.354

Source: Reference 1, Table 1

As open burning of RHW is generally not practiced in urban areas, only the rural population in each county is assumed to practice open burning. The rural and urban populations are taken from 2010 U.S.

Census data for each county [ref 4]. It is assumed that 24% of the rural population burns RHW [ref 5].

$$PBurn_c = RPop_c \times 0.24 \quad (3)$$

Where:

- $RPop_c$ = Rural population in county c in 2020
- $PBurn_c$ = Population likely to burn RHW in county c

The number of people likely to burn waste in each county (from equation 3) is then used with the values of per capita household waste subject to burning (from equations 1 and 2) to determine the amount of household RHW burned.

$$CWst_c = PBurn_c \times PC_{c\text{waste}} \quad (4)$$

Where:

- $CWst_c$ = Annual combustible RHW burned in county c , in tons
- $PBurn_c$ = Population likely to burn in county c
- $PC_{c\text{waste}}$ = Per capita value of combustible waste in the U.S., in tons per person

35.2.2 Allocation procedure

National values for the amount of waste generated are distributed to the counties based on rural population, as described in Section 35.2.1.1.

35.2.3 Emission factors

Emissions factors for open burning of RHW are provided in the “Wagon Wheel Emission Factor Compendium” on the [2020 NEI Supporting Data and Summaries site](#).

The emissions factors for PM, VOC, and HAPs were developed based on the amount of combustible waste burned. Emissions factors for CO, NOX, and SO2 were developed based on the amount of total waste burned; therefore, these factors need to be adjusted to be used with the values of combustible waste burned. This is accomplished by multiplying the emissions factors by a ratio of the total per capita waste to combustible per capita waste in 2015.

$$EF_{p,Com} = EF_{p,T} \times \frac{PC_{twaste}}{PC_{c\text{waste}}} \quad (5)$$

Where:

- EF_p = Emission factor for pollutant p , in lbs. of pollution per ton of waste burned
- Com = Types of combustible waste (not including yard waste)
- T = All types of waste (not including yard waste)
- $PC_{c\text{waste}}$ = Per capita value of combustible waste in the US, in tons per person
- PC_{twaste} = Per capita value of total waste in the US, in tons per person

35.2.4 Controls

Controls for residential household waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. However, literature suggests that burn bans are not 100% effective. It is therefore assumed that approximately 25% of the residents that may burn trash in the yard would burn waste even if a ban is in place. For counties that have burn bans, the assumption is applied by multiplying 0.25 by the annual waste burned. Currently no counties are assumed to have burn bans in place.

$$\begin{aligned} & \text{If county } c \text{ has a burn ban} \\ & \text{Then } CWst_c = CWst_c \times 0.25 \end{aligned} \quad (6)$$

Where:

$CWst_c$ = Annual combustible RHW burned in county c, in tons

35.2.5 Emissions

The annual amount of combustible RHW burned in each county is multiplied by the emissions factors provided in the “Wagon Wheel Emission Factor Compendium” on the [2020 NEI Supporting Data and Summaries site](#).

$$E_{p,c} = CWst_c \times EF_{p,Com} \quad (7)$$

Where:

$E_{p,c}$ = Annual emissions of pollutant p in county c

$EF_{p,Com}$ = Emission factor for pollutant p , in lbs. of pollution per ton of combustible waste burned

$CWst_c$ = Annual combustible RHW burned in county c , in tons

35.2.6 Example calculations

Table 35-2 lists sample calculations to determine the CO and VOC emissions from open burning. The values in these equations are demonstrating program logic and are not representative of any specific NEI year or county.

Table 35-2: Sample calculations for CO and VOC emissions from open burning

Eq. #	Equation	Values	Result
1	$PC_{waste} = \frac{\sum_{Com} W \times 0.60}{P_{y,US}}$	$\frac{188.22 \text{ million tons of waste} \times 0.60}{318.85 \text{ million people}}$	0.354 tons combustible waste per person per year
2	$PR_{twaste} = \frac{\sum_{NC} W \times 0.60}{P_{US}}$	$\frac{222.96 \text{ million tons of waste} \times 0.60}{318.85 \text{ million people}}$	0.420 tons total waste per person per year
3	$PBurn_c = RPop_c \times 0.24$	$22,921 \text{ people} \times 0.24$	5,501 people likely to burn

Eq. #	Equation	Values	Result
4	$CWst_c = PBurn_c \times PC_{cwaste}$	5,501 people × 0.354 tons combustible waste per person	1,947.4 tons of combustible waste burned
5	$EF_{p,Com} = EF_{p,T} \times \frac{PC_{twaste}}{PC_{cwaste}}$	85 lbs. per ton × $\frac{0.42 \text{ tons per person}}{0.354 \text{ tons per person}}$	100.8 lbs. of CO per ton of combustible waste burned
6	If county c has a burn ban Then $CWst_c = CWst_c \times 0.25$	N/A	does not have a burn ban
7	$E_{p,c} = CWst_c \times EF_{p,Com}$	1,947.4 tons × 100.8 lbs. per ton	98.14 tons CO emissions from burning of RHW
		1,947.4 tons × 8.46 lbs. per ton	8.23 tons VOC emissions from burning of RHW

35.2.7 Improvements/Changes in the 2020 NEI

No changes were made to methods for the 2020 NEI. Activity data was updated to reflect best available data for the NEI cycle.

35.2.8 Puerto Rico and U.S. Virgin Islands

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data, since NEI year Census Data does not exist for the U.S. Virgin Islands.

35.3 References

1. U.S. Environmental Protection Agency. 2018. [Advancing Sustainable Materials: 2015 Fact Sheet](#), Table 1. Generation, Recovery and Discards of Materials in MSW, 2015 (in millions of tons and percent of generation of each material).
2. U.S. Environmental Protection Agency. 2011. [Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010](#)—Fact Sheet, p. 4.
3. U.S. Census Bureau. [Total Population](#), American Community Survey.
4. U.S. Census Bureau, Decennial Censuses, 2010 Census: [Summary File 1](#).
5. Environment Canada. 2001. “Household Garbage Disposal and Burning.” Prepared by Environics Research Group.

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